CENTRAL BANKS' DUAL ROLE DILEMMA AND MONETARY POLICY CONSTRAINTS: RESERVE-CONSTRAINED ECONOMY PERSPECTIVE

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This thesis is dedicated to my late mum and beloved daughters Mercy and Nissi. This dissertation is for you mum and my daughters for you are the reason why I strive for excellence.

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Abstract

The past three decades have witnessed an increasing importance and an enormous transformation in the reserve management function of central banks in reserve-constrained economies. Traditionally, central bank reserve management tended to be characterized by a simple custodial mandate of liquidity maintenance required for supporting exchange rate policy, meeting public imports, and servicing foreign debts of the governments. Over time, however, the reserve management function of central banks moved beyond the sole liquidity mandate, to include a portfolio management role with a strong emphasis on generating returns on reserves. This transformation has generated a sharp trade-off between the liquidity and portfolio management roles, creating what we call a “dual role dilemma” in the reserve management function of central banks.

This thesis explores the underlying forces behind this novel dual role dilemma in central banks of reserve-constrained economies, and some of the key factors that exacerbate the dilemma. The thesis also examines the implications of this dilemma for monetary policy, specifically for reserve-constrained economies which have adopted inflation targeting regime.

The thesis begins laying an excellent analytical framework for analyzing and understanding the forces underlying the dual role dilemma. It joins together the perspective of the international monetary asymmetry (anchored on the US dollar) and the global productive structure hierarchy (with reserve-constrained economies heavily rely on primary commodities). It then, provides empirical evidence of the existence of this dilemma based on a detailed qualitative study, combining insights from semi-structured interviews and focus group discussions with central bankers in three Sub-Saharan African countries: Botswana, Uganda and Zambia. This empirical evidence allows us to trace the historical roots and institutional characteristics that create and exacerbate the dual role dilemma in reserve-constrained economies. The thesis’ main results show that the dilemma has its roots in four adverse conditions faced by reserved-constrained economies: (a) their excessively volatile exchange rates and acute loss of monetary policy, (b) their chronically high external obligations, (c) their scarcity of reserves associated with the heavy reliance on primary commodities which faced extreme climatic vulnerability and price volatility, and (iv) the severe erosion of their reserve capital arising from ultra-low yields on reserve assets. Moreover, institutional characteristics, particularly weak fiscal policies, and financial fragilities are shown to exacerbate the dilemma in these countries.

Having provided theoretical and empirical support for the existence of the dual role dilemma faced by central banks in reserve-constrained economies, the thesis then proceeds to examine its monetary policy implications from both a theoretical and empirical perspectives. Theoretically, an innovative model is developed that integrates the reserve management objective function (which captures both the liquidity and portfolio management roles) into a monetary policy rule. This model is tested empirically in macro panel econometric approaches using database on 13 Sub-Saharan African countries over the period 2000-2019. This empirical analysis controls for the effects of climatic vulnerability, exchange rate volatility and external forces. The main result from the empirical estimation shows that the presence of the dual role dilemma, reinforced by extreme climatic and external vulnerability exerts severe constraints for monetary policy operations.

Overall, this thesis makes important contributions to the literature of reserve management and monetary policy in developing countries. In contrast to the existing academic literature, which only considers the custodial mandate of central banking management function, this thesis shows that central banks in reserve-constrained economies are forced to accept both the custodial and portfolio management roles as integral parts of their functions. In this dual mandate, central banks engage in portfolio decisions in an effort to balance liquidity and return objectives required for the growth and preservation of reserves capital to enable their reserve-constrained economies meet the ever-growing external obligations. The thesis further shows that this dual role dilemma, which is located in the deep hierarchies in the world's international monetary system and its productive structure, reinforced by climatic vulnerability creates serious constraints for monetary policy.

This thesis concludes by considering several policy conclusions that help to address the reserve scarcity dilemma, including the following. First, productivity-enhancing strategies that permit reserve-constrained economies to climb up the hierarchy of the global productive structure. Second, reducing dependence on the US dollars or currency at the center of the international monetary system. Third, designing a coherent and stable macroeconomic policy including appropriate monetary policy designs and exchange rate policies rooted in the structural subordinated position of SSA at the bottom of the hierarchies in the world's international monetary system and its productive structure. Fourth, improvement in institutional arrangements surrounding external debt accumulation and its management, mainly by fiscal authorities, including eliminating corruption and lack of transparency and accountability in fiscal policy. Finally, coherent national strategies for combating climate change must be taken into consideration by both monetary and fiscal policy for Sub-Saharan African (SSA) countries.

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List of Abbreviations

AMG	Augmented Mean Group
BIS	Bank of International Settlement
FGD	Focus Group Discussion
IMF	International Monetary Fund
OLS	Ordinary Least Squares
SAA	Strategic Asset Allocation
SSA	Sub-Saharan Africa
VIX	Volatility Index (the Chicago Board Options Exchange Market Volatility Index)

Chapter 1: Introduction

1.1 Background and Motivation

Foreign reserve management is one of the key functions of central banks in reserve-constrained economies. Its importance arises from the crucial role of reserves in the developing world whose currencies are not used for transactions in the international arena. Reserves play four important roles in those economies: (i) Self-protection against international crises. (ii) Supporting exchange rates and monetary policy function. (iii) Meeting external obligations including imports and foreign debts especially for the governments. And (iv) protecting the countries against national disasters (Feldstein,1999; IMF, 2013 and Stiglitz, 2006).

In the 1970s and 1980s, central banks of reserve-constrained economies played a simple custodial mandate in the management of reserves, with the sole goal of maintaining liquidity and safeguard reserves. The supremacy of the liquidity role originated from the premise that since reserves are public funds which are held to perform a set of macroeconomic-wide functions, the need to use reserves may arise suddenly, thus they must at all times be kept in highly liquid and safe assets. As such, central banks traditionally restricted the reserve holdings to short-term liquid treasury securities issued by governments of developed economies, mainly the US (Blackman, 1981and Nugée, 2000).

Interestingly, from the mid-1990s, the reserve management function of central banks, especially of reserve-constrained economies, started to expand beyond its custodial role to also include a portfolio management role, with a strong emphasis on generating returns on reserves with the view of preserving and expanding the stock of reserves. In this new role, central banks expanded the list of reserve assets to include both liquid and risky financial instruments in an effort to achieve a balance between the liquidity and return objectives. A key driver of this fundamental transformation has been the massive growth in external obligations resulting from trade and financial liberalization reforms. As reserved-constrained economies continued to gain access to international

capital markets and international trade, their external obligations grew far beyond the reserves they could generate. In addition, the fear about the volatile and depletable nature of their reserve sources, pressured central banks to seek for high return investments to increase the stock of reserves required to meet their ever-growing external obligations.

The portfolio management role of central banks of reserve-constrained economies became particularly important from the early 2000s, as yields on liquid assets of advanced economies turned to critically low levels, eroding their reserve capital. This came mainly because of the outbreak of the global financial crisis of 2008-09 which pushed central banks of advanced economies to adopt a zero-lower-bound monetary policy in an effort to support the international financial system. As yields on liquid assets declined to almost negative levels, central banks of reserve-constrained economies intensified the 'search for yields' from risky assets that could generate positive returns on reserve holdings to offer preservation to their reserve capital (McCauley and Rigaudy, 2011; Borio, et al. 2008b; Pihlman and Han van der Hoorn, 2010).

As lessons from the reserves portfolio management function were being drawn, a fundamental rethinking of monetary policy function of central banks in reserve-constrained economies has been taking place. This has included the consideration of new objectives and instruments surrounding price and financial stability. One of the more notable of these has been a shift from a monetary policy regime that targets monetary aggregates to a regime anchored on the use of short-term interest rate, as a key instrument to achieve price stability. Another important development has been the increasing use of foreign reserves as part of the "normal" policy toolkit in supporting monetary policy goals. Moreover, the experience with the frequency and intensity of currency crises and the associated monetary policy subordination, led academia ask whether foreign reserves should be incorporated into the monetary policy rule (Caballero and Krishnamurthy, 2003; and Kato et al.,2009). The important role of foreign reserves in monetary policy has in recent years created a strong liquidity pressure on central banks.

With both portfolio management and the liquidity roles becoming binding constraints on central banks of reserve-constrained economies, a sharp trade-off has

been generated between those two roles; creating what we call a “dual role dilemma” in the reserve management function of central banks. This dilemma appears to be worsening with the increasing trend in economic and financial globalization. This dilemma has generated a crucial question among policy makers in reserve-constrained world on which kind of instruments still exist in the world financial markets that meet the definition of liquidity and at the same time generate positive return required for preservation and growth of reserve capital. Indeed, as put forward by Bakker and Ingmar, (2007), ‘‘central banks are caught up on the ‘horns’ of liquidity and returns objectives’’.

So far, the academic literature has not looked at this new dilemma. The existing literature is largely concentrated on the role of reserves for the conduct of monetary policy rather than the particular ways those reserves are managed to generate moderate returns. Generally, economists still hold the view that central banks are mere custodians of foreign reserves, concerned primarily with the liquidity maintenance of reserves. The only literature which has highlighted the changing nature of reserve management has been limited to policy institutions, such as the IMF, the BIS and central banking policy papers (e.g McCauley and Rigaudy, 2011; Pringle and Carver, 2016 and Bakker and Ingmar, 2007). This policy literature, however, has not fully investigated the nature, the determinants, and implications of this dual role problem. In addition, it has not yet conceptualized and theorized it.

This PhD seeks to fill the gap in the literature by making the first attempt to investigate this novel dual role dilemma in reserve management function of central banks in reserve-constrained economies. There are two primary goals of the study. First, we investigate theoretically and empirically the factors underlying the dual role dilemma faced by central banks. And second, we evaluate theoretically and empirically the monetary policy implications of this dilemma in reserve-constrained economies.

1.2 Research Questions and Contributions

To contribute to the ongoing policy debates and unanswered issues surrounding the trade-off in the reserve management function of central banks and its monetary policy implications this thesis addresses the following research questions: 1) which are the forces underlying the dual dilemma in central banks of reserve-constrained economies? and 2) what are the effects of this dilemma for monetary policy conducts, particularly for countries that have adopted inflation targeting monetary policy regime? To address these research questions, this thesis makes several contributions to the literature of monetary policy and reserve management by providing both theoretical and empirical evidence.

Chapters 2 and 3 of this thesis are intended to answer the first question as follows: Chapter 2 presents a theoretical framework that conceptualizes and theorizes the nature and drivers of the dual role dilemma faced by central banks. Chapter 3 assesses empirically the existence of the dual role dilemma in some selected reserved-constrained economies; identifies its nature; and examines the underlying structural, institutional, and macroeconomic factors that contribute to the dilemma. These chapters are guided by the overriding hypothesis that the dual role dilemma in central banks of reserve-constrained economies is shaped by a combination of the asymmetries in the world's international monetary system and its productive structure. There are four harsh conditions associated with the subordinated position of the reserve-constrained economies at the lower end of those hierarchies that contribute to creating and exacerbating this dual role dilemma. The first one which mainly underlie the liquidity role is the excessively volatility of the exchange rate faced by these economies and the associated acute loss of monetary policy autonomy. Second, their chronically large external obligations. Third, the acute reserve constraint arising from their reliance on volatile primary commodity products which exposes them to adverse climatic vulnerability. And fourth, the risk of erosion of reserve capital arising from extremely low yields on liquid assets which reserves are held in. The last three factors are responsible for generating the portfolio management role in central banks of reserve-constrained economies.

Chapters 4 and 5 address the question of monetary policy implications of the dual role dilemma. In particular, Chapter 4 presents a mathematical model that integrates the monetary policy reaction function with the reserves management objective function, capturing the dual role dilemma indicators. Chapter 5 takes an econometric approach to estimate the dual role dilemma model developed in Chapter 4 using macroeconomic data for a panel of 13 Sub-Saharan African countries over the period 2000-2019. To elaborate on the contributions made by each chapter in this thesis, the summary and contributions of each essay are presented in the following sub-sections.

1.2.1 Chapter 2: Theoretical framework for the analysis of dual role dilemma in central banks of reserve-constrained economies.

Chapter 2 presents a novel theoretical framework for the analysis of the dual role dilemma in central banks of reserve-constrained economies. It builds on the Post-Keynesian currency hierarchy theory developed in Andrade & Prates (2013); Kaltenbrunner (2015 & 2008); and Paula, et. al., (2017). The currency hierarchy framework has laid an excellent foundation for understanding the unstable nature of the international monetary system and the external vulnerability it creates for peripheral economies. It establishes the liquidity role of reserves as a precondition for managing the stability of exchange rates and improving monetary policy space.

The theoretical framework presented in chapter 2 extends the Post-Keynesian currency hierarchy theory to incorporate the productive structure asymmetry perspective. A central concept in this asymmetry is the core-peripheral notion of the production system where peripheral economies are viewed as specialized in the supply of a few primary commodity products -typically exposed to extreme climatic vulnerability and terms of trade shocks- in exchange for higher value-added manufactured goods from core economies (Cimoli and Porcile, 2013; Milberg, 2004). By bringing together both elements of the productive structure asymmetry and the currency hierarchy theory, the theoretical framework presented in this thesis clearly depicts the position of reserve-constrained economies at the extreme bottom of the hierarchies in the world's international monetary

system and its productive structure. As such, this theoretical analysis uncovers four dangers that are imposed on reserve-constrained economies because of their subordinated position at the bottom of the hierarchies: (i) Excessive volatility of exchange rate and acute loss of monetary autonomy. (ii) Chronically ever-growing external obligations associated with their heavily dependent on both imports and external borrowings. (iii) Acute reserve scarcity. And (iv) Severe erosion of reserve capital arising from low or sometimes negative yields on reserve assets. There are two important implications for central bank reserve management arising from such an environment.

First, reserves become a crucial instrument that serves three important roles: (i) they are a self-insurance instrument for managing the stability of exchange rates and improving monetary space; (ii) they enable a reserve-constrained country to meet its import needs for both government and short-fall in the private sector; and (iii) they provide a nation with the ability to service its external obligations. This chapter is an important contribution to the post-Keynesian literature which places emphasis only on the self-insurance role of reserves.

Second, the chronically ever-growing external obligations that far outpace the reserves, reinforced by the potential erosion of reserve capital, creates a need for generating returns on reserves to preserve and increase capital. In this perspective, it is established that a dual role is created in the reserve management function of central banks of reserve-constrained economies. Those central banks not only maintain the liquidity, but they also make portfolio decisions on a regular basis. By modelling these two roles, this chapter makes an important contribution to both the Post-Keynesian and mainstream literature which have traditionally treated the role of central banks in managing reserves as a simple custodian role.

1.2.2 Chapter 3: Empirical Evidence on the Dual Role Dilemma in Central Banks of Reserve-Constrained Economies: Perspective from Sub-Saharan Africa

Our theoretical analysis presented in chapter 2 is complemented and supported by an empirical examination of the dual role dilemma in three selected sub-Saharan African

economies, namely Botswana, Zambia and Uganda. This empirical analysis, which is presented in Chapter 3, provides an analysis of the historical evolution and the forces underlying the dual role dilemma. It employs a qualitative research approach, combining insights from focus group discussions and semi-structured interviews with central bankers of these countries. This approach was applied to trace the historical evolution of the dual role dilemma and its underlying sources. A qualitative research approach was chosen for this analysis due to its ability to generate rich and in-depth information on the nature of the dilemma, examine its evolution, and uncover the factors underlying the dilemma. A particular advantage of both focus group discussion and semi-structured interviews is their ability to address the exploratory nature of the research questions in this thesis. The selection of our case study countries was guided by five main reasons: (i) the different degrees of the level of financial markets development and their integration to both the regional and the international financial markets, (ii) the different level of public external debts and the nature, considering if those debts were acquired with commercial terms or purely concessional, (iii) exchange rate arrangements, considering both managed and crawling pegged regime, (iv) geographical location, taking into consideration countries in semi-arid and those in arable land, and (iv) the different level of reserves. These interviews provided important insights into: (a) the rationale for holding foreign reserves and whether there has been any change in those rationales, (ii) the historical evolution of reserves management approaches and the underlying factors shaping those developments, and (ii) the nature and severity of the dilemma and the country's specific factors that worsen the magnitude of the dual role dilemma.

This empirical analysis contributes to the literature on central bank reserve management in developing countries. The few existing empirical studies on the changing reserve management practices focused on emerging economies and not in the developing economies of Africa (see McCauley and Rigaudy, 2011; Pringle and Carver, 2016 and Morahan and Mulder, 2013). Moreover, until recently, previous empirical studies mainly emphasized the evolving portfolio management role in developing countries to the rapid growth in reserves in those countries and the impacts of the recent global financial crisis. We contribute to this existing literature in two ways.

First, by tracing the historical evolution of reserve management practices, this study establishes the deep roots of the emergence of the dual role dilemma since the establishment of the case study central banks of SAA. Specifically, it has identified three stages in the evolution of reserve management function of central banks in SSA. (a) the earlier years spanning from 1960s to early 1990s when central banks performed a pure custodial role concerned primarily with liquidity maintenance required manly for meeting the states' foreign currency needs, mainly public imports. (b) The period between mid-1990s to mid-2000s when a shift started taking place towards a portfolio management role, driven by large external obligations. And (c) the period during and after the global financial crisis of 2008-09, when the pressure for portfolio management role intensified due to the increased risk of erosion of reserve capital. This leads us to confirm that dual role dilemma is rooted in the deep asymmetries in the world's international monetary system and its productive structure as alluded to in our theoretical analysis.

The second contribution to the reserve management literature is the identification of country's specific factors that aggravate the degree of the dual role dilemma in the central banks of SSA. Three important factors are identified in this thesis: (a) geographical location, especially countries located in semi-arid areas which heavily depend on imports including the mere food items, (b) institutional characteristics, including (ii) weak fiscal policy especially in accumulation and managing of external debts, (iii) weak financial system, and (c) exchange rate policy.

1.2.3. Chapter 4: A Simple Model of Monetary Policy and Dual Role Foreign Reserve Management Objective Function: Reserve-Constrained Economies Perspective

Chapter 4 of this thesis develops an innovative model that provides a link between the monetary policy function and the reserve management function of central banks in reserve-constrained economies. The most innovative feature of the model is that it brings together two distinct literature that have been running parallel in the central banking literature. First, the literature on monetary policy models for small open economies, particularly the so called the 'two-targets-two-instruments' approach (Benes, et al., 2008; Ostry, et al., 2012; Benes et al., 2013). This monetary policy approach entails foreign

reserves included as an additional policy tool, which operates alongside short-term interest rate policy instrument. The short-term interest rate is usually represented in the form of the Taylor Rule (Taylor, 1993) which reacts to the deviations of inflation from the target and the deviation of actual GDP from potential GDP. Second, the policy literature dealing with strategic asset allocation frameworks (including BIS, World Bank and IMF) on reserves management (e.g., Romanyuk, 2010; Joia and Coche, 2010; Kisoen, 2010 and Alhumaidah, 2015) which has set a broader parameter for defining and justifying the liquidity and return goals of central banks' reserve management.

The first contribution of our model is to the reserve management literature in developing countries. Specifically, we derive the specification for the measure of the portfolio management role and combine it with the specification for the liquidity role developed in Fisher and Lee (2004) and Fisher (2010) to build a coherent reserve management objective function that captures the dual role dilemma in reserve-constrained economies.

Second, by extending the small open economy Taylor Rule to incorporate the specifications for both the liquidity and portfolio management roles of reserves, we contribute to the literature on monetary policy designs and policy constraints in small open economies (e.g Caballero and Krishnamurthy, 2003; Kato et al., 2009; Aizenman, 2019; Aizenman et al., 2010&2016 and Obstfeld, et al. 2010). Those studies have analyzed the monetary policy trade-off in small open economies in the presence of a 'sudden stop' of capital inflows and has emphasized the important insurance role of reserves in addressing policy trade-offs associated with financial instability and the increased risk of a "sudden stop" of capital inflows, as well as financial crisis. However, by extending the Taylor Rule to incorporate the specifications for both the liquidity and the portfolio management roles, our model shows that the insurance role of reserves can be weakened by the forces that underlie the portfolio management role in central banking, namely, the acute reserve scarcity, the huge structural obligations, and the yield-differentials between the yields on financial assets issued by core and peripheral economies. This model is able to show how the problem of the loss of monetary policy autonomy is exacerbated in reserve-constrained economies.

1.2.4. Chapter 5: An Empirical Treatment of the Monetary Policy Implications of the Dual Role Dilemma in Central Banks of Reserve-Constrained Economies

Chapter 5 takes a macro panel econometrics model to estimate the dual role dilemma model developed in chapter 4. It estimates both the dual role dilemma formulation and the extended Taylor Rule that incorporates the indicators for both the liquidity role and portfolio management role. An Augmented Mean Group (AMG) estimator, supported by the Discroll-Kraay estimator, implemented to traditional panel regression – both fixed effect and pooled OLS are applied on annual data spanning 2000–2019 for 13 Sub-Saharan Africa countries. The choice of macro panel techniques is based on their ability to deal with cross-sectional independence, non-stationarity issues, and slope heterogeneity. The econometrics has helped in this thesis to quantify both the magnitude of the trade-off and its effects on monetary policy. The aim of the empirical estimation is twofold: First, to test the existence of the dual role dilemma. And second, to empirically examine the extent to which the dual role dilemma affects monetary policy in reserve-constrained economies.

Chapter 5's main contribution is to the empirical literature on monetary policy in developing countries that have analyzed the role of reserves in monetary policy rule (e.g Shresthaa and Semmler, 2015 and Berument and Tasci, 2004). Those studies have demonstrated empirically the importance of reserves in the Taylor Rule and emphasized that an increase in reserve levels is associated with an improvement in the monetary policy space. While our empirical analysis reinforces that literature by confirming the importance of the liquidity role in the monetary policy rule, it shows how the crucial role of reserves in monetary policy can be weakened by the existence of large structural external obligations that create a portfolio management role in central banks of reserve-constrained economies. In addition, it shows how the weak productive structure of reserve-constrained economies, particularly their exposure to extreme climatic vulnerability can pose serious threat to monetary policy.

Overall, this thesis makes important theoretical and empirical contributions to the literature on reserve management and monetary policy function in reserve-constrained

economies. It highlights a very novel phenomenon of the changing role of central banking in managing reserves from an institution with narrowly defined liquidity maintenance responsibility, to a dual mandate with both the liquidity and portfolio management roles. It shows that the problem of central banks in reserve-constrained economies goes beyond the issue of reserves accumulation and the reserve adequacy debates, a point which has dominated the literature of reserve management (see Feldstein, 1999; Aizenman and Marion, 2003; Aizenman, Lee and Rhee, 2004; Aizenman and Marion, 2002; Aizenman and Lee, 2007; Aizenman, 2007 and Gallagher and Shrestha, 2012; Heller, 1966; Frenkel and Jovanovic, 1981; Jeanne and Ranciere, 2011; Obstfeld, et al., 2010; IMF, 2011 and Edwards, 1985). This thesis points out that the question for reserve accumulation and its optimal level is one thing. Another important thing is how to management such reserves.

1.3 Structure of the Thesis

The remainder of this thesis is organised as follows. Chapter 2 presents a theoretical framework that conceptualizes and theorizes the nature and drivers of the dual role central banking dilemma. *Chapter 3* presents an empirical existence of the dual role dilemma and the underlying structural factors as well as the institutional and macroeconomic factors that contribute to the dilemma. Chapter 4 presents a mathematical model for the analysis of the monetary policy implications of the dual role dilemma. Chapter 5 takes an econometric approach to estimate the dual role dilemma model developed in chapter 4. Finally, chapter 6 concludes with some thoughts towards showing that the dual role dilemma analysis can much improve our understanding of central banking challenges in reserve-constrained economies, so as to design better monetary policies for financial stability and macroeconomic stabilisation.

Chapter 2: Determination of the Dual Role Dilemma for Central Banks in Reserve-Constrained Economies: A Theoretical Framework

2.1 Introduction

The primary goal of this chapter is to develop a theoretical framework for the analysis of the dual role dilemma in central banks of reserve-constrained economies. The concept of 'the dual role dilemma', as pointed out in chapter 1 of this thesis, considers central banks as mandated with two conflicting roles in the reserve management function – the portfolio management role focusing on the return generation goal, and the liquidity role seen as crucial for supporting exchange rate and monetary policy. This dual mandate, a view distinct from both the mainstream and the Post-Keynesian view of the custodial role of central banks, originates from recent transformations in the reserve management function of central banks.

In most countries of the developing world, central banks were initially assigned the custodial role in the management of foreign reserves with the view of providing liquidity to fulfill three main goals: (i) maintaining exchange rate stability, (ii) financing government imports, and (iii) helping service the state's external debts (Stiglitz, 2006). Over time, this the reserve management function of central banks in reserve-constrained economies has changed significantly. The role which has for long been treated as a simple liquidity maintenance, has now become more of a portfolio management role with return generation goal, has come to dominate. This is evidenced by the significant increase in the composition of return yielding assets in the reserve holdings of central banks of developing countries in recent years (Bakker and Ingmar, 2007; McCauley and Rigaudy, 2011 and Bakker and Van Herpt, 2007).

At the same time, a fundamental innovation has been taking place in the monetary policy function of central banks since the mid-1990s with the rising financial and economic globalization. Notably, foreign reserves have become the chief source of international liquidity to shield-off monetary policy from external forces (Caballero and Krishnamurthy, 2003). Increasingly, foreign reserves have been included as one of the important policy

tools that is normally seen as a first line of defense to address concerns about exchange rate instability, thus providing a crucial role in supporting monetary policy autonomy. This has put an intense pressure on the liquidity role of reserves, thus an acute tension with the emerging portfolio management role. This trade-off is what has been referred to in this thesis as 'the dual role dilemma'.

This chapter aims to develop a coherent analytical framework that synthesizes this dual role dilemma and provides a theoretical foundation for understanding the underlying factors behind the emergence of the dilemma. This analysis builds on the Post-Keynesian currency hierarchy framework which is grounded on Keynes' Own' Rate of Interest (Keynes, 1936). We propose to extend this framework to incorporate the global productive asymmetry perspective to be able to show the mechanisms that underlie both the liquidity and the portfolio management role of the reserve management function in central banks of reserve-constrained economies.

Post-Keynesian currency hierarchy theory has traditionally focused on understanding the nature of the international monetary asymmetry and its policy implications for peripheral economies. It has devoted much attention to the inherent vulnerability and monetary subordination that accompany the existence of this currency hierarchy. It has also emphasized the inability of peripheral economies to borrow in their domestic currencies and highlighted the persistent nature of yield-differentials between the assets issued by core nations and those issued by peripheral economies. They bring to light that in the world of currency hierarchy, reinforced by global financial integration, monetary conditions in the centre country are transmitted world-wide through cross-border gross credit flows and this undermines monetary policy autonomy at the bottom of the hierarchy. This loss of monetary policy autonomy under free capital mobility, requires permanent official interventions in the currency markets to help achieve the goal of monetary and financial stability regardless of the exchange rate regime adopted. In this perspective, the liquidity role of reserves is established as a precondition for managing the stability of fragile currency markets and improving monetary policy space (see Andrade & Prates, 2013; Kaltenbrunner, 2015 & 2008 and Paula, etl., 2017).

The Post-Keynesian currency hierarchy framework comes very close to describing the dilemma in the reserve management function of central banks in reserve-constrained economies. It points to the increasing importance of the liquidity role of reserves for countries seated at the bottom of the international monetary system. However, it misses one side of the story. It does not capture the portfolio management role, or more precisely the need for return generation on reserves. Perhaps, the explanation of this deficiency in the framework can be found in its focus on emerging economies. These economies have a relatively stronger ability to generate reserves due to strong trade balances and relatively developed and active financial markets that can generate sufficient foreign currency inflows. In such economies, portfolio management role is not as crucial as in highly reserve-constrained economies, and the main thrust of the central banks can be directed towards achieving the financial and monetary stability goal. However, this is not the case for central banks in reserve-constrained economies whose ability to generate reserves is critically constrained. In these economies, both the productive structure and the financial markets are very weak, which means they cannot generate any reliable foreign currency inflows. The reserve management function of central banks in such economies goes much further than the liquidity role. In this context, the portfolio management role becomes an integral part of reserve management in the view of generating the return required for the growth and preservation of reserve capital.

The contribution of the present study is to extend the Post-Keynesian currency hierarchy framework by the global productive asymmetry perspective to analyze theoretically the emergence of the dual-role dilemma in reserve-constrained economies. We draw key ingredients from the core-periphery production concept found in the structuralist economic literature (e.g Cimoli and Porcile, 2013 and Milberg, 2004). A central concept here is the idea that in the prevailing international production system peripheral economies specialize in the supply of a few primary commodity products (or low-value added manufacturing goods) in exchange for higher value-added manufactured goods from core economies. This exposes them to structural balance-of-payment constraints associated with natural vulnerability and terms of trade shocks beyond domestic control (Gereffi, 1995; Abdel-Salam, 1996 and Milberg, 2004). The implication of this is noteworthy for reserve constraints and accumulation of external obligations (both

imports and external debts) for countries at the extreme bottom of the international monetary system and the global productive structure.

Incorporating this productive asymmetry concept into the analysis of Post-Keynesian currency framework, specifically in the portfolio choice perspective proposed by Minsky (1975) provides a fruitful ground for understanding that what is important for a central bank is not only the level of reserves, but also which assets reserves are held in. Specifically, it clearly shows two main mechanisms which explain the need for return generation in the reserve management function. First, the nature of external obligations, especially foreign debts (including its interest costs) which far outpace the reserves that structurally weak countries can generate. This, reinforced by the inherently low yields on liquid assets of core nations, means that central banks of reserve-constrained economies must hold their reserves in return yielding assets. This is crucial for achieving growth in reserve capital required for meeting external obligations (both current and future foreign liabilities).

Second, and related to the same notion of the low yields on liquid assets issued by core nations, is a problem which has been referred to as the ‘saver curse dilemma’ (Jeanne, 2011). As already highlighted, the international monetary system offers a privilege to countries at the centre of the system to offer low yields on their assets which are considered safe and liquid. The yields on those assets can turn to be critically low and even negative in some instances, particularly with the prevailing financial globalization. Since reserve-constrained economies are required to hold their reserves in such assets, there is an obvious erosion of reserve capital emanating from the exceptionally low or negative yields. If a central bank wishes to contain the erosion of reserves (preservation of reserves capital), the need to hold reserves in return yielding assets becomes an important factor in central bank decisions to help provide preservation to reserves capital.

There are two overall conclusions of this chapter. First, the reserve management function of central banks in reserve-constrained economies is not a simple custodial role as held in academic textbooks. It consists of both the liquidity role and a portfolio

management role – an important mandate required for the growth and preservation of reserve capital. Second, our theoretical analysis is able to show that the emergence of this dual role dilemma is deeply rooted in the steep hierarchy among world regions in terms of their productive structure and the international monetary system.

The chapter is structured as follows. Section 2.2 presents the main components of the Post-Keynesian theory of currency hierarchy, its implications for peripheral economies and the crucial insurance role of reserves. Section 2.3 extends the discussion of the hierarchy to incorporate the elements of the global productive structure. Section 2.4 applies the extended framework to explain the mechanisms that underlie the portfolio management role in central banks of reserve-constrained economies. Section 2.5 concludes.

2.2. The Currency Hierarchy Theory and Post-Keynesians' Conception of the Role of Foreign Reserves

Our theoretical framework finds its foundations in the Post-Keynesian Currency Hierarchy Framework which is grounded on Chapter 17 of the General Theory. A central tenent in the currency hierarchy theory is the idea that the international monetary system can be perceived as a spectrum from core to periphery currencies. In this setting, the leading currency (currently the US dollar) is placed on the top of the hierarchy, followed by intermediate currencies (the currencies of most developed economies), and finally currencies issued by the peripheral countries at the bottom of the system.

To theorize this currency hierarchy, Post-Keynesian authors (see Andrade & Prates, 2013; Kaltenbrunner, 2015; Prates, 2017; and Paula et al., 2017) have relied on Keynes 'Own rate of interest'. Central to their analysis is the notion of the currency's international liquidity premium which shapes currencies' differential positions in the international monetary system. This section presents the central prepositions that constitute the currency hierarchy theory. It begins with the review of the liquidity preference framework as originally proposed by Keynes (1936). It then briefly reviews the subsequence efforts

to incorporate liabilities in the liquidity preference theory by Minsky to formulate a portfolio choice model. Finally, it shows how the theory is adopted in the context of an open economy setting to explain the positions of different currencies in the international monetary system and the implications for peripheral economies.

2.2.1 Keynes on Liquidity Preference and 'Own Rate of Interest'

In the General Theory, Keynes (1936) presents a liquidity preference theory, dealing with the connection between uncertainty and money in the modern monetary economy and the crucial implications this relationship has for the motives and decisions of economic agents, as much in the short as in the long run. The cornerstone of Keynes' liquidity preference theory is an explanation of the forces determining the demand for money and the repercussions for the dynamic of entrepreneurial economies, including fluctuations in investment and employment.

The central aspect in his theoretical framework is the idea that economic agents operate in a world of fundamental uncertainty where it is not possible even to conceive the universe of possible outcome of a given process, for the attribution of a priori numerical probabilities. In other words, it's not possible to predict the future in a statistically reliable sense (see Davidson, 2002 and Carvalho, 2009). As indicated in Carvalho (2015. p.17), "when facing this kind of uncertainty, agents could not protect themselves, even in theory through the usual appeal to insurance. Therefore, to seek protection against uncertainty, agents had to find instruments that could be activated in situations that could not, however, be specified in an insurance policy".

In such an uncertain world, money is seen as an important means of storing wealth, and as such becomes an alternative to other means of accumulating wealth, especially in times of pronounced uncertainty.

In his work of 1937, Keynes begins his discussion of the functions of money by stressing that:

> “Money, it is well known, serves two principal purposes. By acting as a money of account it facilitates exchanges without it being necessary that it should ever itself come into the picture as a substantive object. In this respect, it is a convenience which is devoid of significance or real influence. In the second place, it is a store of wealth. So, we are told, without a smile on the face. But in the world of classical economy, what an insane use to which to put it! For it is a recognized characteristic of money as a store of wealth that is barren; whereas practically every other form of storing wealth yields some interest or profit. Why should anyone outside a lunatic asylum wish to use money as a store of wealth?” (Keynes 1937, pp.215-16).

His response to this question was that “the possession of actual money lulls our disquietude; the premium which we require to make us part with money is the measure of the degree of our disquietude” (Keynes 1937, p.216). In Keynes’ view, since economic agents know that the future is uncertain, and that making any commitment to specific future scenarios is inherently risky, it is sensible for them to hold part of their wealth in liquid form as a blanket protection against unspecified and unspecifiable adverse future events. In other words, maintaining a liquid cash position helps economic agents to postpone irreversible investment decisions as it provides security against future disappointments of economic expectations (see Davidson, 2002 and Carvalho, 2009). Liquidity preference “therefore is defined in terms of the exposure to yet undefined risks that parting with liquidity implies for a wealth-holder” (Carvalho, 2015. p.22).

In the General Theory, Keynes distinguishes the transactions, precautionary and speculative motives for holding money. The transactions motive is to bridge the interval between the receipt of income and its disbursement, as well as to bridge the interval between the time of incurring business costs and that of the receipt of the sale-proceeds (Keynes, 1936 and Minsky, 1975). The precautionary motive is defined as the need to provide for, “contingencies requiring sudden expenditure and for unforeseen opportunities of advantageous purchases and to hold an asset of which the value is fixed in terms of money to meet a subsequent liability fixed in terms of money” (Keynens,1936, p. 196). Precautionary balances in Keynes’ view are held in money rather than in non-

monetary form to avoid the capital erosion that would be incurred if such assets suddenly have to be sold when prices are low (Runde, 1994, p.134; Tily, 2007, p. 190 and Bibow, 2009). In Dequech's (2000) work, Keynes' emphasis on the need to meet contingency is seen to include the case in which returns from assets turn out to be less than expected.

Lastly, the speculative motive, which is portrayed as the desire of securing profit from speculation between money, which is capital-safe, and bonds whose values vary with the interest rate. To Keynes, "the important factor in determining the degree of liquidity preference was the probability of capital gains and losses, which he referred to as "uncertainty". Capital gains were more likely when rates of interest were considered high and loses when their level were low" (Chick and Dow, 2002, p.589).

In his well-known 'own rate of interest' in Chapter 17 of the General Theory, Keynes did not only present an extended version of his two-asset class liquidity preference framework to incorporate a greater variety of classes of assets, but he also discusses asset attributes that determine their expected return, and in turn their demand by wealth owners. In his postulation, each asset, money inclusive, is characterized by four attributes: (i) the expected (explicit) yields which is seen, for instance as interest payments in the case of bonds; ii) carrying costs arising from storage or wastage; (iii) the liquidity premium which can be interpreted as the implicit yield reflecting how much people are willing to pay for the potential convenience or security' given by the power of disposal over the asset; and (iv) the appreciation (positive or negative) viewed in terms of the difference between the asset price at the end and at the beginning of the period under consideration (Dequech, 2005).

Wealth-owners would demand each class of asset according to their own-rate of interest, given by the expression

r_a = (q-c) + a + l ……(1)

Where r_a represents the expected return, a is the expected appreciation of the asset, "q" is the expected quasi-rent (or yield), "c" is the carrying cost, and "l" is the liquidity premium.

These attributes define a spectrum of assets between which wealth holders can choose, ranging from capital assets, which offer a high yield but little liquidity and high carrying costs, to money for which the yield and carrying cost are nil, but which offers the highest liquidity premium. Liquidity preference would be reflected, in this highly aggregated model, in the terms of the trade-off between monetary returns (a+q-c) and the liquidity premium of money (l).

Some Post-Keynesian economists (e.g Minsky) have taken Keynes's analysis one step further, approaching liquidity preference as a theory of portfolio choice (also see Dequech, (2000). In his book titled "John Maynard Keynes", Minsky (1975) presents a framework where both assets and liabilities are explicitly treated within a model of liquidity preference. Minsky begins by arguing that, while Keynes' precautionary motive clearly suggests that the 'power of disposal" defines the attractiveness of liquidity, Keynes did not introduce explicitly the liability structures and the payments commitment they entail into his definition of precautionary demand for money. Minsky wrote:

> "Once we acknowledge that money embodies an insurance policy, and that the relevant set of transactions for which money is used includes financial payments as well as payments that reflect the production process, then the question arises as to what is being insured against? Against what contingency is money being held for?" (Minskys, 1975, p.79).

Minsky's concern was with the differences in time profiles of cash in and outflows resulting of a given list of assets and liabilities in one's balance sheet that may create the need to borrow or to liquidate assets in order to honour contractual commitments. He asserted that once the liability structure of an economic agent is considered into the liquidity preference framework, the "power of disposal" over an asset is only one of the forms through which liquidity can be provided. In his view, liquidity should be viewed in terms of an asset's ability to generate cash flow that is able to meet contractually fixed cash outflow commitments. That is, committed cash flows pattern the needs that will have to be satisfied by earnings from or by sale of assets.

Accordingly, Minsky argues that other liquid assets such as saving deposits and bonds that yield return, if the assets are believed to be “safe,” dominate money for this purpose. The notion that short-term, highly liquid assets including savings deposits, certificates of deposit, and numerous other short-term debt instruments are superior substitutes for money as store of value or means of holding liquidity has been stressed by Wells (1983).

The next sub-section shows how this Keynes ‘own rate of interest’ has been applied to an open economy setting in developing the currency hierarchy framework or more generally the design of the international monetary system.

2.2.2 Adoption of Keynes ‘Own Rate of Interest’ to the Theory of Currency Hierarchy

Keynes’ ‘Own rate of interest’ discussed above has been adopted by some Post-Keynesians (Andrade & Prates, 2013; Kaltenbrunner, 2015 & 2008; Terzi, 2006 and Paula, et al, 2017; Prates, 2017; De Conti et al., 2014) to theorize the concept of currency hierarchy. Central to these analyses is the notion that different national currencies have different degrees of ‘moneyness’, that is, they are not equally capable of being, at the international level, what money traditionally needs to be: a unit of account, a means of payments and a store of value (Paula, et al., 2017 and Terzi, 2006). Currencies’ differential degree of moneyness creates what has been referred to as ‘the hierarchy of money’, showing the hierarchical positions of currencies in the international monetary system. The central point in the analytical explanation of the currency hierarchy is that the position of each currency in the international monetary system is determined by a currency’s international liquidity premium, that is its ability to perform international money functions.

In the framework proposed in Andrade & Prates (2013), Terzi (2006) and Paula et al. (2017), the main determinants of a currency’s international liquidity premium is conceptualized within the store of value function of money. In their analysis, the main determinant of a currency’s liquidity premium is its relative ability to act as a store of value which is in turn determined by factors such as a country’s expected economic policy and its commitment and ability to maintain the stability of its currency. These include the

existing exchange rate regime, willingness and ability to fight inflation and to defend the currency in a crisis.

Notwithstanding the importance of Andrade & Prates' analysis for understanding the theory of currency hierarchy, Kaltenbrunner (2011, 2015) observes that the centration on the store of value function of money, and therefore the asset side of the international balance sheets, has limitations. It is insufficient to fully account for why only one currency stands at the apex of the international currency hierarchy, yet many currencies have a stable value. The second limitation relates to the emphasis on policy variables in explaining the liquidity premium of a currency. In Kaltenbrunner's view, this fails to explain why even those emerging and developing economies that maintain sound and credible monetary and exchange rate policies find it very hard to progress to higher levels of the international monetary hierarchy.

In order to solve these deficiencies, she proposes a modification to this analysis and develops a framework in which a currency's ability to meet outstanding obligations, as well as its ability to act as a store of value, determine the currency's liquidity premium. Her work is based on Minsky's (1975) concept of the role of asset's ability to meet contractual obligations in determining its liquidity. In this analysis, a country's position in the international debtor-creditor relations, and more specifically its outstanding stock of foreign currency debt and the ability of its currency to meet these contractual obligations is the main determinant of its currency's international liquidity premium. This ability is influenced by several factors including a country's balance of payment position and the nature of the financial markets.

In short, in Kaltenbrunner (2015)'s framework, it's this Minskyan interpretation of currencies' international liquidity premia that not only shapes the asymmetric nature of the international monetary system, but also generates several negative implications for peripheral economies seated at the bottom of the system. These implications are discussed in the following sub-section.

2.2.3 Implications of International Monetary Asymmetry and the Role of Foreign Reserves for Peripheral Economies

The Post-Keynesian literature on currency hierarchy highlights four fundamental implications for peripheral countries that arise from the existence of the hierarchical and structured nature of the international monetary system: (a) inherently fragile and unstable currency markets, (b) the acute loss of monetary autonomy, (c) the 'original sin' problem, and (d) the existence of persistent yield differentials between core and peripheral assets. These adverse implications generate an important role for foreign reserves as a precondition for achieving stability in the currency markets and improving monetary policy space, as explained below.

An inherent instability of the currency markets. Post-Keynesian literature highlights the inherent fragility and unstable nature of the peripheral financial markets, particularly the heightened volatility of exchange rates resulting from the asymmetry in the international monetary system. This, in their view, is frequently independent of domestic economic fundamentals (Bortz and Kaltenbrunner, 2018). The gravity of the currency market instability is exacerbated by financial globalization which exposes peripheral economies to the volatile nature of capital flows directed to those economies. Such capital flows have been shown to be sensitive to sudden reversals caused by changes in the phase of the global economic cycle (governed by an increase/decrease of the liquidity preference of global investors and/or changes in the monetary policy of the centre countries (Paula, et al., 2017). According to Prates (2013), the wide range of fluctuations in exchange rates of peripheral currencies is intrinsically linked to the low liquidity premium of peripheral currencies which exposes them to speculative capital flows. In moments of optimism, agents demonstrate a great appetite for risk and low liquidity preference, which results in a search for yield and therefore are willing to invest in assets that do not have the liquidity premium of the key currency. However, in times of greater uncertainty, there is a high preference for the liquidity of the key currency. Therefore, the wide range of fluctuations in exchange rates of peripheral currencies is exacerbated, because emerging financial assets, with the lowest liquidity premium, are the first victims of the global investors' "flight to quality" (Prates, 2013, p.411).

Loss of monetary autonomy. The existence of currency hierarchy, reinforced by financial globalization, is seen as responsible for creating an acute inability for peripheral economies to fully pursue an independent monetary policy. Pirates (2017) and Kaltenbrunner (2015) point out that the instability and speculative logic of capital flows directed to peripheral economies generates a tendency for central banks in these economies to react to the monetary policy actions of the countries at the top of the hierarchy. This loss of autonomy crucially restricts the space in which the domestic interest rates may be defined as consistent with viable development policies and further limits the ability of peripheral countries to overcome the socioeconomic conditions and structural global subordination in which they find themselves (also see Prates, 2017).

The "original sin" problem. The existence of the international monetary asymmetry is also shown to create a strong inability for peripheral economies to borrow in their domestic currency (see Kaltenbrunner & Painceira, 2018). The explanation provided for this is that the lower liquidity premium and instability of peripheral currencies make their currencies cease to be the medium of contractual settlement. This implies that if they are to borrow from the international financial markets to provide the much-needed capital to finance development projects, they must assume net foreign currency debtor position, a situation described in Eichengreen, et al. (2003) as the 'original sin'. This inability explains the presence of large foreign currency denominated debts in most peripheral economies. This contrasts with the neoclassical explanation of the 'original sin' which attributes it to misguided economic policies which cause information asymmetries and moral hazard. It is stressed that the presence of "original sin" leads to other consequences for peripheral economies, including a serious currency mismatch situation.

Existence of yield-differentials. It is also shown that the international monetary asymmetry gives core economies the privilege to offer lower yields on their financial assets due to the higher liquidity premium of their currencies. This is in sharp contrast to the countries at the lower end of the hierarchy which are typically required to offer higher interest rates to compensate for the lower liquidity premium in order to maintain investor demand and minimize agents' pro-cyclical behavior particularly in times of perceived

uncertainty. This is in addition to the lower maturity of their assets (as part of their institutional liquidity) to allow quick and immediate reversal.

To support the stability of the currency market and improve monetary policy space, the standard view in Post-Keynesian economics is that foreign reserves gain an important precautionary or insurance role. Reserves provide a central bank with the defensive mechanism in the world of an unstable international monetary asymmetry. They play a unique role in providing a central bank with the ability to act as market maker in their currency markets, with the purpose of controlling exchange rate volatility and improving policy space (Paula, et al., 2017; Andrade & Prates, 2013 and Ocampo, 2001). Post-Keynesian authors stress that reserves provide a central bank with the ability to ensure stability of the currency markets in times of capital flows reversal, and hence protect their economies against crisis. The degree to which a central bank can achieve this stability is viewed to depend on the size of reserves of the country and the degree of financial openness. The larger the foreign reserves, the greater the central bank capacity to reduce the currency volatility" (Andrade & Prates, 2013). This crucial role of reserves is in line with the "self-insurance" strategy of reserves accumulation suggested in the literature (Aizenmann et al., 2004; Dow, 1999; Carvalho, 2009; Feldstein, 1999; Aizenman and Marion, 2003; Aizenman and Lee, 2007).

In sum, this section showed the important role Post-Keynesian theorists attribute to the existence of international monetary asymmetries for the volatility of exchange rates in peripheral economies, monetary autonomy, 'the original sin'', and financial instability conditions which create a case for precautionary reserves holdings. However, so far, the literature has not questioned the role of the central bank in regard to the portfolio choice decision in managing foreign reserves. Their analysis is limited to a system in which reserves are purely held for its liquidity role in managing stability of the exchange rates. The literature fails to take account of the changing nature of reserve management practices in countries at the lowest rank of the currency hierarchy. As set out in Chapter 1, these countries manage reserves not only for liquidity purposes, but are also forced to generate positive returns. The theoretical development of this dual role, that is the liquidity/custodial and return generating/portfolio management role, is what this chapter

turns to next. To do so it complements the monetary and financial asymmetries highlighted in the Post-Keynesian currency hierarchy literature, with the productive asymmetries discussed in the structuralist and neo-structuralist tradition.

2.3 Incorporating Elements of the Productive Structure Asymmetry into the Theory of Currency hierarchy

The Post-Keynesian currency hierarchy framework presented above emphasizes the monetary subordination of developing and emerging economies in the international economy. In this framework, the importance of reserves is restricted to the liquidity role required for stabilizing currency markets and insulating monetary policy against instabilities associated with the global financial cycle. In addition, the framework is largely focused on analyzing the implications of the hierarchy on emerging economies. These economies have a relatively stronger ability to generate foreign reserves due to their stronger balance of payment positions and relatively more developed financial markets. In such a setting, the portfolio management role is deemed unwarranted, and the reserve management function can be easily viewed as a simple custodial role with a focus on the maintenance of liquidity.

However, when the analysis is extended to countries at the extreme lower end of the hierarchy, there are strong structural forces that generate additional roles for foreign reserves. First, the weak productive structure of their economies creates a strong dependence on imports and external debts. As a result, a significant amount of reserves is required for meeting those structural external obligations. Moreover, the same weak productive structure creates a tight reserve constraint, that is the inability to generate foreign exchange through diversified and high value-added exports.

In this section, the post-Keynesian currency hierarchy theory is extended to incorporate the perspective of productive structure asymmetry to show theoretically the emergence of a dual role central bank dilemma in reserve constrained economies. The section begins by a brief discussion of the concept of productive structure asymmetry, its key implications for the external obligations and the role of reserves and finally show how

those generate the need for portfolio management role in central banks of reserve-constrained economies.

2.3.1 The Perspective of Productive Structure Asymmetry and Implications for External Obligations and reserves constraints

The concept of global productive asymmetry is associated with the notion of the core-periphery production system found in the structuralist economic literature (see e.g Cimoli and Porcile, 2013). The central idea here is that the world production system is divided into two parts. On one side is the core world with diversified manufactured goods and it leads in innovation and shows high level of labour productivity which are relatively homogeneous across sectors. At the opposite extreme end is the peripheral world which remains highly specialized in a narrow set of primary commodities and keeps a large share of its workers in low-productivity and substance activities (Cimoli and Porcile, 2013). The structural roots of this asymmetry have been explained through technology gap and the evolution of their 'international relations', reflecting both internal and external factors as well as the internal deficiencies. Colonialism and the emergence of foreign direct investment have been particularly blamed for this asymmetry. The main problem is that lead firms in the production networks typically take over ownership of strategic sectors crucial in the production process, leaving developing countries with lower value-added activities (Milberg, 2004).

Given the existence of the productive asymmetry, the periphery's insertion into the world trade system implies that it assumes the role of suppliers of nonindustrial means of consumption (primary commodity products) in exchange for manufactured goods from core countries (see e.g. Gereffi, 1995; Abdel-Salam, 1996 and Milberg, 2004). This reliance of peripheral economies on primary commodity products naturally exposes them to structural and persistent balance-of-payments constraints mainly due to two factors.

First, the heavily dependent of peripheral economies on primary means that production is exposed to extreme climatic vulnerability including rising temperatures,

prolonged droughts, floods, and devastating cyclones. That is especially so in Sub-Saharan African countries which mostly depends on primary agricultural products which production is notoriously subject to disruption from adverse weather condition. This does not only affect production and foreign currency inflows from exports but also destruction of infrastructure, disruption of supply chains and tourism and depreciation pressure on exchange rates (Rigaud et al., 2019).

Second, the peripheral economies' strong reliance on exports of undiversified primary products means that they attract highly volatile and low or price crashes in the world markets (Bevan, et al. 2000). This is commonly caused by the low quality of their products which is harmful to their bargaining power which forces them to become price takers, especially in the world of intense competition from global producers of similar products. This is in addition to the demand disturbances driven by macroeconomic fluctuations in the importing economies (industrialized countries). Specifically, economic downtown in the core, as the main markets for commodities, spilled over to the periphery in diminished demand for commodities and lower commodity prices, which, in turn, led to a decline of imports by the periphery, thereby creating large swings in SSA's external balances.

One natural consequence of this subordinated position of countries at the extreme bottom of the global productive structure with heavy reliance on undiversified primary commodities is the highly constrained capital flows. Crucially, the volatile and low prices of primary commodities have systematic and strong effects on capital flows through their impact on risk-return profiles of these economies. Specifically, lower, and volatile commodity prices deteriorate the external financial positions and increase the risk of lending and investment in peripheral economies (see Akyüz, 2020; Reinhart, et al. 2008 and Byrne and Fiess, 2016). This is especially so in SSA but is also the case in some other developing economies such as in Latin America with weak productive structure, reinforced by weak institutional characteristics (Christensen, 2016 and Collier and Gunning, 1999). The lower and volatile commodity prices potentially lower the return on lending and investment in commodity economies by leading to reduced growth and weakness in asset and currency markets. This, in turn affects sovereign spreads of

commodity dependent economies and they often cause currency depreciations and lower the prospects of capital gain on lending and investment (Diego et al., 2013). This is in contrast with emerging economies with at least higher level of manufactured products. These economies normally receive large FDI, portfolio investments and other investments associated not only with bust cycles of commodity prices (Doojav and Batmunkh, 2018) but also better economic performance anchored on increasing manufacturing, sound fiscal outcomes, a greater degree of financial openness, and stronger institutions (Calderón, et al., 2019).

A combination of the weak productive structure with exposure to extreme climatic vulnerability and the low and volatile commodity prices with the associated constrained capital inflows, reinforced by the implications arising from the international monetary asymmetry discussed above, generates special challenges for reserve management in these economies. This includes: (a) the essential role of reserves for meeting imports, (b) the reliance on reserves for servicing external debts, and (c) the acute reserves constraint. These are detailed below:

The role of reserves for import payment. As already pointed out, the existence of the global productive asymmetry generates a strong disequilibrium in the structure and growth of imports and exports for countries at the extreme bottom of the system. This arises from the higher propensity to import expensive manufactured capital goods required in the production process. This is in addition to the volatile nature of their export revenues associated with the seasonality and lumpiness of primary commodity products. As a consequence, the central bank will have to maintain considerable sums of foreign reserves to meet the essential import needs during both seasonal and cyclical variations in foreign exchange inflows. Indeed, the role of reserves in meeting imports was at the core of the traditional approaches for reserves adequacy determination, including those proposed by Heller (1966) and Frenkel and Jovanovic (1981) and the simple rule of thumb such as the import cover ratio of 3 months commonly used among policy makers. The justification given for reserves-to-import cover measures in the traditional models is that reserves provide governments with foreign cash needed to even out receipts and payments-current account balances (see Flood and Marion, 2002).

The historical roots of the role of reserves for meeting imports can be traced back to Keynes himself, although Post-Keynesians have so far largely ignored it. As indicated in Obstfeld, et al. (2010, p.61), in his Treatise on Money first published in 1930, when he was discussing his view of the then-accepted principles governing the optimal level of free gold reserves, Keynes placed external drain at the heart of his views on the appropriate amount of a country's free reserves. External drain is viewed in terms of sudden withdrawal of foreign funds, or through a sudden drop in the value of exports. In this view, the nation which depends on a few and volatile exports needs larger reserves than a country which boasts diversified and stable exports.

The role of reserves for servicing external debt obligations. Another important implication of the existence of the global productive asymmetry is the chronic dependence on external borrowings to bridge the large financial gap required to support development in countries at the bottom of the global productive system. This chronic external debt problem has been emphasized in both the mainstream and Post-Keynesian literature in what has been referred to as the 'original sin' problem. The severity of the external debt burden is typically reinforced by high interest rates on those borrowing. Given that these debts are typically denominated in foreign currencies, a particular implication arising from the existence of the international monetary asymmetry, external debt accumulation poses a particular problem for the demand for foreign reserves required for servicing those foreign debts (see Dooley, et al.1989). The role of reserves in servicing external debts was at the heart of the earlier debate regarding the determinants of reserves adequacy (see Greenspan, 1999; Ben-Bassat and Gottlieb, 1992 and Ben-Bassat, 1980) and in the literature on reserves management more generally. Nugee (2000), for instance stresses that reserves provide the central bank with the ability to ensure stability and a smooth servicing of foreign debts in an economy.

Reserves Scarcity Problem. The fact that the stock of foreign reserves is seen as the net foreign currency earnings which depends on the structure and growth of one's nation imports and exports, it's clear that the level of reserves is determined, largely, by the productive structure of the economy and its position in the global trade. The implication of this for countries at the bottom of the global production system is massive since their

productive structure is anchored on primary commodity or low value-added manufacturing exports which are both volatile and exhaustible in nature. This critically limits the amount of reserves their central banks can generate. Earlier literature of balance-of-payment of developing countries (e.g Abdel-Salam, 1966) points to such reserve scarcity problems arising from weak export revenue. The reserve scarcity problem is reinforced by the limited and unpredictable nature of capital flows in Sub-Saharan African countries due to the weak financial markets which is considerably different from that of emerging markets (Calderón, et al., 2019).

To sum up, the analysis in the present section contributes to Post-Keynesian currency hierarchy theory since it provides an important missing element—the analysis of the role of reserves for meeting structural external obligations. Precisely, the analysis shows that, when we take into account both the productive structure asymmetry and the international monetary asymmetry, numerous roles emerge for foreign reserves, including exchange rate stabilization, meeting imports, and servicing external debts. This is consistent with early literature on the principal determinants of reserves demand and its currency composition which places emphasis on trade flows, financial flows and currency pegs (e.g Eichengreen and Mathieson, 1989 and Flanders, 1971 and Grimes, 1993). Most importantly, the analysis shows that the global productive structure asymmetry imposes serious constraints on the country's ability to generate reserves for meeting those external obligations. This framework provides a fertile ground for a more comprehensive study of the role of central banks in managing the limited reserves given the magnitude and the structure of the external obligations (including the interest rates and maturity structure of those debts). In the next section, we extend the analysis to understand the need for the portfolio management role in central banking in reserve-constrained economies.

2.4 The Need for Portfolio Management Role in Central Banking in the face of international monetary asymmetry and the productive structure asymmetry.

The analysis presented in Sections 2 and 3 allows us to carry the analysis of the reserve management function of central bank a step further. In particular, an extension of the Post-Keynesian currency hierarchy framework to incorporate the productive structure asymmetry leads to two important conclusions. First, it enriches our knowledge that a combination of the productive structure asymmetry and currency hierarchy is responsible for generating the extraordinarily large external obligations in countries at the extreme bottom of the system. These large external obligations, in addition to the needs for intervention in the fragile foreign currency markets associated with volatile short-term capital flows, generate a high and structural demand for foreign reserves. Unfortunately, poor countries of the world do not have the ability to generate adequate and reliable reserves due to the weak productive structure of their economies. There is therefore a large gap between the level of reserves and the volume of external liabilities in reserve-constrained economies. Second, Post-Keynesian currency hierarchy theory has highlighted the existence of yield differentials between the core and peripheral economies – a phenomenon originating from the asymmetry in the international monetary system. The diminished yields arising from the asymmetry in the international monetary asymmetry can turn to critically low especially with the rising financial globalization that makes the so called the 'safe assets' which reserves are typically held in become unattractive. In what follows, the chapter discusses in more detail how these two forces – structural external obligations and persistent yield differential on core and peripheral assets – can explain the emergence of the portfolio management role in a Post Keynesian currency hierarchy framework.

2.4.1 The role of liabilities in the liquidity preference model

As already discussed in section 2, according to the Minskian approach adopted in the currency hierarchy framework, when the liability structure is incorporated into the liquidity preference framework, it naturally gives rise to what has been referred to as 'the time

profiles of cash in and outflows of economic units'. As a precondition to be able to meet contractually fixed cash outflow commitments (including its interest costs), one must consider both the liquidity and the return attributes of assets which are held to hedge against such liabilities. In this perspective, the nature of the assets that an economic agent owns is determined by the nature of its liabilities.

Applying this principle to central banking, specifically to the relation between foreign reserves and foreign liabilities in the central banks' balance sheets, shows that while it is crucial for central banks at the lower end of the hierarchy to hold reserves in liquid assets, the structural external liability pressures oblige them to start assuming the role of a portfolio manager too. This external liabilities-related portfolio management role works on two main levels.

(a) ***The role of return for growth of reserve capital.*** As discussed already, countries at the deep bottom of the asymmetric international monetary system and productive structure are characterized by ever-growing structural external obligations that far outpace the level of reserves that they can generate. Given the acute reserve constraints in those economies, reinforced by the fact that the nature of those reserve sources is both volatile and exhaustible, central banks are typically forced to rely on the return on reserve investments to help grow the reserves. Since the yield on liquid assets are typically too low to help bridge the gap, it is natural for central banks to look for return from relatively better yielding assets to ensure they achieve a certain level of growth in reserves capital. Such growth is required to provide central banks with some ability to be in position to meet the growing foreign obligations.

(b) ***The role of return for matching the structure of interest rates on external liabilities.*** The second factor is the interest costs charged on external obligations of reserve-constrained economies which are stubbornly higher than the yields earned on liquid assets issued by the core nations. Together with the already high level of those external obligations, the level of reserves in those economies fall far

below the level required for meeting those external obligations, including their interest costs. The implication of this to the central banks is the need for holding reserves in the forms of assets that generate return that become crucial to provide central banks with the ability to smoothly meet foreign debts and offset the associated costs of foreign obligations. This is in line with the Minsky's asset-liability structure principal which views the 'portfolio management' needs from the perspective of the interests associated with cash flow commitments (liabilities).

2.4.2 Capital Preservation-Driven Portfolio Management Function

In the discussion of the liquidity preference theory, aside from the liquidity and return attributes of an asset, one principal concept is the notion of 'the security' or the protection that an asset should be able to offer. This has traditionally been seen as the ability of an asset to safeguard against capital erosion arising from price fluctuation. In the modern world where capital erosion arises not only from asset prices, but also from extreme low yield on assets, the return attribute becomes crucial in providing protection to the capital of wealth owners (see Tily, 2007 and Bibow, 2009). Particularly, in the world of currency hierarchy, coupled with the increasing globalization in financial markets, the possibility of negative yields on liquid assets especially in times of pronounced uncertainty becomes a new source of threat of capital erosion to wealth management.

In the context of central banks in peripheral countries, which are obliged to hold reserves for managing exchange rate stability and meeting foreign obligations, it is imperative in the world of yield-differential, that those reserves are held in assets that meet both the liquidity and capital preservation goals. As such, to be able to provide protection of reserves capital against erosion in environment of low/negative yielding assets, central banks must accept to hold their reserves in assets that have ability to yield positive return. Recent studies on reserves management point to this notion (e.g see Bonza, Gómez and Pabón, 2010 and Pringle and Carver, 2016). It is shown that while liquidity is crucial in achieving the goal of currency markets stability, in times of extreme low yields, liquid assets fall short of achieving the capital preservation goal of foreign reserves as it suffers negative returns.

2.5 Conclusion

The purpose of this chapter was to fill the void in both post-Keynesian and mainstream literature regarding the role of central bank in the management of foreign reserves. Specifically, the existing economic literature has neglected the discussion of the portfolio decisions in central banking in the management of foreign reserves as it's always maintained that central banks act just as custodians of foreign reserves. The analysis developed in this chapter, however, identifies a theoretical explanation for the portfolio management role of central bank, - an important role missing in the mainstream and post-Keynesian one. This explanation is strongly based on the post-Keynesian currency hierarchy framework, incorporating elements of global productive asymmetry to understand the relationship between the fragility of the currencies markets of countries at the lower end of the hierarchy, the acute reserve scarcity, and the various roles of foreign reserves for both exchange rate stabilization and for meeting foreign obligations. This sort of analysis is particularly relevant for understanding the difficulties faced by central banks in reserve-constrained economies. This study leads to three main conclusions.

First, that the concept of currency hierarchy can be extended to capture both the needs for reserves emanating from international monetary asymmetry and the reserves constrained imposed by developing countries' weak productive structure.

Second, adopting Keynes' and Post-Keynesian's views of liquidity preference into central banking problem therefore leads to the acknowledgement that what is important for a central bank in the world of currency hierarchy is not only the level of reserves, but also which assets reserves are held in. This suggests that central banks are not mere custodian of reserves, as it is held in both Post-Keynesian and mainstream literature, but they pursue an important portfolio management role. Building reserves is only the first step in the stabilization process. A prudent portfolio choice process to build a solvent and liquid balance sheet is the next problem to be solved by central banks, especially those who are conscious of the uncertainties surrounding the future and the cost of borrowing as well as the risk of capital erosion their reserves are exposed to.

Central banks at the lower end of the hierarchy, therefore, essentially perform 'dual' functions. They are not simply monetary authorities concerned with the role of achieving the stability of the financial and economic system. Rather, they play a key role in portfolio

decisions on the choices of currencies and assets to hold reserves that ensure its liquidity in terms of the ability to sell quickly and to ensure both the security (capital preservation) and growth of reserves as a proper hedging of the foreign debts and commitments. What ultimately explains the source of portfolio management function of central bank is a combination of the international monetary asymmetry and the global productive structure asymmetry. The asymmetric system creates for them strong external obligations that far outpace the reserves central banks can generate. This compels central banks in reserve-constrained economies into making asset choice decisions in an effort to grow reserves required for meeting both current and future external obligations. It also entails the choices of which kind of assets in which to hold reserves that are able to generate cash that can help offset the yield-differentials that accompany the currency hierarchy. This is reinforced by the needs to generate return required for offsetting negative return arising from the exceptionally low yields on liquid assets – a phenomena created by the international monetary system asymmetry.

Chapter 3: Empirical Evidence on the Dual Role Dilemma in Central Banks of Reserve-Constrained Economies: Perspective from Sub-Saharan Africa

3.1 Introduction

The primary purpose of this chapter is to provide empirical evidence on the dual role dilemma in the reserve management function of central banks in reserve-constrained economies. This dilemma, as already discussed, forces central banks to pursue both the liquidity role (crucial for supporting exchange rate and monetary policy), and the portfolio management role with a key focus on generating returns. This study pursues a qualitative research strategy which combines insights from focus group discussions with semi-structured expert interviews in three case study central banks in SSA (Botswana, Uganda, and Zambia). The analysis makes three important contributions to the literature of reserve management in developing countries. The first is to empirically investigate the nature and empirical manifestations of the dilemma for three comparative case studies. The second is to make the first attempt to conduct an extensive stocktaking of the historical evolution of central bank reserve management, including its policy frameworks, asset choices and risk management approaches. The third and final is to make an empirical investigation of the underlying structural factors which drive the dilemma across all the central banks under this study, and the country-specific factors that are critical in accounting for the variegation of different country experiences.

This chapter substantiates the theoretical analysis of chapter 2 of this thesis. In that chapter, a theoretical framework was developed that captures the structural forces which underlie the dual role dilemma. Specifically, it showed that the dilemma is rooted in the deep hierarchies in the world's international monetary system (anchored on the US dollars) and its productive structure with peripheral economies specialized in production of primary commodities. On the one hand, those hierarchies generate excessive exchange rate volatility and acute loss of monetary policy autonomy for countries seated at the bottom of the systems. Thus, the liquidity role of reserves is created in such an environment as a precondition for managing the stability of the exchange rates and improving monetary policy space. On the other hand, the same hierarchies create three conditions that are responsible for necessitating the portfolio management role in central

banks of those countries: (i) chronically and continuously growing external obligations to augment their limited capital stock required for development, (ii) acute reserve scarcity associated with the weak productive structure which exposes them to extreme climatic vulnerability and volatile primary commodity prices, and (iii) the erosion of reserve capital emanating from the extreme diminished yields on reserve assets issued by countries at the center of the international monetary system .

To better understand the deep nature of this dilemma and its historical roots, this study draws on experience of central bankers, especially those with direct roles in the reserve management or those who have previously been involved in the reserve management portfolio decisions. Focus groups and semi-structured interviews were preferred for this analysis because of their ability to explore and provide in-depth information about the nature, historical evolution, and underlying determinants of the dilemma. Furthermore, given the unavailability of data on asset allocations of central bank reserves (Beck and Rahbari, 2011), and the lack of a proper policy choice models in central banking reserve management that can help guide this study, we believe these qualitative research techniques are best suited to trace and uncover the deep roots underlying this dilemma The choice of the three countries in our sample has been made to have a relatively varied sample within SSA with regards to the level of reserves, the nature and size of public external debts, exchange rate arrangements, geographical location, and degree of integration into both regional and global financial markets.

The chapter is structured as follows. Section 3.2 provides a brief description of the methodology adopted in the study. Section 3.3 of the chapter presents the findings from the case study and the discussions of the historical evolution of portfolio management role and risk management practices in central banks. Section 3.4 discusses the empirical findings on the underlying factors behind the development of portfolio management role in central banking. Finally, section 3.5 concludes.

3.2 Methodological Considerations and Sample Choice

This study pursues a qualitative research strategy which combines insights from focus group discussions with semi-structured expert interviews in three case study countries. The use of qualitative research methods was motivated by the deep historical and novel nature of the study, which required an understanding of the reserve management problems from the perspective of central bankers in reserve-constrained economies. Qualitative research methods provide an important explorative ability that allows researchers to better trace not only the deeper causal historical processes of economic events, but also to understand better the social structures and their associated powers and causal mechanisms which underlie such patterns. As such, qualitative methods provide grounds to obtain inevitably richer and in-depth analyses of a particular topic (Downward and Mearman, 2007; Lawson, 1997; Berik, 1997; Bryman, 2001).

The study conducted 12 focus group discussions with 33 technical teams responsible for portfolio management, risk management, and exchange rate and debt analyses in the Central banks of Botswana, Uganda, and Zambia. The focus groups were complemented with 9 semi-structured interviews with senior reserve managers, including the heads or former heads of the respective functions/divisions from the same central banks to obtain strong historical accounts of the evolution in reserve management practices and the forces underlying this evolution. Focus group and interview participants were approached based on existing contacts, publicly available contact information, and snowballing.

The choice of the three case study countries was based on five key factors. First, the level of financial market development and the countries' integration into both regional and international financial markets. Second, the level and nature of public external debts, taking into account countries which are heavily indebted (e.g Zambia and Uganda) and those with both concessional and commercial forms of external debts (mainly Zambia). Consideration for the external debts obtained with commercial terms is crucial to help gauge the nature of interest rates on those debts and their implications for reserve management. Third, the stability of the foreign exchange market and the exchange rate

arrangements including both managed and crawling peg regimes to help understand the degree of foreign liquidity demand under the different exchange rate regimes. Fourth, geographical or environmental conditions were also taken into consideration, with the three countries representing different structural characteristics- including semi-Arid (Botswana) and tropical land (Uganda and Zambia). This consideration does not only have broader geographical coverage in terms of regions (East and Southern Africa) but it helps to understand the degree of external dependence especially on imports given the weak productive structure of those economies. And finally, the level of reserves and economic growth. In our sample, Botswana had the highest level of reserves and economic growth, followed by Uganda and Zambia had the lowest level of reserves.

3.2.1 Design of Focus Group Discussions

Focus group discussions (FGDs) typically fall under the umbrella of techniques that emphasize data collection among small groups characterized by homogenous participants with common experiences about a topic. A facilitator, who introduces the topics and enhances discussions, usually leads the discussions in a relatively informal atmosphere, in an open, free and relaxed format where the researcher can probe questions and stimulate interaction between the participants (Kitzinger, 1994).

The flexibility and interaction between participants in FGDs enable the researcher to drill deeper into issues to attain in-depth insights and often richer information (Barrows, 2000 and Dahlin-Ivanoff & Hultberg, 2006). In addition, the shared knowledge among group members and the range of different experiences allow to explore issues that are not well understood (Freeman, 2006; Gill, etl. 2008 and Dahlin-Ivanoff & Hultberg, 2006).

The FGD approach used in this project can be classified as exploratory, seeking to identify and explain thoughts, feelings, and behavior of central bankers in key components of both the portfolio choice decisions and liquidity policy in reserves management (Schaafsma, et al.2017). This approach was conducted mainly with the different technical teams including; portfolio managers, risk managers, analysts on

exchange rate policy and debt and reconciliation managers. A total of 12 focus group discussions were conducted, with a total of 33 participants from the three central banks.

3.2.2 Design of Semi-Structured Interviews

Semi-structured interview is a form of in-depth qualitative study approach which is normally conducted conversationally with one respondent at a time. Semi-structured interviews typically employ a blend of closed-and-open-ended questions, often accompanied by follow-up why or how questions (Adams, 2015). Semi-structured interviews are suitable for gathering information from key informants who have personal experiences, attitudes, perceptions, and beliefs related to the topic of interest (Barbour & Kitzinger, 2001 and Heiskanen, et al. 2008).

The main motivation for the use of this approach in the context of this thesis was to minimize potential weaknesses involved in focus group discussions. Perhaps the commonest weakness has been the unwillingness of participants to discuss some aspects of reserve management in a group given the sensitive nature of the topic. Moreover, semi-structured interviews with senior officials who have strong historical institutional background of reserves management aided the historical tracking of the dual role dilemma, its changing nature (e.g. asset classes, currency composition and risk management approaches) from the late 1960s to 2019, and the underlying factors.

3.2.3 Implementation strategy and Analysis

The focus groups and in-depth semi-structured interviews followed the same discussion guide (semi-structured interview protocol), meaning that a structured set of questions were followed though deviations from the exact order of questions were tolerated. The structure of the conversation guide was organized around four major themes: (i) What do you consider the key roles foreign reserves play in your central bank or your country? Have these roles been changing over time, and if so, what are the factors behind such changes? (ii) How have reserve management practices (portfolio choice and risk management approaches) evolved in your central bank and what forces/factors are behind this evolution? (iii) Has the evolution in reserve management objectives and

approaches caused any tensions/conflicts with any other central bank objective? What factors do you think aggravate the conflicts? (iv) What approaches or policy strategies do you have in place that help minimize the conflicts?

The focus groups and interviews were conducted between May 2019 and September 2019 and all the interviews were carried out at the central banks' offices. This was in addition to the written consent from the central banks as well as the subsequent verbal and email consent from the participants about their involvement in the study. Since it was not possible to audio record the interviews due to the sensitive nature of central bank reserve management, meeting notes for both focus group discussions and the in-depth semi-structured interviews were taken.

A thematic data analysis technique was followed. This approach allows for identify emerging themes in the data and develop a framework to explain the historical developments of portfolio management and the underlying factors behind the changing reserves management practices. To enhance reliability, the meeting notes were first typed and deductive reasoning for data categorization was employed, utilizing key elements of the theoretical framework. Also, before the analysis, data were inductively placed within the broader categories of domestic structural and institutional characteristic as well as the macroeconomic and financial policy, adhering to Creswell's (2013&2014) suggestion to read and memo the data in its entirety. This grouping of the data into broader themes helped generate insights and facilitated the interpretation of the data. The final themes were then reviewed and interpreted within the context of the broader theoretical framework and relevant literature.

Given the confidential nature of information on central banks reserve management, it was expected that there would be some bias in the primary data collection. To minimize this bias, secondary data - especially reserve management reports and in some few instances observations of meetings - were used as a mechanism of validation and further triangulation. Analysis of documentation involved examining reserve management investment policies and guidelines, which helped piece together the development of portfolio management role and asset selection criteria for reserve portfolios.

3.3 Results on the Historical Evolution of the Dual Role Dilemma in the Case Study SSA Central Banks

This section presents the empirical examination results from both the focus group discussions and the semi-structured interviews. The section is divided into two parts. The first part provides the empirical manifestations and evolution of the portfolio management role taking note of the changing objectives and approaches. The second part presents the evolution in risk management approaches that were adopted to help mitigate losses on reserve portfolios arising from the emergence of portfolio management role.

3.3.1 A historical Perspective on the Evolution of the Portfolio Management Role

To understand the empirical manifestations and historical evolution of the portfolio management role, reserve managers were asked to discuss (i) the rationale for holding foreign reserves and whether there has been any change in this rationale, and (ii) changes in the reserve management practices. The focus groups and interviews paid particular attention to three main components of reserve management: the ultimate objectives of holding reserves, asset choices, and risk management approaches of reserves managers and the changes in these components over time.

In their explanations of the evolution of the portfolio management role in central banking, interviewees referred to the immediate post-colonial periods around the late 1950s-1960s when most republic governments took the decision to establish their national central banks. Prior to this period, foreign reserves were under the custodial arrangement of the governments and their role was tied up with meeting the fiscal needs of the nascent states to finance government expenditures, mainly imports. After their establishment in the 1960s, central banks took on the role of managing the nations' foreign exchange reserves and continued with deploying reserves to finance government imports. This role continued to gain an increasing importance with the widespread openness in international trades in the 1970s and 1980s. The interviewees pointed to the balance of payment difficulties, stressing that SSA countries with a high degree of dependence on imports would find themselves under constant pressure to look for foreign

exchange to meet those imports, both for the governments and their agencies as well as any short fall in the private sectors.

Given their role in providing foreign exchange for import financing, at this time, central banks played a typical role of “liquidity managers”. The key concerns were on safety and liquidity with the primary aim of facilitating trade-flow transactions especially meeting the nations’ imports to maintain exchange rate stability. Around this period, the topic of portfolio choice for central banks hardly existed, as there was zero tolerance to risk. Nor did the term “portfolio management” exist. Certainly, it was not acceptable at that time to apply any asset choice decisions that would impact on the safety and liquidity of reserve assets.

With time, when governments began to borrow more heavily from abroad, especially from bilateral or multilateral official sources to reduce the amplitude of current account deficits, foreign reserves gained an additional role. The role of central banks’ reserves expanded from meeting public import demands to eventually becoming a bulwark against sovereign foreign debt pressures and providing liquidity for an array of public services, including foreign obligations of the central banks themselves. In the process, central banks acquired the responsibility of taking a currency choice decision as they became increasingly aware of the risk arising from currency mismatches between their reserve assets and the foreign obligations. Although the US dollar strongly dominated the currency composition of foreign reserves, new currencies including the Pound Sterling, the Japanese Yen, and currencies of European countries started to emerge in central bank reserve holdings around this period. However, risk taking was not acceptable by central banks and therefore central banks continued to hold highly liquid and safe assets, particularly the bills issued by the governments of those economies.

During the 1990s, central banks increasingly had to contend with rising capital mobility driven by the financial liberalization policies adopted by those countries. This development, combined with the heightened instability in the foreign exchange rate markets, raised the costs of monetary autonomy by forcing the central banks to pay greater attention to exchange rate fluctuations. Following these events, the consensus

within the central banking community evolved from intervention for containing trade flow shocks to encompassing intervention to contain volatility arising from many other foreign shocks including, speculative attacks, and financial crises. As such, foreign reserves became an important tool for supporting the monetary policy goals of price and financial stability. This new role for reserves did not only raise the needs for more reserves, but also put pressure on central banks to continue pursuing the liquidity and safety objectives to be able to provide protection for their economies.

By the mid-1990s, however, cracks had begun to appear in the foundation of reserve management approaches as reserves managers of SSA realized the need for return generation on reserves holdings. Two key factors created this need, according to the reserve managers interviewed. The first was the rising foreign debts burden which crucially depleted the reserves for central banks, especially in Uganda and Zambia. The external debt pressure brought to the attention of central banks the limited nature of their reserves and this triggered the management at the central banks to begin putting emphasis on efforts needed to protect reserve savings and to grow the available reserves to ensure their sustainability. Fortunately, with the debt relief initiatives under the highly indebted poor countries (HIPC) program and the multilateral debt relief program (MDRP) which were implemented around the same period to reduce the external debt pressure of most SSA countries, central banks gained room to rebuild some level of reserves from their export earnings. Consequently, central banks took the advantage to invest the reserves built up during this debt relief program to further grow their reserves to ensure their sustainability. In this period, reserve managers at the central banks begun to attach some weight to the goal of achieving reasonable and consistent return on their foreign reserves required for reserve growth.

Second, central banks started to realize the danger of relying on primary commodities as the key sources of reserves as foreign exchange earnings from such nature sources are not only subject to fluctuation, but more so to the risk of depletion. A key concern here was that the risk of depletion of reserves would make it impossible to meet future external obligations in the medium to long-term. This concern created the

need for return generation on reserves which eventually triggered the evolution of some form of portfolio management within central banking.

The first known portfolio management role among the case study countries occurred in the Bank of Botswana in 1994 when the reserves managers decided to launch an investment portfolio, called the Pula Fund. The Fund had as its primary goal the generation of returns; followed by capital preservation and lastly liquidity. The portfolio was specifically intended to grow reserves at a rate of return above the inflation rate aiming at both, the preservation of the reserves' purchasing power and for meeting future external obligations. In 1997, the Bank of Uganda also began conducting some form of asset choice by dividing its reserve holdings into a liquidity portfolio and an investment portfolio. The investment portfolio was managed with the help of an external fund manager. The Bank of Zambia reported starting the process of portfolio management activities in the early 2000s.

One of the more contentious issues in reserve management around that time was in which set of assets a central bank should operate in and hold on its balance sheet? Trying to define the asset classes for central banks' reserve portfolios raised interesting and difficult questions. For example, should the reserves portfolio include both short-term money markets assets and bonds? And if so, should it include only government bonds or also corporate bonds? Should it include private equity? As indicated by most reserve managers, in addition to the treasury bills and term deposits of highly rated commercial banks, government bonds of the core advanced economies mainly the US became the preferred assets for reserves holdings. The basis for their preference was the belief that these assets had deep and broad markets, thus carrying the attributes that meet both the liquidity and safety as well as reasonable return for reserves holdings. An exception was reported by the Bank of Botswana which accepted also equity in the asset classes for reserves investments. The justification for the acceptance of equity was based on the consideration for the unique long-run investment horizon of the government and the overall economy.

As central banks gained more experience in investing for return, they expanded their reserve investments into varieties of more medium-term fixed income securities. The

scope of the portfolio management responsibilities rapidly evolved, especially from the beginning of 2000s, and central banking became a typical portfolio management role in the classical sense of the world. Central banks began accepting longer-dated government bonds, agency government-backed bonds, and some corporate bonds to provide them with some guarantee of reasonable and consistent returns. Central Banks also started expanding their markets to progressively larger areas of other core advanced economies including; Switzerland, the Netherlands, Denmark and New Zealand. As indicated by the interviewees, the transition was facilitated by the development in financial markets around the same time. In particular, the emergence of new financial assets and risk management tools in the global financial markets, made it easier for central banks to understand the real-time risks associated with their investment positions, while offering the potential for tighter trading prices and execution.

Additionally, in the beginning of the 2000s, central banks in SSA faced two significant external events that triggered more need for portfolio management role in the reserve management function: a sudden drop in US monetary policy rate following the early 2000s recession and a general rise in commodity prices. Each had a dramatic impact on central bank portfolio decisions. The sudden decline in US interest rates to historically low levels produced an unfavorable investment environment that started to affect central banks' efforts of growing reserves through holding liquid and safe assets. The surge in commodity prices triggered a temporary rise in reserve levels especially for mineral reached countries. Since central banks were aware that the rise in reserve level was temporary due to the volatile and depletable nature of their reserve sources, the management at those central banks saw this temporary rise in reserves as an avenue to invest them in better yielding assets to further grow the reserve capital for future uses.

The outbreak of the global financial crisis of 2007-09 represented a crucial phase-almost a complete turning point in the conduct of the central bank portfolio management role. As the developed world fell deeper into recession, their monetary authorities switched to a more expansionary policy and cut interest rates to almost zero to stimulate the economies. This episode was particularly significant for the substantial lowering of yields and what it reveals about the central banks' general attitude toward the old belief

that safety and protection can only be gained by holding liquid and safe assets. Not only did the low yields affect the earning of the central banks, but they also- at a capital maintenance level- rooted the central banks more deeply into the fear of capital erosion emanating from the ultra-low yields.

By 2011, yields on most liquid and safe assets dropped much deeper as monetary authorities in advanced countries continued to pursue a more expansionary policy by implementing a number of unconventional monetary policy measures, including QE. In fact, advanced economies' unconventional monetary policy, combined with the zero lower bound policy, produced a negative yielding environment particularly in the euro area. Crucially, the negative yields on assets of core economies eroded reserves capital of developing countries. This in turn forced central banks particularly the Bank of Uganda and Bank of Zambia to try to protect their reserve capital by expanding their markets to non-traditional reserve assets of Australian Dollar and Canadian dollar and cutting their holdings in the negative yielding currencies. Central banks were pushed further to begin accepting even the much lower rated and risky assets of emerging markets economies, particularly sovereign debts and deposits denominated in Chilean Peso, South Korean Won, Chinese Yuan, and Malaysia Ringgit, among others. Some participants also indicated they engaged their custodians into the security lending activities to supplement the return on their reserves from the revenues generated from the security lending activities to increase the chance of safeguarding reserves capital against erosion.

3.3.2 The Evolving Risk Management Framework for Central Bank Foreign Reserves

As the reserve management function of central banks in SSA changed over time, so did their risk management framework. During their early years, central banks managed reserves in highly liquid and safe assets without considering anything like risk management. With the custodial approach purely concerned with liquidity maintenance, reserves were held primarily in assets considered risk free.

The transformation of central bank reserve management in the 1990s and 2000s introduced a drastic change in their risk management. The acceptance of new assets

such as mortgaged backed securities, corporate bonds and emerging market government securities introduced new risks to the management of reserves. These risks included: (a) market risk - the volatility of asset prices which triggered large fluctuation of the value of reserves; (b) credit risk or potential default of the bond issuers or counterparty banks where central banks held their reserves in deposits; and (c) liquidity risk, that is the failure to meet the liquidity needs of the country due to the illiquid nature of the assets in which reserves are held in. These risks were worsened by the outbreak of the global financial crisis of 2008-09 - a crisis which made the global financial system more fragile with heightened volatility in assets prices including the liquid assets issued by the governments of advanced economies.

The emerging awareness of higher risks and the resulting losses on reserves portfolios, confronted central banks with difficult choices: whether to switch their portfolios back into safer and liquid assets and accept the erosion of their reserve capital, or to continue with pursuing the return goal but look for instruments that could minimize the risk on their portfolios. However, because of the crucial role of return on reserves - both in providing capital preservation and growth of reserves - central banks started to explore more actively ways of managing the new risks on reserve investments.

As a result, central banks adopted several risk management approaches. First, to manage credit risk, the approaches adopted range from the simple reliance on the rating system provided by credit rating agencies, to designing their own internal rating systems to help guide the selection of asset classes and counterparties. Second, to manage the market risk, a number of risk measures were introduced. These included Value at Risk (VaR) and Conditional Value at Risk (CVaR) – risk matrices which analyze and estimate the expected losses the central banks' portfolios would be exposed to. Furthermore, central banks took advantage of financial derivatives instruments, mainly futures contracts to enhance the management of their currency and interest rate risks.

Finally, to manage the liquidity risk, the concept of 'portfolio tranching' started flourishing among the three central banks. This approach involves the process of dividing the reserves holdings into what has been referred to as the "liquidity tranche" - aiming for meeting short-term liquidity needs which entails macro-economic analysis -, and the

“investment tranche” , which aims at achieving the return generation goal. This tranching system was supported by the introduction of a strong governance structure of foreign reserve management, which included a clear separation of duties among different units in the reserve management department. The key reason here was to ensure independence of the risk management function to safeguard against conflicts of interest within the department (reflecting the dilemma).

In sum, using the insights from extensive focus groups and in-depth semi-structured interviews, this section has documented the significant transformations in central banking roles and goals in Sub-Saharan Africa over recent decades, particularly pertaining to their conduct in the management of foreign reserves. A striking finding common to all three case studies is that the pursuance of the return goal, or the assumption of a portfolio management role, has become an integral part of central banking functions. This role developed gradually from the classical custodial ways of managing foreign reserves (responsible for simple fiduciary trustee of public assets) but has evolved into an active portfolio management responsibility since the mid-1990s. This asset management role has become even more crucial in the 2008–2009 periods of the global financial crisis and its aftermath, as reflected in the nature of the asset classes in which central banks hold their reserve portfolios and currency compositions of reserves investments as well as the approaches for managing risk of those assets.

In the next sub-section, we discuss the underlying forces behind the emergence of this portfolio management role and the consequent dilemma for reserve managers in the three case study countries.

3.4 Discussion of the Underlying Sources of the Dual Role Dilemma in the Reserve Management Function of Central Banks.

We now consider the discussions on the forces behind the emergence of the dual role dilemma in central banks of reserve-constrained economies. There is of course, clear evidence from previous sub-section which suggests that the dual role dilemma originates from the deep hierarchies in the world’s international monetary and productive system, worsened by country’s specific structural and institutional factors.

3.4.1 Implications arising from the deep hierarches in the world's International Monetary System and its Productive Structure.

This part discusses some of the fundamental structural forces which generate both the liquidity role and the portfolio management role in the reserve-management function of central banks in reserve-constrained economies. The discussion also highlights which forces contribute to the degree of dilemma in the different central banks in our case study.

3. 4.1.1. Factors behind the Liquidity Role of Reserves

Beginning with the liquidity role side of the reserve management function, there is a strong evidence from our qualitative study that the exceptionally volatile exchange rates is the key force behind the liquidity role of reserve management in central banks of SSA. This excessive volatile exchange rate affects the monetary policy autonomy, thus forces central banks to maintain adequate reserves in liquidity form for intervention if they are to maintain stability in the exchange rate markets and achieve the monetary policy goal of price and financial stability. There are two primary factors stressed by all the participants from the case study central banks that lie behind the exceptionally volatile exchange rates in reserve-constrained economies and both factors are rooted in the deep hierarchies in the world's international monetary system and its productive structure.

The first and most fundamental factor is the strong demand for foreign currencies from private importers and governments which normally exerts strong pressure on exchange rates. This, according to the interviews originates from the heavily dependent of SAA on imports of manufactured goods and to some extent food items, particularly countries in semi-arid areas such as Botswana with critically constrained productivity. Since those imports are typically involved and settled in US dollars and a few key currencies, the central banks are required to always hold large reserves to facilitate government imports and to bridge large, shortfall in the private sector which normally comes along with exceptionally volatile exchange rates. This has gained particular importance in the recent years as most SAA countries get access to the international trades, with their imports dominated by expensive manufactured products and exports heavily concentrated in single primary commodities. This result confirms the danger of the prevailing international monetary system anchored on the US dollar as key currency

for trade invoicing and settlement discussed in earlier literature (see Goldberg and Tille, 2008; Obstfeld, 2011 and Boz,et al. 2018).

Interviewees, particularly from the Bank of Uganda and Bank of Zambia stressed the danger of heavy reliance on primary commodities and the harmful effects emanating from climatic vulnerability, particularly prolonged drought and other harsh weather conditions that seriously disrupt production. This, according to most interviews generates large mismatches between import demands and foreign currency inflows – a critical condition which requires their central banks to hold substantial reserves to be in the position to maintain stability of the currency markets and meet government foreign currency outflows. This finding does not only confirm the theoretical analysis of chapter 2 which brings to light the structural disequilibrium in current account balances in countries at the bottom end of the deep hierarchies in the world's international monetary system and its productive structure but also consistent with existing literature on current account vulnerability of SSA (Kregel, 2009; Greene, 1989 Osakwe and Verick, 2007; Chong, et al. 2011 and Calderon, et al. 2002 for related discussions).

The second factor is the rising volatile short-term capital flows into SSA and the implications for exchange rate volatility and loss of monetary autonomy. This has gained particular importance in the new millennium as domestic financial markets have become more linked to the international financial markets, with SAA's assets traded as purely speculative assets, and attracting short-term capital inflows that are subject to sudden reversal. According to the qualitative research, the volatility of the capital flows is driven mainly by two factors: (a) the riskiness of the domestic financial instruments due to the weak financial markets and economic developments characterized by lack of transparency and information access. (b) conditions in the international financial markets which normally spill over to SAA and typically generate large swings in capital flows and the associated volatility of the exchange rates. This volatility creates additional pressures for the liquidity role of reserves required for intervention in the foreign exchange market.

Although the volume of short-term capital flows has remained small in SSA, it was shown that it has significant impact on the exchange rate instability, mainly because of their speculative nature. The implication of this has been an intense liquidity pressure

especially on central banks of Uganda and Zambia. In this perspective, the liquidity role of reserves in SAA is imposed on them by their insertion into the asymmetric international monetary and financial system - a factor commonly stressed in the Post-Keynesian literature of currency hierarchies (Terzi, 2006; Prates and Andrade, 2013; Tarullo, 2003 and Kaltenbrunner, 2015).

3. 4.1.2 Factors behind the Portfolio Management Role of Reserves

Turning now to the portfolio management side of the reserve management function, there are three key factors which compel central banks of reserve-constrained economies to pursue aggressive return goal on foreign reserves. The three factors are: (i) the exceptionally large and ever-growing external obligations, (ii) reserve scarcity and volatility of reserve sources, and (iii) fear of erosion of reserve capital.

An Ever-growing Structural External Debt Obligations

As highlighted in sub-section 3.3.1, the interviews attested to the danger of large public external debts in the SSA economies which greatly outpaced the reserves of those economies. As the volume of external debts continue to grow and grow, and more so in an environment of limited reserves, the interviewees indicated that their central banks were pushed to start assuming portfolio management role in attempts to grow reserves to be in position of meeting those large external obligations that fall due especially in the longer term. This is especially so in Zambia which has acquired external debts at commercial terms and higher interest rates, but is also the case in Uganda with large external debts though acquired largely in concessional terms. Indeed, early studies such as Greene (1989) testify to such a strong mismatch between foreign liabilities and assets among many SSA countries that found themselves unable to meet their foreign debt service obligations. Based on this, it can be seen that the large external debts and the acute reserve scarcity that underlie the portfolio management role in central banks are typical manifestations of SSA subordinated position at the lower end of the deep hierarches in world's international monetary system and its productive structure.

Reserve Scarcity and Volatile nature of Reserve Sources

Another important factor, which has been emphasized by most participants, is the scarcity and volatile nature of reserves of SSA countries. In all the three countries in our case study, participants stressed the importance of return on reserves to help in growing their limited reserves and provides a shield against such volatile nature of reserve sources. There are two main reasons provided for the limited and volatile nature of reserves in the case study economies. First, the heavy reliance on primary commodities exposes their reserve sources to harsh climatic conditions and extreme low prices of their exports in the international markets. Second, the structure of ownership of strategic factors of production which is typically dominated by foreign firms. The main implication of this is the rapid depletion of those resources, in addition to the repatriation of foreign currency inflows which normally leaves the economy without any inflows from exports. Earlier studies have highlighted such problems associated with foreign direct investments in fragile Sub-Saharan African and their links with weak governance (Besada, 2006 and Dupasquier and Osakwe, 2005). These two factors are clear features of the weak productive structure of SSA.

The acute reserve scarcity problem, together with the ever-growing external obligations which emanated from the deep hierarchies in the international monetary system and its productive structure has resulted into major changes in the reserve management function of central banks with strong emphasis towards return generation goal. Typically, in situation when there is a risk of potential exhaustion of reserves sources and the ability of the monetary authority to accumulate reserves is curtailed by the weak productive structure of the economy, it is natural to look for return through portfolio management to fill the gap. Indeed, a strong portfolio management action is seen as an effective response to grow reserves capital that is crucial for meeting the growing foreign obligations and to provide a shield against both the risk of depletion of reserves and any temporary, cyclical weakness in reserves sources.

Reserve Capital Erosion

The third important factor stressed by all the participants, is the fear of erosion of reserve capital as a result of the very low yields on liquid assets of core economies. The main concern here is that the losses on reserve holdings generated by the low or negative yield environment may weaken the ability of central banks to meet some of the external obligations. The diminished yields on liquid assets, as confirmed in the literature, is not primarily a consequence of the global financial crisis, but a more long-standing phenomenon associated with the international monetary asymmetry (see Eichengreen, 2011; Jeanne, 2011, Warnock and Warnock, 2006; D'Arista, 2001; Negro, et al. 2018; Bernanke, etl. 2011; Gourinchas, et al. 2010; Caballero and Gourinchas, 2008 and Gourinchas and Rey (2007a).

Seen from the above perspectives, the impetus to adopt the portfolio management role by central bank is rooted in the asymmetries of the international monetary system and the global productive structure. Specifically, these asymmetries produce elevated demands for foreign reserves that exceeds what central banks of SAA can generate. This is made worse by the ultra-low yields on assets considered liquid and safe for reserves investments.

3. 4. 2. Factors aggravating the Degree of the Dual Role Dilemma

This sub-section discusses the country's specific factors that worsen the degree of the dual role dilemma in central banks as reveled in our interviews with the three-case study central banks. Four important factors related to the domestic institutional and macroeconomic policies were mentioned by the participants that appear to have played a critical role in the dual central banking dilemma.

The first and most important is the weak fiscal policy that is viewed as dominated by chronic corruption and lack of transparency. A weak fiscal situation, according to the participants, contributes to the excessive build-up of external debts. Often fiscal weaknesses were seen to be directly intertwined with political motives and the associated mismanagement of funds. The magnitude of external debts associated with the deficiencies in fiscal policy was particularly acute in Zambia, where external debts had

grown to unsustainable levels and where their repayment had depleted almost the entire reserves of the central bank. The case of Zambia reflects the situations of many African countries which have suffered external debt problems driven by deficiencies in fiscal policy and the associated misuse of borrowed funds (Cobbe, 1990; Greene and Khan, 1990; Alemayehu, 2002, 2003&1997; Lekomola, 2010; Adedeji, 1993; Ezenwe, 1991).

Second, the case studies' weak financial system appears to have contributed to the dual role dilemma in two ways: (i) the underdeveloped financial markets characterized by large information and transaction costs increases risk on financial assets which end up attracting mainly speculative capital flows. This, as already discussed exerts pressure on the liquidity role of reserves required for intervention in the exchange rate market. And (ii) the high interest rates offered on financial assets issued by SSA attributed to the illiquidity and riskiness of financial assets (see Knight, 1998; Reinhart and Tokatlidis, 2003 and Allen and Giovannetti, 2011 for similar discussions) have implication for the dual role dilemma in the reserve management. To the extent that those financial assets are held by oversee investors, the high interest rates on those assets exert pressure on central bank reserves, thus reinforcing the need for portfolio management role.

Finally, the central bank dilemma is shown to have been magnified by the exchange rate policy adopted by countries. Among the three countries in the current study, the contribution of exchange rate policy to the foreign liquidity pressure appears to have been most dramatic in Botswana, which follows a crawling-peg exchange rate regime. It is shown that such a regime requires continuous heavy intervention in the currency markets to maintain the stability of the exchange rate level. This is in contrast with the relatively flexible though managed exchange rate regime adopted in Uganda and Zambia where central banks only intervene to smoothen extreme volatility of the exchange rates. The result is generally consistent with the early studies on the strong link between regimes and demand for reserves (Edwards, 1983; Bahmani-Oskooee and Brown, 2002; Bahmani-Oskooee, 1985 and Elbadawi, 1990). In addition, the interviews also reveal that countries within regional economic block that uses the domestic currencies for trade settlements within the region have reduced demand for liquid reserves. This is consistent with the argument about the benefits of exchange rate regime,

particularly the currency union is believed to help in enhancing trade and growth among members as well as a reduction in the demand for reserves (see Choi and Baek, 2008).

In sum, the combination of deep hierarchies in the world's international monetary system and its productive structure, the weak domestic institutional characteristics, including weak fiscal policy and financial system and macroeconomic policies are key forces that underlie the dual central banking dilemma. The magnitude of this dual role dilemma is particularly acute in extreme poor countries such as Zambia and Uganda with extreme low level of foreign reserves and huge external debts. The large external debts in those economies since the early 1990s, amplified by weak fiscal policies have pushed central banks to start assuming portfolio management role in attempts to grow their limited reserves.

3.5 Summary and Conclusions

This chapter provided the historical evolution of the dual role dilemma in the reserve management function of central banks in selected SAA countries and its underlying factors. Since the goal of the chapter is to examine the deep structural roots of the dilemma and the actual influence of institutional and domestic macroeconomic factors on the portfolio choice process of managing foreign reserves, it becomes critical to evaluate the perspectives of policy makers themselves. This chapter therefore relies on a multiple case study approach with selected central banks in Sub-Saharan African countries (Botswana, Zambia and Uganda) to take advantage of the experiences of the reserves managers to provide an in-depth understanding of this dilemma. This study traces the deep roots of this dilemma to a combination of two key structural problems: (i) international monetary asymmetries, and (ii) the asymmetry in the productive structure of developing economies.

First, the asymmetric international monetary system anchored on the use of US dollar reinforced by globalization has put developing countries at critically disadvantaged positions in three key international economic and financial relationships: (i) extreme

difficulty in accessing cross-border trades without sufficient international currency, (ii) dependence on external borrowings denominated in currencies of core nations, and (iii) the inherent currency fragility and crises associated with short-term volatile capital flows. These conditions generate elevated foreign reserve demand for central banks at the lower end of the hierarchy required to meet those foreign obligations and liabilities. Moreover, the same asymmetry produces very low yields (in fact negative) on liquid and safe assets of core economies, thus eroding the reserves for developing countries holding such assets.

Second, the productive structure of developing economies has remained predominantly dependent on primary commodity products with strong exposure to adverse climatic vulnerability and exceptionally volatile prices of their exports. The key danger is that it presents central banks with no reliable means of accumulating sufficient and sustainable foreign reserves. The problem is magnified by (i) geographical factors-mainly for countries located in semi-arid areas which exacerbates their degree of dependence on imports, and (ii) the structure of ownership of factors of production typically dominated by foreign firms, thus limits the flow from export earnings.

A combination of the above productive structural deficiencies and the global monetary asymmetries, demands a strong portfolio management role to become an integral part of a central bank function required for(i) the growth of reserves capital to be able to meet the growing foreign obligations and, (ii) to provide a shield against both the risk of depletion of reserves and any potential erosion of reserves capital.

Finally, this chapter shows that the gravity of the dilemma is made even more severe by a number of domestic institutional deficiencies and macroeconomic factors. Specifically, the; (i) lack of fiscal discipline and transparency in the accumulation and management of public external debts, (ii) financial sector frailties that do not only lack a stable and sustainable financing mechanism for acceptable current account imbalances, but which further weakens the central banks' balance sheets, and (iii) the exchange rate policy. The gravity of this dual role dilemma has been found to be particularly acute in poor countries such as Zambia and Uganda with extreme low level of foreign reserves

and huge external debts. This confirms the danger of a combination of low foreign exchange reserves, large external debts and general financial deficiencies which underlined a number of financial and currency crises in most developing countries (see Corsetti, et al. 1999; Frenkel, 1978; Asonuma, 2016 and Frankel and Roseb, 1996).

Chapter 4: A Simple Model of Monetary Policy and Foreign Reserve Management Objective Function for a Dual Role Central Bank: A Reserve-Constrained Economy Perspective

4.1 Introduction

This chapter presents a simple model that is intended to provide a link between the reserve management function and the monetary policy function of central banks in reserve-constrained economies. Specifically, we extend the Taylor Rule to incorporate specifications of the liquidity and portfolio management roles of foreign reserves. The resulting model will let us analyze the monetary policy implications of the dual role dilemma in countries with acute reserve scarcity, particularly those which have adopted inflation targeting regimes. It should be stressed from the onset that the model we build in this chapter is not intended to derive an optimal monetary policy rule to be followed by a reserve-constrained economy nor is it intended to be calibrated/solved but for illustrative purpose only. It is only meant to show how the acute reserve scarcity challenge and the portfolio management role are constraints for monetary policy. This model is motivated by recent transformations in both the monetary policy and reserve management functions of central banks in reserve-constrained economies presented in previous chapters.

First, regarding the monetary policy function, there has been a fundamental shift from monetary policy arrangements that centered on money targets, often with some forms of a de facto exchange rate peg, to monetary arrangements that are anchored on targeting inflation (e.g Berg and Portillo, 2018; Muhanga, 2014, Azad and Das, 2017). In its most basic form, the inflation targeting regime has two key features: (a) the acceptance of price stability as the ultimate goal of monetary policy. It regards such policy as crucial to holding down inflation, with the view that, once price stability (referring to both stable and low inflation) is achieved, sound economic growth is naturally attained (Agenor, 2002); (b) An interest rate rule, commonly known as the Taylor Rule (Taylor, 1993 & 2001; Rochon & Rossi, 2007; Atesoglu and Smithin, 2006 and Lavoie, 2004) which central banks rely on as the key policy instrument to achieve the price stability goal.

The implementation of an inflation targeting regime in a reserve-constrained economy, as in any other developing country, is typically supported by interventions in the foreign exchange market. This is because of the high frequency and intensity of currency crises in developing economies, and more generally the excessive volatility of their exchange rates, which creates an acute loss of monetary policy autonomy. To improve monetary policy space under conditions of such extreme volatility, foreign reserves are included here as an additional policy tool, which operates alongside short-term interest rate policy. This is based on the perspective that foreign reserves can act as a powerful insurance instrument that help to de-link the exchange rate from interest rate policy, thus allowing monetary policy to concentrate on domestic factors (Benes, et al., 2013 and Catalán-Herrera, 2016).

Second, regarding the reserve management function, we have established that there has been a significant expansion in the central bank's role, from a primary focus on simple custodial tasks involving liquidity maintenance, to a portfolio management role focused on return generation. This creates a sharp trade-off between the liquidity and the portfolio management roles in the reserve management function of central banks with acute reserve scarcity, a phenomenon we have referred to as the 'dual role dilemma'. This dual role dilemma, as shown both theoretically and empirically in previous chapters, is rooted in the deep hierarchies in the world's international monetary system and in its productive structure. These asymmetries generate four key dangers for countries at the extreme bottom of these hierarchies: (a) excessively unstable exchange rates and monetary policy subordination, (b) chronically high external obligations, worsened by high interest rates on those debts, (c) acute reserve scarcity, a condition associated with these nations' weak productive structures with strong exposure to adverse climatic vulnerability and volatile primary commodity prices; and (d) the erosion of reserve capital. This last danger arises from the exceptionally low yields on reserve assets in the global economy, a situation that is a by-product of central banks' support for the international financial system during and after the Great Financial Crisis of 2008. In such a situation, while the liquidity role remains superior to help guarantee stability in the currency markets and support monetary policy, a significant thrust of the central banks in this structural position

must be to generate returns on their reserve holdings. This permits the reserve growth and capital preservation these central banks require so their reserve-constrained economies can meet their ever-growing external obligations.

The connection between this dual role dilemma in the reserve management function and monetary policy function is crucial, particularly in such an environment characterized by acute reserve scarcity but where both interest rates and foreign reserves are both accorded prominent roles in the pursuit of monetary policy. The model developed in this chapter shows the implications of this dual role dilemma in the reserve management function for monetary policy (interest rate setting in the context of a Taylor rule) in reserve-constrained economies. It draws in key ingredients from two distinct literature that have been running parallel in the central banking literature. The first is the literature which develop monetary policy models for small open economy, particularly the so called 'two-targets-two-instruments' approach (Benes, et al., 2008; Oshry, et al., 2012; Benes et al., 2013 and Castillo, 2014) and those which have proposed to introduce reserves into the Taylor rule (Caballero and Krishnamurthy, 2003 and Kato et al., 2009). The second is the strategic asset allocation framework developed by Fisher and Lee (2004), Fisher, (2010) and Kisoen, (2010) found in the policy papers (including BIS, World Bank and IMF) on reserves management. This literature has made attempts to specify the objective function for reserve management, describing and justifying both the liquidity role and the return goal in reserve management.

By extending the basic reserve management objective function to include the specification for the measure of the portfolio management role, this chapter contributes first of all to the literature on reserve management. The basic strategic asset allocation framework in the existing policy literature provides the specification only for the measure of the liquidity role which is based on the magnitude of short-term external obligations of the economy. It regards the portfolio management role as subordinate to the liquidity role: the excess of reserves beyond what is required for that role is a mere residual. Our model is based on the premise that both the liquidity role and the portfolio management role are binding constraints on central banks of reserve-constrained economies. Specifically, based on the theoretical elaboration in chapter 2 and the empirical investigation of chapter

3, in our model the central bank's portfolio management role is determined by the dynamics of long-term external debts. This clarifies why central banks in reserve-constrained economies face a dual role dilemma.

Second, our work contributes to the literature on monetary policy rule and policy constraints in small open economies as in the works of Aizenman, (2019) and Aizenman et al. 2010&2016), which analyzed monetary policy constraints in the presence of 'sudden stop' of capital inflows and the Trilemma trade-off. They emphasize the role of reserves in addressing these policy trade-offs emanating from greater exposure to financial integration which always come along with financial instability and increased risk of "sudden stop" of capital inflows as well as financial crisis. Curiously, however, in spite of the prominence given to the role of reserves in the monetary policy rule, its treatment of foreign reserves misses the potential constraints introduced by the acute reserve constraint and the dual role dilemma in the reserve management function of central banks in these economies. In particular, the specification introduces foreign reserves from the perspective that the primary focus of the central bank is a simple custodial task involving liquidity maintenance and reserves are typically viewed as sufficient and modelled solely as a precautionary instrument that always guarantees stability in the currency markets. In contrast, as discussed in this thesis, in reserve-constrained economies, the ability of central banks to generate reserves is crucially constrained by the weak productive structure of their economies and their subordinated position in the deep hierarchies in the world's international monetary system and its productive structure compels them to pursue a portfolio management role, in addition to the liquidity role of reserve management. By extending the Taylor Rule to incorporate the specifications for both the liquidity and the portfolio management roles of reserves, our model shows that the insurance role of reserves can be weakened by the forces that underlie the portfolio management role in central banking (acute reserve scarcity, the huge structural obligations and yield-differential). More precisely, the dual role dilemma built into the model developed here shows how the problem of the loss of monetary policy autonomy is exacerbated in reserve-constrained economies.

The structure of the chapter is as follows. Section 4.2 lays out the existing frameworks for both monetary policy and reserve management of a developing economy. We start with a stripped-down small open economy monetary policy rule that allows an incorporation of foreign reserves in the Taylor Rule. This allows us to capture the so-called 'two-targets-two instruments' approach in a single monetary policy rule. We then present the objective function of reserve management, drawing from the standard strategic asset allocation framework of central bank reserves. This objective function of reserve management captures the measure for the specification of the liquidity role and provides the broad principles that underlie the portfolio management of foreign reserves. Section 4.3 extends the basic reserve management objective function to specify the measure for the portfolio management role. It also considers deriving the trade-off equation between the liquidity role and the portfolio management role to formally capture the dual role dilemma in the reserve management function of central banking. Section 4.4 joins the specifications for the liquidity role and the portfolio management role to the Taylor Rule to capture the effect of the dual role dilemma on monetary policy. Section 4.5 concludes.

4. 2 Basic Monetary Policy Rule and Reserve Management Objective Function

In this section, we present the basic frameworks for both the monetary policy rule and the reserve management objective function that serve as a basis to the integrated monetary policy rule developed in this Chapter. The section begins by presenting a simple baseline monetary policy rule for the small open economy: a Taylor Rule specification including foreign reserves. It then presents the reserve management objective function, capturing the liquidity role and the justification for the portfolio management role. It draws key ingredients from the strategic asset allocation framework of central bank reserve management, that describes and justifies the determination of central bank's asset allocations and their associated liabilities over specified investment horizons.

4. 2.1 A Small Open Economy Monetary Policy Rule with Foreign Reserves

The baseline framework used in this chapter is a monetary policy model for a small open economy charasterised by excessive volatile exchange rate. In our context, two factors

generate exchange rate fluctuations: (i) the presence of large current account deficit associated with weak terms of trade, and (ii) “sudden stop” of capital inflows or capital reversal. In this environment, monetary policy looses its potency due to high exchange rate pass-through to inflation. To achieve the overriding goal of maintaining price stability, the central bank has two policy instruments as proposed in the “two-targets-two-instruments’ monetary policy models (see Benes, etl., 2008; Oshry, etl., 2012; Benes et al., 2013; Montoro and Ortiz, 2016; Berg, etl., 2006 and IMF, 2011). The first and primary tool for controlling inflation is the short-term interest rate, typically represented in the form of the Taylor Rule (Taylor, 1993). The second is foreign exchange intervention which operates alongside the policy interest rate. In this framework, foreign exchange interventions play a crucial role in helping to de-link exchange rate movements from the domestic interest rate, thus improving the monetary policy space (Benes et al., 2013 and Montoro and Ortiz, 2016).

Essentially,this monetary policy model of a small open economy rests on five major equations. One is the IS curve, or aggregate demand function, which decomposes real output growth into an endogenous component that depends on the real interest rate and an autonomous component that is assumed to vary for example with the balance of payments or fiscal policy. The second is the Phillip curve that describes the change in the rate of inflation as determined by (a) the discrepancy between the actual and natural rate of growth in the previous period, (b) both the past and expected inflation, and (c) the imported goods inflation – a sum of foreign inflation and the change of the nominal exchange rate. The third is the exchange rate equation which typically takes the form of a modified UIP in which the exchange rate is determined by the interest rate parity, together with the risk premium and the level of the country’s foreign exchange reserves (or the fluctuations of foreign reserves around their optimal level). The fourth is the monetary policy reaction function in the form of a Taylor rule which reacts to the deviations of inflation from the target, the deviation of actual GDP from potential GDP (the output gap), and the change in the exchange rate. The fifth is the foreign exchange intervention rule, which is determined by the exchange rate deviation from some sort of exchange rate target level.

To avoid complicating the analysis, we refrain from providing the details of the rest of the equations, but directly introduce the key relationship between the monetary policy rule and foreign reserves. Our interest here is to show the role of reserves in monetary policy design in the inflation targeting tradition for a reserve-constrained economy. We follow the approach of Caballero and Krishnamurthy (2003) and Kato et al., (2009), which propose to directly incorporate the reserve holdings in the Taylor Rule. The essence of this incorporation is the idea that foreign reserves interact directly with the monetary policy rule as they provide a crucial insurance role that can help to break the links between the interest rate policy and the exchange rate movement. As such, extending the Taylor Rule to incorporate foreign reserves allows for capturing all the key equations of the open economy monetary policy model. This is because the presence of reserves in the Taylor rule eliminates the role of the exchange rate in monetary policy rule.

To see the precise way how reserve holdings can formally enter in the Taylor Rule, we combine the monetary policy rule specification developed in Ball (1998), Svensson, (2000) and Taylor, 2001), with the foreign exchange intervention rule proposed in the Benes, etl., (2008) (see details in appendix 1). This yields the following equation:

$$i_t = i^* + \gamma_1(\pi_t - \pi^T) + \gamma_2(y_t - y^*) + \gamma_3(R^* - R_t) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 1.1$$

Where i_t is short-run neutral interest rate, i^* is the target policy rate consistent with the Wicksellian natural rate of interest, π_t is current inflation rate, π^T is the central bank's inflation target, y_t is current (real) output, y^* is the natural rate of output (corresponding to the nonaccelerating inflation rate of unemployment [NAIRU]), R_t is the current level of reserves and R^* is the target or optimal level of reserves. The monetary policy literature takes the target level of reserves as the precautionary reserves required to provide insurance against capital reversals and thus insulate the economy from external shocks and preserve a degree of monetary autonomy. Such level can take the various forms of the reserve adequacy measures found in the literature of optimal level of reserves (e.g ; Aizenman and Lee, 2007; Aizenman, 2007 and Gallagher and Shrestha, 2012; Heller, 1966; Frenkel and Jovanovic, 1981; Jeanne and Ranciere, 2011).

Equation (1.1) is a variant of an adjusted Taylor Rule that describes the central bank as acting on the real interest rate in response to events within the economy (namely, the difference between the actual and natural rates of growth and any departure of actual rate of inflation from the central bank's target rate) and the level of foreign reserves.

Under this modified Taylor rule, whenever inflation grows above its inflation target, central banks raise the rate of interest. Similarly, whenever output grows beyond its target long-run value, the rate of interest rises. It is also assumed here that a lower level of reserves generates higher interest rates as a response especially in times of sudden stops in capital inflows. The explanation to this is that when foreign reserves are below their target level - implying central bank's inability to insulate the economy against external forces, - monetary authority is forced to rely on interest rates to manage the stability of the exchange rate.

Indeed, the monetary policy rule presented in this section is a useful framework for understanding the role of foreign reserves in the functioning of monetary policy in reserve-constrained economies. However, its treatment of foreign reserves misses the potential constraints introduced by the dual role dilemma in the reserve management function of central banks in these economies. In particular, the specification introduces foreign reserves from the perspective that the primary focus of the central bank is a simple custodial task involving liquidity maintenance. Reserve holding is modelled solely as a precautionary instrument that always guarantees stability in the currency markets. As such, this monetary policy rule is less useful for reserve-constrained economies where central banks face stark trade-off between the liquidity and the portfolio management roles which are both binding constraints. As developed theoretically in chapter 2, the portfolio management role gains importance in countries at the bottom of both the hierarchical international monetary system and the productive structure because of three key conditions: (i) the huge structural external debts, (b) the acute reserve scarcity associated with the exposure of their production to adverse climatic vulnerability and huge price volatility, and (c) the existence of a substantial yield differential between assets in developing and developed countries. It is this property that is the object of our attention in the next section.

4. 2.2 The Reserve Management Objective Function

This sub-section lays out the basic reserve management objective function developed by Fisher and Lee (2004), Fisher (2010) and Bonza et al. (2010) and uses it to derive the specifications for the liquidity and the portfolio management roles of reserves. This framework is of interest because it specifies the macro-based portfolio choice rule for central bank reserves management and provides broad principles that underlie both the liquidity, and the return generation goals. Although this framework elevates the liquidity role in the central banks' hierarchy of goals given its crucial importance in supporting exchange rate and monetary policies, it brings to light that the central banks will also have to consider what return must be earned on reserve holdings. The importance of generating returns in this framework results from the nature and structure of the external liabilities which reserves are normally held to hedge against. This is in addition to the diversification benefit and the protection returns offer against capital erosion in periods of extremely low yields.

This basic reserve management objective function is grounded in the concept of the strategic asset allocation framework of central bank reserves management which is well developed in the policy literature (see Romanyuk, 2010a&b; Joia and Coche, 2010; Coche and Sahakyan, 2010; Kasen, 2010; and Alhumaidah, 2015). Central to the strategic asset allocation framework is the idea that external liabilities are at the core of portfolio choice of reserves management, and that this has important implications for the allocation of reserves to different asset classes. It is based on the premise that the asset selection for reserves holdings should be structured in different asset classes that closely match the structure of foreign liabilities, including: (a) the maturity structure, (b) interest on foreign liabilities, (c) the currency composition of the obligations, and (c) the interest rate risk. In our study, however, we will ignore the discussion of the currency composition since it can easily be assumed that all the reserves of a reserves-constrained economy are held in the key currency (the US dollar). This can be justified by the fact that the asymmetry in the international monetary system confines the foreign obligations of those countries to the currency of the top nation of the system.

At the heart of the strategic asset allocation framework is the approach referred to as portfolio tranching – a process of dividing reserve holdings into sub-portfolios– typically the liquidity and the investment portfolios respectively. The liquidity portfolio is aimed at meeting short-term external liquidity needs, including: (a) short-term public external debts falling due within one year time, (b) imports especially of government and shortfalls in the private sector, and (c) the intervention needs to guard against potential capital reversal. Perhaps, the most useful formulation of the liquidity level that captures all the three components is developed in Bonza, et al., (2010). Their approach takes the form of a contingent claim approach which uses the sovereign liquidity at risk (SLaR) concept to define the barrier to critical liquidity requirement (the distress barrier of critical liquidity needs). Such distress barrier of critical liquidity is the precondition for meeting the minimum amount of reserves needed in order to meet any external liabilities falling due especially within one year.

A specification found in in Bonza, Gomez and Pabon based on the contingent claim approach defines the distress barrier of critical liquidity ($\boldsymbol{BCL}$) as equation below:

$$L^* = BCL = std + 20\%m + 10\%bm \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 2.1$$

Where std denotes short-term debts, m represents imports (both public imports and shortfall in the private sector), bm denotes base money which represents capital outflows associated with speculative attacks. According to the model proposed by Bonza et al. (2010), the liquidity level should be able to cover full amount of short-term external debts, at least 20% of total imports for a country (estimated to be equivalent to 2.4 months of imports) and 10% of base money which is believed to be the amount of reserves required for meeting intervention needs to insure the economy against capital reversal arising from speculative attacks.

The investment portfolio, on the other hand, aims at meeting long-term external obligations; thus, it focuses on return generation required for meeting those long-term external obligations, consisting of both foreign debts and future imports of the economy.

Based on this macro approach to strategic asset allocation, the objective function of reserve management developed in Fisher and Lee (2004) and Fisher (2010) is specified in form of an optimization function that captures a joint objective of maximizing return and maintaining liquidity. This is given by the expression below:

$$\underset{\{w(i),w(L)\}}{\text{Max}} E \sum_{i=1}^{J} [I_t(1 + w' x_i r_i) + L_t(x^f r^f)] - \lambda w V w' \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (\mathbf{2.2})$$

Subject to:

$$R_t = I_t + L_t$$

$$L_t \geq L^*$$

$$\sum_{i=1}^{I} w(x_i, x^f) = 1$$

where R_t, I_t, L_t, L^* denote respectively: the total level of foreign reserves, the portion of reserves in the investment portfolio, the portion of reserves in the liquidity portfolio and the target level of the liquidity portfolio. x_i, x^f, r_i and r^f represent respectively the risky asset (meant for the investment portfolio), the risk-free asset (for the liquidity portfolio), the return on the risky asset, and the return on the risk-free asset. w and λ are the weights of each asset class in the reserve portfolio and the risk aversion coefficient respectively. The expressions wVw' and $(1 + w' x_i r_i)$ are the covariance matrix and the expected realized market rate of return on the portfolio at time t respectively.

Equation (2.1) models three constraints. The first constraint is the equality condition which stipulates that the foreign reserves are comprised of risky assets (investment portfolio) and quasi-risk free (liquid) assets (liquidity portfolio). The second constraint stipulates that the level of liquid reserves should be at least equal to the target level of the "liquidity portfolio" which focuses on meeting short-term external liquidity needs of the form specified in equation 2.1. The final expression describes the usual

portfolio constraint which states that the total weights of all assets in the entire portfolio (including risky and risk-free assets) must sum to one.

Under the simplified portfolio choice rule in equation (2.1), the central bank acts as a typical forward-looking optimizing economic agent faced with two stark choices. The first is the choice of how much reserves to be allocated between the liquidity portfolio (L_t) and the investment portfolio (I_t). This naturally leads to the second question, which is concerned with what sort of asset classes should the respective portfolios be held in so that each goal can be achieved.

Notwithstanding the important contribution of the basic reserve management objective function presented above in providing the broad principles that underlie both the liquidity, and the return generation goals, it has one key limitation. It focuses much attention to the derivation of the specification for the liquidity role. No specification has been provided for the portfolio management role as this mandate is regarded subordinate to the liquidity role; thus, its level is treated as a mere residual or an excess over and above the liquidity portfolio. This treatment is not appropriate for central banks in reserve-constrained economies given that the portfolio management role is a binding constraint imposed on them by the structural asymmetries both in the international monetary and productive system. As already discussed, those two asymmetries create structurally growing external obligations, acute reserve scarcity and the capital erosion of reserves arising from low yields on liquid assets. In such a situation, the return on reserve holdings becomes crucially important to permit capital preservation and the reserve growth required for meeting these external obligations. Given this importance of the portfolio management role in central banks of reserve-constrained economies, it needs further specification. This is what the next section turns to.

4.3 Extending the Reserve Management Objective Function to capture the formulation of the Portfolio Management Role

In this section, we extend the basic reserve management objective function presented in the previous section to allow for the specification of the portfolio management role. To

derive the measure for this portfolio management role, we build on both the theoretical framework presented in chapter 2 of this thesis and on the broader principles set out in the strategic asset allocation framework presented in the previous section which place strong emphasis on the structure of external obligations in determining the return generation needs of central banks' reserves (see Claessens and Kreuser, 2004&2007; Joia and Coche, 2010 and Alhumaidah, 2015). This extension will enable us to formulate the trade-off equation capturing the tension between the liquidity role and the portfolio management role. This trade-off equation is crucial for understanding the impact of the dual role dilemma on the monetary policy rule of reserve-constrained economies as we will see in the next section.

4. 3.1 Specification of the Portfolio Management Role

We begin by specifying the portfolio management role as being largely determined by the level of reserves required for meeting an economy's/the public sector's medium to long-term external obligations. For the sake of simplicity, and in order to capture the form of external liabilities with clear repayment schedule of both principal and interests, it is convenient to restrict our attention to public external debts. It is worth noting that in the reserve-constrained economies we are looking at, public external debts are the most important external obligations for the central banks. In addition, we assume that those external debts are denominated in the key currency (the US dollar). This assumption is motivated by our theoretical framework on the asymmetry in the international monetary system with the US dollar being at the center of the system. In this view, a combination of the nature of the maturity structure and the interest rates on those debts determine the portfolio management role. The higher those debts, the higher the pressure on central banks to generate returns and to allocate their scarce foreign exchange reserves to higher yielding assets.

We therefore begin with constructing the dynamics of public external debts of the economy. In our case, we specify this according to the well-known law of motion of government foreign debts in the literature of external debt sustainability. This dynamic as

specified in Adler and Sosa (2013) is driven by the pre-existing level of debt and various aspects of macroeconomic conditions, given by the following function:

$$d_t^f = \left(\frac{(1+r_t^d)}{1+g_t}\right) d_{t-1}^f - nica_t - ndcf_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.1$$

where d_t^f denotes a measure of external debt as a ratio of GDP (expressed in foreign currency), r_t^d is the interest rate on external debt, and g_t is the GDP growth rate. $nica_t$ is the current account balance excluding interest payments; and $ndcf_t$ are the non-debt-creating flows (FDI and equity portfolio), all expressed as ratios to GDP.

In equation 3.1, the first term captures changes in the ratio of interest on debts plus pre-existing debts to GDP. The second term is the direct contribution of changes in current account primary balance (mainly net exports and transfers). Intuitively, positive primary current account balance reduces the needs for external debts. Similarly, a negative balance would mean more need to rely on external borrowing. The third term reflects the role of other external financing items apart from debts (mainly equity and FDI). These forms of external financing (e.g FDI) are modelled as associated with a lower, or less positive number for $ndcf_t$, since a country with more FDI receipts means that it is able to rely to a greater degree on alternative means of foreign exchange earnings, implying lower need for debts.

Adopting this view, we can specify the size of reserves required for the portfolio management role as the minimum amount of reserves that should be available to cover the pre-existing level of external debts (inclusive of interest on those debts), taking into account contribution of the various aspects of current and financial accounts under different macroeconomic conditions. This yields the formulation for the degree of the portfolio management role which can be characterized by the following equation:

$$I_t = \left(\frac{(1+r_t^d)}{1+g_t}\right) d_{t-1}^f - nica_t - ndcf_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.2$$

There are three key ideas in equation (3.2) as regards the determinants of the portfolio management role in reserve-constrained economies. First, the actual growth of

external debt plays a crucial role in influencing the degree of the portfolio management pressure. Second, the interest rates on external obligations are seen as another important factor that influence the level of the portfolio management role. The final factor that influences the degree of the portfolio management role is the country's balance of payments position. This reflects the ability of an economy to generate foreign exchange inflows from both the productive structure and nature of the financial system which dictates the magnitude and trajectory of (non-debt creating) capital flows.

4. 3.2. The Dual Role Dilemma Specification for a Reserve-Constrained Central Bank

To characterize the magnitude of the trade-off faced by the central bank in the pursuance of the dual mandate in the reserve management function, we combine the derivations for the liquidity role (equation 2.1) and the portfolio management role (equation 3.2), together with the central bank objective function in equation (2.2). For the purpose of making the formulation relatively transparent, we make two further simple assumptions. First, we assume that because both the liquidity and investment constraints are binding, it is not possible for the central bank to liquidate the reserves assets from the investment portfolio to meet shortfalls in the liquidity portfolio. The reason for this is simple. The restriction against sudden selling is to avoid that the central bank incurs losses, which put its reputation at jeopardy, and to avoid any potential insolvency (or failing to meet future liabilities).

Second, unlike in the classical world of a pure custodial central banking role which assumes a zero risk tolerance in reserve management, in our case for the dual role central banking, we consider the risk aversion (represented by the parameter $\lambda wVw'$ in equation 2.2) to be determined by the forces that underlie the portfolio management role (the need to grow and preserve the reserve capital in the reserve-scarce and a diminished yielding environment). As such, it can be taken that the risk aversion parameter will be implicitly included within the parameters in the specification for the investment portfolio in equation 3.2. Thus, we can drop the parameter $\lambda wVw'$ from our central bank objective function since it's already implicitly captured within the portfolio management role specification.

This yields the central bank objective function in terms of the macro-based strategic asset allocation rule as in equation (3.3)

$$\underset{\{w(i),w(L)\}}{\text{Max}} \sum_{i=1}^{J} [I_t(1 + w' x_i r_i) + L_t(x^f r^f)] \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (\mathbf{3.3})$$

Rearranging equation (3.3) based on the reserve allocation two-portfolio tranching constraint in section (2.2) together with the two formulations for both the liquidity role and the portfolio management role, yields:

$$L_t = R_t - \sum_{i=1}^{J} [I_t(1 + w' x_i r_i)] \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.4)$$

Subject to:

$$L_t \geq L^* = (std + 20\%m + 10\%bm)$$

$$I_t = \left(\frac{(1 + r_t^d)}{1 + g_t}\right) d_{t-1}^f - nica_t - ndcf_t$$

Equation 3.4 states, first, that, the fraction of the reserve holdings for the liquidity role falls when the degree of the portfolio management role increases. This happens because the higher the external debt burden, worsened by high interest costs, the higher the needs to hold reserves in return yielding assets to help in matching the structure of public foreign debts. Given that both the liquidity and portfolio management roles are binding constraints, equation (3.4) illustrates that there is a permanent dual role dilemma for central banks in reserve-constrained economies. This trade-off is somewhat akin to the link between the jump in the exchange rate and risky asset in the central bank's foreign management developed in Zhang & Zhou, (2013) where liquidity pressure originating from demand for intervention in a volatile exchange rate has a strong connection with the asset allocation of foreign reserves.

In summary, this section has extended the reserve management objective function to include the specification for the portfolio management role, in addition to the specification

of the liquidity role. It has also derived the formulation for the policy trade-off balance between the liquidity role and portfolio management role. In the next sub-section, we combine the specifications for both the liquidity and the portfolio management roles, with the monetary policy objective function presented in sub-section 4.2.2.

4.4 INTEGRATING THE CENTRAL BANK DUAL ROLE FORMULATION INTO MONETARY POLICY OBJECTIVE FUNCTION

This section joins the reserve management objective function presented in the preceding section with the monetary policy rule presented in section 4.2.1 to illustrate the complications the reserve management dual role dilemma creates for the conduct of monetary policy in reserve-constrained economies. The aims here is to capture the dual role dilemma equations into the Taylor Rule. We do this in two steps. First, we incorporate the liquidity role into the Taylor rule. Then, finally, we extend the model to capture the portfolio management role.

4.4.1. Introducing the Liquidity Role into the Monetary Policy Rule

To understand the precise way in which the liquidity role can enter the central bank monetary policy function, we turn back to the extended Taylor Rule in equation 1.1. In this modified Taylor Rule, reserve holdings are explicitly incorporated into the monetary policy rule to insulate the interest rate monetary policy from external forces. We reproduce the modified Taylor rule here for convenience.

$$i_t = i_r^* + \gamma_1(\pi_t - \pi^T) + \gamma_2(y_t - y^*) + \gamma_3(R^* - R_t) \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots 4.1$$

As already mentioned, in the monetary policy literature, the target or optimal level of reserves (R^*) is viewed as the precautionary reserves level required for insuring the economy against 'sudden stop' of capital inflows or reversal of capital flows defined according to the literature on optimal level of reserves (e.g; Jeanne and Ranciere, 2011;

Barnichon, 2009 and Basu, S.S., Ghosh, et al. 2016&2017). A key limitation with such approach is that it does not incorporate all the key components of external liquidity needs that in practice influence the demand for reserves in most reserve-constrained economies.

To capture the target level of reserves that reflects the key components of external liquidity needs for reserve-constrained economies in a more accurate way, we modify the reserves target that enters the monetary policy rule to take the form of the specification for the liquidity role in equation 2.1 ($R^* = L^*$). This also means that the reserves that enter the monetary policy rule should be equivalent to the actual level of reserves required for the liquidity role ($R_t = L_t$). In this view, we can write the central bank's objective function as in the following equation

$$i_t = i_r^* + \gamma_1(\pi_t - \pi^T) + \gamma_2(y_t - y^*) + \gamma_3(L^* - L_t) \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots 4.2$$

Where $L^* = R^* = std_t + 20\%m_t + 10\%bm_t$

This expression shows how different components of external liquidity needs – short-term external debts, imports and intervention needs - can have an impact on monetary policy in poor countries. When reserves needed for the liquidity role fall below the target level, the central bank is forced to raise interest rate in the case of a sudden stop or reversal of capital flows. The liquidity constraints can originate not only from the weak productive structure of the economy but also from an increase in short-term external obligations.

4.4.2 Introducing the portfolio management role into the Monetary Policy Rule

We now introduce the portfolio management role into the monetary policy rule, so that the dual role dilemma is fully captured in the Taylor Rule for a reserve-constrained economy. In this setting, the portfolio management role creates a tension with the liquidity role as derived in equation 3.4, reproduced here for convenience.

$$L_t = R_t - \sum_{i=1}^{J} [I_t(1 + w' x_i r_i)] \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (4.3)$$

Substituting equation (4.3) into the monetary policy reaction function equation (4.2) yields the monetary policy rule below.

$$i_t = i_r^* + \alpha((\pi - \pi^T) + \delta(y_t - y^*) + \lambda[L^* - (R_t - \sum_{i=1}^{J}[I_t(1 + w'x_i r_i)]] \quad \text{.....(4.4)}$$

Subject to:

$$L^* \geq std_t + 20\%m_t + 10\%bm_t$$

$$I_t = \left(\frac{(1 + r_t^d)}{1 + g_t}\right) d_{t-1}^f - nica_t - ndcf_t$$

The monetary policy reaction function developed in equation (4.4) embeds two principal ideas regarding the links between monetary policy and central bank reserve management. First, the potency of monetary policy in times of sudden stop of capital inflows can only be attained when the central bank is able to accumulate sufficient reserves that fully offset the short-term external liquidity needs – comprising of short-term external debts, foreign intervention against capital stops, and meeting import demands ($\boldsymbol{L} = \boldsymbol{L}^*$). But many developing countries do not have any capacity of mobilizing reserves that can match such liquidity needs due to their weak productive system exposed to extreme climatic vulnerability and their fragile financial system as well as the structure of ownership of key factors of production. This means that the level of the liquidity portfolio typically falls below the actual level of reserves a country can generate ($R_t \leq \boldsymbol{L}^*$). In this environment, monetary policy is directly exposed to external forces.

The second idea is that the portfolio management pressures, as reflected by the measure of the portfolio management role (I_t) , creates a new and a serious dimension to the loss of monetary policy potency. In particular, an increasing need for the portfolio investment role - associated with elevated structural foreign obligations and the risks of both capital erosion and depletion of reserves - directly reduce the level of reserves available for meeting short-term external liquidity needs. This has a very large effect on the ability of the central bank to maintain the stability of the exchange rate, and thus

implies a severe loss of monetary policy autonomy. As indicated in the introductory section, the equation we have presented is not intended to derive an optimal monetary policy rule to be followed by a reserve-constrained economy nor is it intended to be solved but for illustrative purpose only. It is only meant to show how the acute reserve scarcity challenge and the portfolio management role are constraints for monetary policy

4.5 Conclusion

In recent decades, the monetary policy and reserve management functions of central banks in reserve-constrained economies appear to have changed in ways that have made the conduct of monetary policy more challenging. In particular, there has been a transition from monetary policy arrangements that centered on money targets, to monetary arrangements that are anchored on targeting inflation. The implementation of inflation targeting for reserve-constrained, and developing economies more generally, is centered on the use of an interest rate rule and supported by interventions in the foreign exchange markets. Typically, foreign reserves have become one of the key monetary policy tools that operates alongside the short-term interest policy that acts as a strong insurance instrument to insulate the economy against external factors, thus helping to improve the monetary policy space. At the same time, the reserve management function of central banks, especially those with acute reserve scarcity, has been transformed into a dual mandate with both the liquidity and portfolio management roles becoming binding constraints on central banks. This transformation originates from the asymmetries in the international monetary system and in the global productive structure – structural forces which create large external obligations, acute reserve constraints and a phenomenon of "saver course dilemma" for countries seated at the extreme bottom of the system. In such an environment, central banks are compelled to accept the portfolio management role as an integral part of their operations to ensure return generation required both for meeting the large external obligations and preserve the capital of their reserves.

Understanding the impacts of the dual role dilemma requires a model that places the accumulation of external obligations, reserve scarcity associated with the weak productive structure with strong exposure to extreme climatic vulnerability and the

instability of the currency markets in the center of the analysis. We have argued that a combination of the small open economy monetary policy model and the strategic asset allocation framework in the policy literature offers a valuable contribution to develop such a model.

The model presented in this paper, first, proposed to specify the objective function of reserve management that captures the specifications for both the liquidity and the portfolio management roles. Second, it joined the Taylor rule with the dual role dilemma formulations to build a model that can be used to analyze the impacts of the dual role dilemma on monetary policy in reserve-constrained economies. Our model is able to show the constraint the dual role dilemma exerts for the interest rate policy setting in reserve-constrained economies.

Clearly, this is a simple model that has not addressed some important topics that are important for both reserve management framework and monetary policy model, especially establishing the adequate level of reserves that would alleviate the dual role dilemma. It would be an important theoretical step forward to have a model which specifies a reserve level that provides a balance between the liquidity role required for monetary policy autonomy, and the portfolio management role required for both capital preservation and meeting external obligations. Second, it would also be interesting to establish within such a model the level and nature of external debts that may not create too much pressure for the portfolio management role. However, these may just be appealing from the theoretical perspective, but may not be easy to implement in practice given the existence of the deep hierarchy among world regions in terms of the international monetary system and the productive structure.

CHAPTER 5: An Empirical Treatment of the Monetary Policy Implications of the Dual Role Dilemma in Central Banks of Reserve-Constrained Economies: Evidence from for Sub-Saharan Africa

5.1 Introduction

The goal of this chapter is to establish empirical evidence on monetary policy implications of the dual role dilemma in the reserve management function of central banks in reserve-constrained economies. Specifically, the chapter seeks to understand the extent to which acute reserve scarcity and the associated policy trade-off shape the behavior of policy rates in Sub-Saharan Africa (SSA) as their economies move towards inflation targeting regime. This monetary policy regime is based on the policy rule characterized by a Taylor Rule – where central banks change interest rates according to deviation of inflation from a target and an output gap, with the ultimate goal of achieving price stability. The implementation of such a monetary policy rule in SSA like any developing country is supported by foreign reserves which are deemed a vital tool which acts as an insurance instrument that helps shield off external forces (Berg and Portillo, 2018; O'Connell, 2010&2012 and Heintz and Ndikumana, 2010). While we are solely concerned with the impacts of the reserve scarcity dilemma on monetary policy, a critical element also taken into consideration in our empirical analysis is the impacts arising from strong exposure to both climatic and external vulnerability. We are unaware of any previous attempt to accomplish this goal in monetary policy analysis in SSA.

This empirical investigation arose from our concern over the recent expansion in the central bank reserve management function in SSA from the traditional custodial mandate of liquidity maintenance (required for supporting exchange rate stability and monetary policy function) to include a portfolio management role with strong focus on return generation. This dilemma as theorized in chapter 2 and substantiated empirically in chapter 3 of this thesis has been imposed on those central banks by the deep hierarchies in international monetary system (anchored on the US dollar) and its productive structure with SSA relying solely on primary commodities. Specifically, there are four harsh conditions originating from those structural hierarchies that underlie the

dual role dilemma. First, the excessively volatile exchange rates and acute loss of monetary policy autonomy. Second, the chronically large and ever-growing external obligations (both external debts and imports). Third, acute reserve scarcity associated with weak financial markets and heavy reliance on primary commodities with strong exposure to adverse climatic vulnerability and extreme price volatility. Fourth, chronic erosion of reserves capital emanating from extreme low yields on reserves assets. In such a world, while the liquidity role of reserves remains key in supporting exchange rate stability and monetary policy autonomy, a strong portfolio management role becomes an integral part of central banking function focusing on the achievement of capital preservation and growth of reserves to enable reserve-constrained economies meet their ever-growing external obligations.

The connection of this dual role dilemma to the monetary policy function has been provided in chapter 4 of this thesis. Specifically, the chapter presented a mathematical model which built on a monetary policy rule of a small open economy proposed in Caballero and Krishnamurthy (2003) and Kato et al., (2009) which introduces reserves into the Taylor rule. However, unlike in their model which directly incorporates the level of reserves in the monetary policy rule, in our model, we incorporate the liquidity and the portfolio management role specifications into the Taylor Rule which are both acting as binding constraints on a central bank. In the model, the liquidity role is determined by short-term external obligations (specifically short-term external debts, public imports and intervention needs against capital reversal) and is shown to play crucial role in supporting the monetary policy function. The portfolio management role, on the other hand, is determined by long-term external obligations and is viewed as a constraint for monetary policy operations.

Our goal in this chapter is to estimate this mathematical model of chapter 4 to establish the extent to which monetary policy in SSA is constrained by the reserve scarcity dilemma, especially the trade-off between the liquidity and portfolio management roles. Our analysis in this chapter is guided by two specific objectives. First, we develop an estimation of the dual role dilemma specification to obtain econometric evidence on the existence of the dual role dilemma. Second, we estimate the novel monetary policy

formulation in the form of a Taylor Rule that incorporates the liquidity and portfolio management roles indicators. Our empirical specifications capture two additional key forces that play prominent role in monetary policy in SSA: (i) the weak productive structure captured mainly by climatic vulnerability, and (ii) external forces captured by global uncertainty index and the US monetary policy. The incorporation of this additional element in our analysis is in line with the recent debts regarding the effects of climatic change, exchange rate dynamics and external forces on monetary policy (see Parrado, 2004; Mukherjee and Ouattara, 2021; Batten et al., 2020; Belhadj, 2009; Ostry et al., 2012; Ghosh et al., 2016 and Demir, 2019).

Our empirical strategy takes advantage of two important panel data approaches to address the above issues using data from a sample of 13 SSA countries. The first is the Augmented Mean Group (AMG) estimator. This approach works well with a moderate panel dataset and has the ability to deal with cross-sectional dependence, slope heterogeneity and non-stationarity problems. The second is the Discroll-Kraay estimator, implemented with traditional fixed-effect and pooled OLS panel regression. The use of the Discroll-Kraay estimator in this study is guided by the fact that it also works well with moderate panel data and has the ability to deal with cross-sectional dependence and heteroskedasticity.

The chapter is organized into four additional sections. Section 5.2 reviews the related literature; Section 5.3 presents the methodology, empirical specifications and the data used for the analysis; Section 5.4 presents and discusses the results for the estimations of both the dual role dilemma equation and the monetary policy rule that incorporates the dual role dilemma effects; and finally, Section 5.5 concludes the study.

5.2 Previous Studies of Monetary Policy Rules for Developing Economies

There is a growing empirical literature on monetary policy rules in developing countries, including SAA. This section focuses on the ‘inflation targeting’ framework: for while monetary policy in SAA is still anchored on monetary aggregate targeting, several African countries have now started either implementing or showing interest in transitioning to

inflation targeting regimes (see Berg and Portillo, 2018; O'Connell, 2010; Honohan and O'Connell, 1997; Heintz and Ndikumana, 2010 and Chileshe and Olusegun, 2017).

The notion of inflation targeting as a monetary policy rule derives from a model proposed by John Taylor (1993) for estimating the central bank reaction function. What this paper proposed, in a formulation now known as the Taylor Rule, is that the central bank should determine its interest rate on the basis of the deviation of output from an output target and of the deviation of price inflation from an inflation target (Lima and Setterfield, 2008). This approach is rooted in the belief that the central bank, through manipulation of short-term rates, can control inflation through influencing the level of liquidity in the system, and thus aggregate demand and inflation (see Arestis, 2009). Typically, the Taylor Rule is specified as a linear function of these two deviations. Denoting i_t as the short-term interest rate, i^* as the 'natural' rate of interest in Wicksellan terms, π_t as the inflation rate, π^* as the inflation target, y_t as actual output, and y_t^* as potential output, then:

$$i_t = i^* + \beta(\pi_t - \pi^*) + \gamma(y_t - y_t^*) \qquad (1)$$

A major limitation of the original Taylor Rule is that it excludes exchange rates. This builds in two implicit assumptions: either that the economy is closed; or – if open – that economic forces originating in the rest of the world do not significantly influence its monetary policy decisions. The usefulness of this approach for developing countries experiencing exchange rate volatility due to shocks originating in the rest of the world is therefore quite limited – especially when these countries are indebted in a foreign currency, such as the US dollar or the euro. Default risks will rise in the latter case if these countries' central banks were to let the exchange rates fluctuate freely. The same volatility issue arises due to the fact that foreign trade in developing countries are invoiced mainly in US dollars and in euros. Thus, abrupt exchange rate variations in these countries are harmful for foreign trade (see Svensson, 2000; Corsetti and Pesenti, 2005; Corsetti, Dedola and Leduc, 2007 and Corsetti, et al. 2011; Bharucha and Kent, 1998; Buffie, et al. 2018 and Epstein and Yeldan, 2008).

The exchange rate thus plays a key role in the transmission mechanism of monetary policy in developing countries. The exchange rate can affect monetary policy through its effects on both the domestic currency prices of imported final goods and of imported intermediate inputs. In addition, the exchange rate can transmit foreign disturbances such as; foreign inflation, foreign interest rates, and foreign investors' foreign-exchange risk premium (Svensson, 1998; Edwards, 2007 and Mishkin, 2008).

The Taylor Rule has thus been modified to include the exchange rate, so as to make it suitable for a small open economy (see Ball, 1998; Svensson, 2000; Taylor, 2001 and Kollmann, 2002). A Taylor rule specification of the monetary policy reaction function that incorporates the exchange rate is as follows:

$$i_t = i^* + \gamma(\pi_t - \pi^*) + \lambda(y_t - y^*) + \delta(q_t - q^*) \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (2)$$

where q_t denotes the real exchange rate and q^* is its target level consistent with the long run real exchange rate. In effect, equation (2) takes into account currency market stability or instability along with the focus on price stability and output growth built into the original formulation (equation (1)).

Caballero and Krishnamurthy (2003) and, Kato Proaño and Semmler (2009) have proposed another modification of the Taylor Rule that attempts to capture another key feature of the small open economy: that is, the level of foreign reserves. The rationale behind this modification is that reserves provide liquidity that can prevent capital stops and stabilize currency markets; consequently, the level of reserves can play a crucial role in maintaining a monetary policy rule such as the Taylor Rule. An extended Taylor Rule that incorporates precautionary reserves into the monetary policy reaction function can be defined as follows:

$$i_t = i^* + \gamma(\pi_t - \pi^*) + \lambda(y_t - y^*) + \delta(R_t - R^*) \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (3)$$

Where, R_t is the actual level of foreign reserves and R^* is the target level which is assumed to be determined according to a reserve adequacy measure.

The importance of incorporating either exchange rates or reserve levels into monetary policy rules reflects the importance of what has been called the 'impossible

trinity' or 'trilemma' problem in open economies. As Aizenman (2019) and many previous authors have shown, any economy in a financially integrated world cannot simultaneously maintain free capital mobility, exchange rate stability and independent monetary policy. This 'trilemma', of course, strikes developing economies with special force. Foreign reserve accumulation is the only instrument that in practice allows developing economies' central banks to achieve an intermediate level of capital account openness (controlled financial integration) and exchange rate stability (managed exchange rate flexibility) to retain some monetary policy autonomy.

A number of papers have included exchange rates in empirical estimations of monetary policy reaction functions for emerging economies (see Ostry et al., 2012; Ghosh et al., 2016; Ilosa, 2001; Mohanty and Klau, 2004; Akyürek et al., 2011 and Hammermann, 2005). These papers have generally found that the interest rate policy reacts to exchange rates via pass-through effects on prices. A limited number of empirical studies have included the exchange rate in estimations of the Taylor Rule for African countries. For example, Aram et al. (2009) estimated the Taylor rules in three Maghreb countries (Tunisia, Morocco, and Algeria) over the period 1990-2006; Nyumuah (2018) examined the monetary policy rule in Ghana; Apanisile & Ajilore (2013) estimated an exchange-rate augmented Taylor Rule for Nigeria; and Elshamy (2012) also estimated a monetary policy reaction function for Egypt. These studies, using different methods, have generally found that the exchange rate is a statistically significant determinant of monetary policy, and that interest rate policy reacts to the exchange rate.

Very few papers have tried to estimate whether foreign reserves play a role in emerging economies' monetary policy rules. Shresthaa and Semmler (2015) for instance, employed an ARDL model for five crisis-affected East Asian countries. Incorporating international reserves into the monetary policy reaction function, they found that monetary policy significantly reacts to the level of international reserves, particularly in the post-crisis period. Berument and Tasci (2004) estimated a forward-looking monetary policy rule for Turkey by using monthly data from 1990:01 to 2000:10. Using a baseline specification incorporating money growth, industrial production, foreign reserves and target inflation as regressors, they found that foreign reserves play a significant role in the

Taylor Rule. In a related study, Hasanov and Omay (2008) estimated monetary policy rule for Turkey, finding that its central bank reacts to foreign reserves changes, in addition to other variables such as output deviations, net foreign assets, real exchange rates and short-term capital inflows. In the case of Sub-Saharan African countries, Shortland and Stasavage (2004) is the only paper which has analyzed the role of foreign reserves in the monetary policy reaction function; they found that the central bank for the West African Economic and Monetary Union (BCEAO) does consider foreign exchange position in setting its monetary policy rule.

In sum, previous studies have shown that developing countries' implementation of monetary policy rules, including the Taylor Rule, have incorporated exchange rates and/or foreign reserves. The dual role dilemma for monetary policy highlighted in the previous chapter has not been explicitly modeled. Failing to account take the dual role dilemma is problematic, however, because it implicitly builds in assumptions about developing economies that are unwarranted. Specifically, the dual role dilemma can be ruled out if an economy has a developed and active financial market with perfect access to international financial markets, or if its productive structure is sufficiently strong to maintain a sound trade balance that is unaffected by adverse natural hazards. If both conditions were met, this economy could readily generate foreign reserves as required to support both its chosen monetary policy rule and to meet its other external obligations. In such a case, the central bank's role would be restricted to the conventional custodial role of keeping reserves in purely liquid assets. But these assumptions are not warranted: Sub-Saharan African countries are critically constrained by their weak productive structures with exposure to adverse climatic vulnerability and fragile financial markets; so, their central banks have been forced to make portfolio management considerations an integral part of their functions. This brings us to the model we estimate in this chapter.

5.3 Empirical Framework and Data

This section discusses the empirical methodologies employed in this study and displays the empirical specifications for both the dual role dilemma formulation and the monetary policy rule, capturing the liquidity and portfolio management role indicators, together with

key control variables. In addition, it describes the nature of data and various sources of the series used in our empirical analysis.

5.3.1 Econometric Methodology

This study uses panel data models to examine the dual role dilemma and its implications for monetary policy in SSA which have adopted some degree of inflation targeting and Taylor rule monetary policy function. It uses annual data spanning 2000–2019 for 13 SSA. Given the fact that this dataset falls under moderate panel in terms of both time-dimension (T) and cross-section dimension (N), it faces potential challenges associated with the nature of macro panel data. This includes: (i) challenges of non-stationarity, (ii) a much richer pattern of heterogeneity caused by economic and institutional differences, and (iii) cross-sectional dependence originating from omitted common effects, spatial effects, or potential interactions within socioeconomic networks such as trade relations. Conventional panel estimators, such as fixed effects, random effects, or GMM estimators are not suitable for estimation of such macro panel data (Baltagi, 2015). Moreover, even the most popular macro panel approaches such as Panel ADRL models do not work well with this kind of moderate panel since a typical macro panel data approach requires data with very long period ($T \geq 25$).

Two intermediate panel approaches that are available in the literature and which work well with such moderate dataset are: (a) the Augmented Mean Group (AMG) estimator of the Macro panel data model, and (b) the Discroll-Kraay estimator applied to the traditional panel data methods of fixed effect and pooled OLS. A key similarity in the two approaches is their ability to address cross-sectional dependence.

To ensure robustness of results, in this study we adopt both approaches. The pooled OLS with Driscoll-Kraay adjustment also enables us to trace the impact of observable common variables such as global factors which would not be possible in AMG and Fixed Effect models.

5.3.1.1 The Augmented Mean Group (AMG) estimator

The Augmented Mean Group model (AMG) proposed by Eberhardt and Bond (2009) and Eberhardt and Teal (2011) is one of the key approaches used in the analysis of macro

panel data. It has the key merit of working well in the presence of slope heterogeneity, cross-sectional dependence, and non-stationarity of the variables. It solves the cross-sectional dependence problem by including as additional regressors what has been referred to as the 'common dynamic process' (CDP), which represents the levels-equivalent mean evolvement of unobserved common factors across all countries. The AMG procedure is implemented in three steps: First, a pooled regression model augmented with year dummies is estimated by first difference OLS and the coefficients on the (differenced) year dummies are collected. This is referred to as the 'common dynamic process'. Second, the CDP is then added to the model by either subtracting it from the dependent variable or by including it in each of the N regressions. Finally, the AMG estimates N individual regressions and computes the averages or the individual estimated slopes.

The general AMG equation takes the form

$$y_{it} = \beta_i x_{it} + \mu_{it} \quad (1)$$

$$x_{it} = \alpha_{2,i} + \lambda_i f_t + \gamma_i g_t + \varepsilon_{it} \quad (2)$$

$$\mu_{it} = \alpha_{1,i} + \lambda_i f_t + e_{it} \quad (3)$$

where x_{it} and y_{it} are observables, β_i are country-specific slopes on the observable regressors, and μ_{it} contains the unobservables and the error terms e_{it}. The unobservables in equation (3) are made up of standard group fixed effects $\alpha_{1,i}$, which capture time-invariant heterogeneity across groups, as well as an unobserved common factor f_t with heterogeneous factor loadings λ_i, which can capture time-variant heterogeneity and cross-section dependence. Note that the factors (f_t and similarly g_t) are not limited to linear evolution over time, but can be non-linear and nonstationary, with obvious implications for cointegration. For simplicity, the model only includes one covariate and one unobserved common factor in the estimation equation of interest (1). Additional problems arise if the regressors are driven by some of the same common factors as the observables (note the presence of f_t in equations (2) and (3); see discussion in Coakley, Fuertes and Smith (2006)). ε_{it} and e_{it} are assumed white noise.

5.3.1.2 The Driscoll-Kraay Estimator

The Discroll-Kraay estimator has been designed to improve the robustness and flexibility of traditional panel regression methods, particularly the Fixed Effect and Pooled OLS model. It has the flexibility to work with series of medium to longer time dimension compared to the cross-section dimension. In addition, it can account for potential heteroscedasticity and any spatial and temporal dependence or interdependence across countries (Driscoll and Kraay, 1998). It works for both balanced and unbalanced panels and it is capable of handling missing values. As indicated in Hoeche (2007, p.284), *"Driscoll and Kraay's approach loosely applies a Newey-West–type correction to the sequence of cross-sectional averages of the moment conditions. Adjusting the standard error estimates in this way guarantees that the covariance matrix estimator is consistent, independently of the cross-sectional dimension".*

5.3.1.3 Panel Unit Root Tests and Cross-sectional dependence test

We first conduct Panel Unit Root Tests and Cross-sectional dependence tests to confirm the stationarity of the series and cross-sectional correlation. These are crucial in the choice of the panel data models applied in the estimations. For panel unit root tests, we apply both the first-generation and the second-generation approach to investigate the stationarity of the data. In the first-generation approach, we implement the Im-Pesaran-Shin (IPS) and Fisher- Type unit root tests. In the second-generation approach, which accounts for cross-sectional dependence in the variables, we implement Pesaran's (2003) unit root test. This technique is based on the Dickey–Fuller regression augmented with the cross-section averages of lagged levels and first differences of the individual series. To test for cross-sectional dependence, we apply two different techniques: the Pesaran (2003) cross-sectional dependence (CD) test, and Pesaran (2004/2015) cross-sectional dependence (CD) test as well as the Friedman's test.

5.3.2 Model Specifications

The empirical specifications in this analysis are based upon the mathematical model of the dual role dilemma developed in Chapter 4. Since our analysis is focused on

establishing both the econometric existence of the dual role dilemma and how this dilemma affects monetary policy, two formulations of the model are relevant for this chapter. The first is the dual role dilemma equation that captures the trade-off between the liquidity role and the portfolio management role of reserves. The second is the monetary policy rule which extends the Taylor Rule to incorporate the dual role dilemma indicators. To remind the reader, in this sub-section, we reproduce these two key formulations here.

5.3.2.1 The Dual Role Dilemma Specification

The trade-off equation describing the tension between the degree of the liquidity role and the portfolio management role derived in chapter 4 is given by:

$$L_t = R_t - \sum_{i=1}^{J} [I_t(1 + w' x_i r_i)] \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots . (4)$$

Subject to:

$$L_t \geq L^* = (std + 20\%m + 10\%bm) \ldots\ldots\ldots\ldots\ldots\ldots\ldots . . 4a$$

$$I_t = \left(\frac{(1 + r_t^d)}{1 + g_t}\right) d_{t-1}^f - nica_t - ndcf_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots . 4b$$

Where, the variable L_t is the proportion of reserves required for supporting the liquidity role and L^* is its target level. The variables R_t and I_t are the total reserves and the proportion of reserves required for supporting portfolio management role respectively. The variables x_i and r_i represent respectively, the return yielding asset and its return. The variable w represents the weight of each asset class in the reserve portfolio. The variable d_t^f denotes a measure of the external debt as a ratio GDP (expressed in foreign currency), r_t^d is the interest rate on foreign debts, and g_t is the GDP growth. The variable $nica_t$ is the current account balance excluding interest payments; and $ndcf_t$ are the non-debt-creating flows, all expressed as a ratio to GDP.

Equation 4a describes the measure of reserves required for the 'liquidity role'. It is determined by short-term external obligations which consist of short-term external debts ($\boldsymbol{std}$), import demands ($\boldsymbol{m_t}$), and intervention needs against volatile short-term capital flows. The short-term capital flows are approximated to be equivalent to 10% of base money ($\boldsymbol{bm_t}$). Equation 4b is the indicator of the 'portfolio management role', specified in terms of the law of motion of foreign debts.

We strengthen our empirical analysis by introducing three sets of control variables to equation 4: (a) structural productive factors: terms of trade and the climatic vulnerability, (b) balance of payments variables: the current account balance and short-term capital flows, (c) a country institutional factor: trade openness, (d) and global Factors: the US monetary policy rate and an index measuring global uncertainty. The essence of including these factors into the dual role dilemma specification is to capture the fundamental forces aggravating the dilemma as informed by both the theoretical framework and the empirical findings in chapters 2 and 3 respectively.

Given these modifications, we propose the following econometric specification for the dual role dilemma formulation:

$$I_{it} = \theta_{0i} + \theta_{1i}L_{it} + \theta_{2i}CAB_{it} + \theta_{3i}STCF_{it} + \theta_{4i}CV_{it} + \theta_{5i}TOT_{it} + \theta_{6i}TO_{it} + \theta_{7i}YD_{it} + \theta_{8i}VIX_{it} + \mu_{it} \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots .. \dots \dots (5)$$

Where I_{it} and L_{it} are the fractions of foreign reserves required for supporting the liquidity role and the portfolio management role respectively. CAB and STCF are current account balance and short-term capital flows. CV, TOT and TO are climatic vulnerability, terms of trade and the country' trade openness. YD is yield differential and VIX is the Global Uncertainty index.

Expected signs are important at this stage. First, if the dual role dilemma exists, the coefficient on the fraction of reserves for the portfolio management role (θ_{1i}) should be negative. This would confirm the core assumption of the tension between the liquidity role and the return generation role of reserves. Regarding productive structural factors, improvement in the terms of trade is expected to reduce the dual role dilemma. This is

because a strengthening in terms of trade is normally associated with improved foreign currency inflows. On the other hand, climatic vulnerability is expected to be associated with acute reserves scarcity arising from loss of productivity and diminished imports, thus an increase in the dilemma.

For balance of payment flows, an improvement in current account balance leads to an increased foreign currency inflow, thus a decline in the dilemma. On the other hand, an increase in short-term capital flows exposes the economy to the potential risk of capital reversal, thus worsening the degree of the dual role dilemma. Openness of the economy to international trade may either be associated with increased foreign currency inflows or sometimes a deterioration of the current account position especially in countries with extreme weak productive structure. First, a country with a large export sector can generate large foreign currency receipts and this strengthens the country's ability to service its debt obligation. Second, greater openness also makes the country more vulnerable to terms of trade shocks and thus a larger demand for reserves (see Corsetti, et al. 1999 and Edwards, 1984). Finally, a rise in both global factors (US monetary policy and VIX) is likely to be associated with capital reversal, thus requiring the central bank to use its liquid reserves to intervene to support the stability of the system.

5.3.2.2 Monetary Policy Rule Specification

The monetary policy reaction function formulated in the model of chapter 4 joins together the Taylor Rule of equation (3) with the reserve management dual role trade-off formulation of equation (4). This yields the following equations:

$$i_t = \alpha((\pi - \pi^T) + \delta\hat{y} + \lambda[\boldsymbol{L}^* - (R_t - \sum_{i=1}^{J}[I_t(1 + w'x_i r_i)]] \quad \text{.....(6)}$$

Subject to:

$$\boldsymbol{L}^* = min\ \boldsymbol{std_t} + \boldsymbol{20\%m_t} + 10\%\boldsymbol{bm_t}) \ \text{... ... ...} \boldsymbol{6a}$$

$$I_t = min\left(\frac{(1 + r_t^d)}{1 + g_t}\right) d_{t-1}^f - nica_t - ndcf_t \ \text{... ... ...} 6b$$

Equation (6) captures two crucial elements. The first is the conventional Taylor Rule with the short-term interest rate reacting to the inflation deviation from the target and the output gap. The second is the role of foreign reserves in monetary policy and the constraints arising from the policy trade-off between the liquidity role and the portfolio management role of reserves.

To transform equation (6) into an empirical specification, we introduce the following control variables: (a) climatic vulnerability to reflect the climatic-related disruptive effects arising from the inherently weak productive structure of the economy with strong exposure to adverse climatic crises, (b) exchange rate to help capture the monetary policy transmission mechanism arising from the exchange rate volatility as postulated in small open economy monetary policy literature, and (c) the global factors – both US monetary policy rate and the VIX. This gives us the following econometric specification for the monetary policy rule:

$$i_{it} = \theta_{0i} + \theta_{1i}\hat{y}_{it} + \theta_{2i}\hat{\pi}_{it} + \theta_{3i}lnFX_{it} + \theta_{4i}I_{it} + \theta_{5i}L_{it} + \theta_{6i}CV_{it} + \theta_{7i}i_t^f + \theta_{8i}VIX_t + \mu_{it} \quad \ldots (7)$$

Where i_{it} is the monetary policy rate, $\hat{y}_{it}$ is the output gap, $\hat{\pi}_{it}$ is inflation deviation from the target, and FX_{it} is the nominal exchange rate. I_{it} and L_{it} represents the dual role dilemma indicators in terms of portfolio management and liquidity pressures. CV is the climatic vulnerability. i_i^f and VIX_t are the US monetary policy rate and the global uncertainty index respectively.

Regarding the expected signs of the coefficients, output gap, inflation deviation, exchange rate depreciation and external factors are expected to have positive sign, confirming the postulation in the conventional Taylor rule for a small open economy. The impact of external forces and loss of monetary autonomy in developing countries has been discussed extensively in the literature (see Rey, 2013 and Caceres, et al. 2016). The fraction of reserves for the liquidity role is expected to have a negative sign as adequate liquid reserve portfolio guarantees monetary autonomy against external vulnerability. The fraction of reserves required for portfolio management role driven by large external obligations, on the other hand, exacerbates loss of monetary autonomy,

thus is expected to have a positive sign. Climatic vulnerability is also expected to have a positive sign given its impacts on monetary policy through inflationary pressure. This mainly comes through climatic disruptive effects on the severity of negative supply shocks arising from extreme weather events and the associated damages to crops, property, and infrastructure (see McKibbin et al., 2020).

5.3.3 Data sources and description of variables

This empirical investigation utilizes annual data observations from 2000 to 2019 on a set of thirteen Sub-Saharan African countries. The countries in our sample are; Uganda, Zambia, Gambia, Ghana, Kenya, Madagascar, Malawi, Mauritania, Mozambique, Nigeria, Rwanda, Sierra Leone, and Tanzania. Both sample of countries and periodicity of this investigation are constrained by issue of data availability and the time when the inflation targeting regime started making inroads to SAA and when the dual role dilemma in the reserve management function started becoming more clearer in those economies.

Specifically, the countries have been chosen based on their gradual adoption of some form of inflation targeting regime and Taylor rule for monetary policy. Though most countries in the sample had not formally adopted a full-fledged inflation targeting during the time covered by our dataset, there was an existence of at least some elements of targeting inflation in their monetary policy framework (see discussion in O'Connell, 2010 and Heintz and Ndikumana, 2010). Another important consideration we made in the country selection, is the existence of acute reserves scarcity and some form of dual role dilemma pressure. We based this selection on the information obtained during our interviews with central bankers in three countries (Uganda, Botswana, Kenya), and supported it with the level of reserves (measured in terms of imports cover) for the respective countries. Finally, excluded from our sample are countries with a pegged exchange rate regime and those in a monetary union (both the ECOWAS and the South and Western African Union) as they do not seem to have their independent policy rates and exchange rates.

The series as summarized in Table 1 can be grouped into the dual role trade-off and monetary policy variables. The key variables of interest for the dual role dilemma

estimation are; (i) portfolio management role indictor, (ii) the liquidity role indicator, (iii) climatic vulnerability index, and (iv) the balance of payment measures. As for the monetary policy rule estimation, the key variables include: (i) monetary policy rate, (ii) inflation, (iii) GDP growth, (iv) exchange rate, (v) the liquidity role indicators, (vi) portfolio management role indicators, and (vii) climatic vulnerability index.

Given that data on reserves allocations between the liquidity role and the portfolio management role are not publicly available for almost all Sub-Saharan African countries, we had to work with approximations. For the liquidity role, we use the level of short-term external obligations - 100% short-term external debts, plus 20% imports, plus 10% base money. And for the proportion of reserves required for the portfolio management role, we use the long-term external debts as a proxy. The choice of external debts as the proxy for the portfolio management role is in line with the asset-lability management principle in the policy literature on reserves management in central banking (Alhumaidah, 2015) and the theoretical framework developed in chapter 2 as well as our empirical findings presented in chapter 3.

As monetary policy rate (the dependent variable in our monetary policy estimation), we choose the 3-months Treasury bills yields, rather than the actual central bank rates. The following two considerations drive this decision. First, the actual short-term or policy rates are only available for short-time periods for most countries as majority of these countries started implementing the interest rate policy approach in recent years. Second, short-term treasury bills rates are traditionally a reflection of the monetary policy rate in an economy since both are typical benchmarks for interest rate setting.

Our primary data sources are the World Development Indicators provided by the World Bank and the series for financial variables provided by the IMF's International Financial Statistics. We supplement these primary sources with data from the Federal Reserve Bank of St. Louis, the University of Notre Dame, and the OECD.

Table 1: Data and Variables Selection

Panel A - Dual Role Dilemma Variables

Variable Classification	Variable	Description	Data Source
Dependent variable	(a) Liquidity role Indicator	Proxied by 100%STD + 20%imports + 10%base money	WDI
Independent variables			
Portfolio Management Function Factor	Portfolio management Indicator	Proxied by long term external debts	WDI
Balance of Payment Flows	Current account balance	Current account balance (% of GDP)	WDI
	Short-term capital flows	Represented by net private Portfolio investment-(% of GDP)	WDI
Productive Structural Factors	Climatic vulnerability Index	Composite indices of exposure to natural hazard and temperature	University of Notre Dame
	TOT	Terms of trade Index	WDI
Global Factors	US Monetary policy	US monetary policy rate (proxy by 3-month US Treasury bills yeld)	IFS
	VIX	Log of global uncertainty Index	Federal Reserves of St. Louis

Panel B – Monetary Policy Rule Variables

Variable Classification	Variable	Description	Data Source
Dependent variable	Monetary Policy Rate	Central Bank policy rate (proxy by 3-month bill Rate)	IFS and various central banks' websites
Independent Variables			
Baseline variables	Inflation	Inflation, CPI(%)	WDI
	GDP Growth	GDP Growth (%)	WDI
	Exchange Rate	Log exchange rate	WDI
Dual Role Dilemma Indicators	Reserves	Log foreign reserves (including gold)	WDI
	Liquidity role Indicator	Proxyed by 100%STD+20%imports+10%base money	WDI
	Portfolio management Indicator	Proxied by long term external debts	WDI
Productive Structural Factors	Climatic vulnerability Index	A composite indices of exposure to natural hazard and temperature	University of Notre Dame
Global Factors	US Monetary policy	US monetary policy rate (proxy by 3-month US Treasury bills yeld)	IFS
	VIX	global uncertainty Index	Federal Reserves of St. Louis

Tables 4 and 5 in appendix A present the descriptive statistics and the correlation matrix of the key variables employed for the overall sample. As shown in Table 2, the standard deviation of all variables except climatic vulnerability and openness are dispersed around the mean. This shows that not only heterogeneity between countries exists, although all

of them are SAA, but also that important changes within countries have taken place during the period considered. Finally, it is important to mention that the highest correlation among the variables is 0.54, which indicates that all variables can be included simultaneously in the model without causing multicollinearity issues.

In our preliminary analysis, we conducted cross-sectional dependence and panel unit root tests (all results shown in table 6 and 7 in Appendix 2). Both the Pesaran (2003) and the Pesaran (2004/2015) CD tests, suggest the presence of cross-sectional dependence in the model for both the monetary policy rate variables and the dual role dilemma variables at the 1% level of statistical significance. The panel unit root tests, particularly the second-generation Pesaran (2003) test, confirm that most of the variables are stationary, except inflation and the proxy for the reserves required for the liquidity role. The presence of cross-sectional dependence and an element of non-stationarity of one variable justify the use of the Augmented Mean Group Estimator as the core model for the estimations of both the dual role dilemma and the monetary policy model.

5.4. Empirical Results

This section presents the estimation results for both the dual role dilemma and monetary policy specifications. The section is organised in two parts. First, we discuss the results for the empirical existence of the dual role dilemma and the key factors underlying the tension between the liquidity role and the portfolio management role in central banks of reserve-constrained economies. Second, we discuss the estimation results for the monetary policy rule and discuss the forces that shape the behaviour of monetary policy in reserve-constrained economies, including the effects of the dual role dilemma, exchange rate dynamics, climatic vulnerability and the global forces.

5.4.1 The reserve management Dual Role Trade-Off Estimations

We first estimate the dual role dilemma specification of equation (5), capturing the liquidity role and portfolio management role indicators, and the control variables which have been broadly classified into structural productive factors, balance of payments variables, country institutional factors, and global Factors. Table 4 shows the estimated results for

the dual role dilemma specification. The panel data regression is estimated using both the AMG and the Discroll-Kraay estimator applied to the fixed effect and pooled OLS model. The results are provided column-wise representing each of the models. The coefficients for global factors are not showing under AMG technique since such common observable factors are naturally eliminated by the computation procedures for the AMG estimator.

Table 2: Estimation of the Dual Role Trade-off Formulation

Independent var: Liquidity role indicator (100%std+20%imports+10%bm)			
	AMG	**FE -DK**	**POLS-DK**
Portfolio management indicator	-0.038***	0.005	0.021**
	(0.000)	(0.497)	(0.014)
Yield differential	0.015	-0.026	-0.024
	(0.480)	(0.352)	(0.364)
Openness	-0.016***	0.006	0.005
	(0.000)	(0.568)	(0.625)
Current account balance	-0.008	-0.071***	-0.048***
	(0.791)	(0.003)	(0.009)
Short-term capital flows	-0.682	-0.080	-0.003
	(0.310)	(0.434)	(0.948)
Terms of trade	-0.008**	0.010***	0.006**
	(0.026)	(0.000)	(0.031)
Climatic Vulnerability	6.222**	4.362	5.048
	(0.036)	(0.607)	(0.585)
IT dummy	-0.162	0.590	0.154
	(0.68)	(0.220)	(0.708)
VIX			0.041
			(0.126)
Time-Trend	-0.025		
	(0.351)		
_cons	0.360	-2.586	-3.529
	(0.832)	(0.562)	(0.510)
Number of obs	228	228	228
Prob > chi2	0.0000	0.0000	0.0000
RMSE	0.3445		1.4616
R-squared (Within/Overall)		0.2734	0.2209

Source: Authors' calculations.

, **, * represent the level of statistical significance at 1%, 5%, and 10%, respectively*

Several observations are noteworthy from Table 4. First, we find a negative and statistically significant association between the liquidity role indicator and the portfolio management role indicator under AMG as seen in column 2. The negative coefficient is an indication that as the fraction of reserves allocated for the portfolio management role

rises (approximated with long-term external debts), a tight tension arises with the liquidity role as the reserves required for this custodial mandate declines.

Second, our estimation results confirm that the weak productive structure influences the dual role dilemma. This is shown by the significant coefficients on both climatic vulnerability and terms of trade. Climatic vulnerability seems to be associated with a rise in the liquidity role indicator. This suggests that as countries' exposure to climatic vulnerability rises, the liquidity needs to support intervention in the exchange rate or other short-term external obligations such as imports rise. This result support our theoretical analysis which shows the damaging effects of climatic crises, especially on exports and production more generally and acute pressure for imports. The coefficient on terms of trade is negative and significant under the AMG model. This implies that as terms of trade improve, the liquidity pressure decline. However, under the Discroll-Kraay estimator models, terms of trades appear to be associated with an increase in the liquidity role indicators.

Third, trade openness is associated with a decline in the liquidity role indicator. An improvement in current account balance is also associated with a decline in the liquidity role indicator. This may suggest two important benefits arising from a strengthening in the current account position. The first is that in period when there is an improvement in current account balance, some of the external obligations, such as imports are directly met by foreign currency inflows from exports earnings. This means that the burden for the liquidity role of reserves is reduced. The second is that a strengthening in the current account balance may lead to a reduction of reliance on short-term external debts to finance domestic development and consumption. This may also imply a reduction in the pressure such short-term external debts normally exert on the liquidity role of reserves.

Finally, external factors represented by VIX and yield differential are found to have less impacts on the degree of the dual role dilemma. This could be due to the less role played by financial factors, specifically capital flows into reserve-constrained economies.

5.4.3 Empirical Results for the Monetary Policy Rule Estimation

We now consider the impact of the dual role dilemma on monetary policy in SSA. Also presented in this sub-section are the effects arising from exchange rate dynamics, climatic vulnerability, and external forces. The results from both the AMG and the Discroll-Kraay estimator applied to the Fixed Effect and Pooled OLS models are reported in Table 5. As in the case with the reserve management dual role dilemma estimation in previous sub-section, the estimates for global factors are not shown for AMG approach since they are common observable factors that are automatically eliminated from the estimation under AMG estimator.

Table 3: Estimation of the Monetary Policy Reaction Function Capturing the Dual Role Dilemma Formulation

Independent var: Monetary Policy Rate			
	AMG	FE_DK	POLS_DK
Gdp	0.171 (0.344)	0.117 (0.271)	0.083 (0.432)
Inflation	0.285*** (0.002)	0.694*** (0.000)	0.705*** (0.000)
Exchange rate (log)	1.358***	-0.899**	-0.843**
	(0.000)	(0.033)	(0.033)
Liquidity Portfolio Indicator	-0.164 (0.566)	-1.039*** (0.004)	-1.033*** (0.002)
Portfolio management indicator	0.159*** (0.002)	0.173*** (0.001)	0.194*** (0.000)
Climaticvul	96.145*** (0.000)	77.244** (0.014)	72.950** (0.013)
Itdummy	1.791** (0.027)	3.557** (0.042)	3.689** (0.013)
VIX			0.039 (0.524)
USbills			0.332 (0.208)
Time-Trend	0.050 (0.675)		
_cons	-44.818*** (0.000)	-34.967* (0.011)	-34.787** (0.008)
Number of obs	228	228	228
Prob > chi2	0.0000	0.0000	0.0000
RMSE	2.2841		1.4592
R-squared (Within/Overall)		0.5123	0.5459

Source: Authors' calculations.

, **, * represent the level of statistical significance at 1%, 5%, and 10%, respectively*

There are four key results obtained from our estimations of the monetary policy rule that incorporates the dual role dilemma indicators.

First, there is a strong evidence that central banks in SSA seem to adjust short-term interest rates according to the specification of small open economy Taylor rule which incorporates exchange rates into the monetary policy reaction function. This is shown by the statistically significant coefficients on both the inflation and the exchange rate. The positive coefficient on inflation implies that an increase in inflation is accompanied by a rise in short-term interest rates. This is in line with the Taylor rule specification which postulates that, under the inflation targeting regime, whenever inflation grows above its inflation target, the central bank needs raise the rate of interest to cool the economy. In addition, the coefficients on the exchange rates are significant and positive under AMG, implying that exchange rate depreciation are associated with a rise in the short-term interest rates. This finding is also consistent with the small open economy Taylor Rule where excessive volatile exchange rates is seen to be associated with the loss of monetary policy autonomy due to high pass-through to inflation. The results generally suggest that SSA's monetary policy is crucially exposed to external vulnerability. This result confirms the evidence on monetary policy trade-off in developing economies imposed on them by external vulnerability (see Fraga, et al. 2003; Chisha, 2018 and Furusawa, 2016).

Second, insofar as the dual role dilemma is concerned, there is an evidence that the short-term interest rates are influenced by the dual role dilemma indicators. (i) the coefficients on the indicator for the liquidity role is significant and negative. This negative sign would suggest that a rise in the proportion of reserves required for the liquidity role leads to a decline in the short-term interest rates. The interpretation of this is that, if a central bank has a higher fraction of reserves for supporting the liquidity role, it may be able to insulate the monetary policy from external forces. This provides a central bank with a leeway to maneuver its policy rate. (ii) The coefficients on the indicator for the portfolio management role are significant and positive. These positive coefficients

suggest that an increasing importance placed on portfolio management role (proxied by long-term external debts) causes an increase in short-term interest rates. This may suggest an inability to provide immediate liquidity to support the stability of the system as this portion of reserves is typically allocated in relatively illiquid return yielding assets, thus exposing monetary policy to external vulnerability. The result is also consistent with the literature which provide evidence on the constraint large external debts impose on monetary policy in SSA (Christensen, et al. 2018).

Third, this study finds strong evidence for the impact of climatic vulnerability on short-term interest rates. This is shown by the positive and significant coefficients on climatic vulnerability across all the models applied in this investigation. The significant and positive result suggests that an increased exposure to adverse climatic conditions puts upward pressure on short-term interest rates. These results are consistent with the recent debates on the links between climatic crisis with inflation and productivity and the associated constraints for monetary policy in developing countries (Mukherjee and Ouattara, 2021; Batten et al., 2020; De Gregorio, 2012; Nguyen, 2015 and IMF, 2011). Recently, McKibbin et al., (2020) have showed that for a carbon-constrained and climatically disrupted world, strong linkages exist between climate change and monetary policy regimes. Such linkages originate mainly from the fact that climatic disruption normally increases the frequency and severity of negative supply shocks. For example, ‘‘extreme weather events and sea-level rise can result in damages to crops, flooding of major cities and industrial areas, coastal erosion that destroys property and physical plant, extensive power outages, infrastructure damage, and the dislocation of workers (McKibbin et al., 2020 p.580)’’. This raises an important question how central banks should anticipate and respond to inflation increases and output decreases that result from climate policy.

Fourth, the external factors represented by both VIX and US monetary policy rate seem not to show significant results. It is possible that these results are not significant as the impacts of such global financial factors are still minimal in SSA given the limited capital inflows into the continent. This result is not surprising since the degree of financial markets development in SSA and their interconnectedness to the global financial markets are still

low. This implies that the monetary policy subordination of SSA triggered by external vulnerability does not necessarily originates from the events in the international financial markets that normally trigger sudden capital reversal but rather the weaknesses in the terms of trade or current accounts more generally.

Taken together, the results in our empirical analysis in this chapter provide some important evidence on the monetary policy implications arising from the acute reserve scarcity dilemma in SSA and their exposure to adverse climatic and external vulnerability. In line with the theoretical model presented in chapter 4, the indicator for the liquidity role appears to be associated with a decline in short-term interest rates, an evidence of improvement in monetary policy space. On the other hand, the portfolio management role (proxied by long-term external debts) seems to weaken the importance insurance role of reserves, thus further aggravating the loss of monetary autonomy. This, reinforced by the impact of the weak productive structure (reflected by significant coefficients on climatic vulnerability), raises an important question on the appropriateness of inflation targeting regime for SSA. More precisely, the empirical analysis in this chapter is a signal that in reserve-constrained economies seated at the bottom of the deep hierarchies in the world's international monetary system and its productive structure, short-term interest rates are highly exposed to external vulnerability and shocks originating from the weak productive structure. While foreign reserves would provide a crucial role in supporting monetary policy function in such a world, this is not the case for reserve-constrained economies characterized by excessively volatile exchange rates, chronically large external obligations, acute reserve scarcity and severe erosion of reserve capital.

It is important to note here that our results are robust to various alternative models and the probability of Chai Squared in our empirical framework are all significant at 1% confirming the appropriateness of the model specifications.

5.5 Conclusion

This chapter sought to address two important issues. The first is to estimate the dual role dilemma formulation, capturing the policy trade-off between the liquidity goal and the portfolio management goal in the reserves management function of central banks in SSA that have adopted some degree of inflation targeting and short-term interest rate as monetary policy instrument. The second is to estimate the monetary policy reaction function in the form of a Taylor rule, that incorporates the dual role dilemma indicators, taking into consideration key forces arising from climatic and external vulnerability. The aim of the first estimation is to establish the econometric existence of the dual role dilemma in SAA. The second focuses on investigating the monetary policy implications of the dual role dilemma. In this empirical estimation, due to the unavailability of data on asset allocation of reserves, the level of reserves required for the liquidity role and the portfolio management role are proxied by short-term external obligations and the long-term external debts respectively. Country's structural productive characteristics and climatic vulnerability as well as external factors are included in the model as control variables.

Using annual data for 13 SSA spanning from 2000-2019, we estimated the two equations employing the Augmented Mean group (AMG) panel estimator and the Discroll-Kraay estimator applied to Fixed Effect and Pooled OLS models. The results from the estimation of the trade-off equation indicate that there is a negative and significant relationship between the measures for the liquidity needs and the portfolio management measures. This, indicates that, when the degree of portfolio management goal increases in a central bank, it creates a tension with the fraction of reserves held for achieving the liquidity role. Strikingly, we find that the gravity of the dilemma tends to worsen with a deterioration in current account balance, heightened climatic vulnerability, and when there is a decline in the terms of trade. Curiously, neither short-term capital flows nor yield differential appear to play an important role in the dual role dilemma.

Empirical results from the estimation of the monetary policy rule reveal three important insights about monetary policy in SSA. First, we find consistent and statistically

significant evidence of the exacerbation of loss of monetary policy autonomy arising from the existence of the structural forces behind the dual role dilemma. Specifically, the results indicate that, on the one hand, an increase in the liquidity role proxy leads to a decline in monetary policy rate. This suggests that when a higher fraction of reserves is allocated for achieving the liquidity goal, it provides a central bank with strong ability to insulate its monetary policy against external forces. On the other hand, an increase in the portfolio management role proxy is associated with a rise in monetary policy rate. The implication of this is that, while reserves play an important role in supporting monetary policy, this crucial insurance role can be weakened significantly by the strong external obligations that underline the dual role dilemma in central banking. This poses a fundamental challenge to SSA policy makers whose economies are characterized by chronic structural external obligations, specifically foreign debts, worsened by weak institutional characteristics.

The second key result is the demonstrated evidence of structural constraints, which can be attributed to the existence of SSA economies' weak productive structures. To explain this, we estimated the effect of climatic vulnerability as one of the indicators of weak productive structure on monetary policy rate. The coefficient on this variable was positive and statistically significant. The positive coefficient suggests that monetary policy rate rises as the country's exposure to climatic vulnerability worsens. This result provides evidence on the notion that the weak productive structure is a key determinant of inflation dynamic in SSA, which in turn shapes the nature of short-term interest rate in an inflation targeting monetary regime.

Finally, the results provide broad evidence that monetary policy in SAA can be somewhat defined by the conventional small open economy Taylor Rule with short-term interest rate reacting to movements in the domestic variables and the exchange rate. This is confirmed by the positive and significant reaction of monetary policy rate to increase in inflation and exchange rate depreciation. However, the appropriateness of this form of interest rate setting policy approach in SSA is highly questionable given the existence of the strong structural external obligations, the acute reserves shortages, the general weak

productive structure and the inherently volatility exchange rate associated with the increasing financial and economic globalization.

Our findings have important implications for future research and for economic policy. Much of the existing literature, including that which analyses the impacts of global factors in the monetary policy, pay insufficient attention to reserve-scarcity dilemma. Some open-economy models analyzing monetary policy in the adjusted Taylor Rule tradition have a key role for foreign reserves, but most of this literature has focused on incorporating reserves in the monetary policy rule without looking at the dual role dilemma. Our empirical findings suggest that while these models might still be important for Sub-Saharan African countries, future theoretical as well as empirical models of monetary policy should pay more attention to the reserves scarcity and weak productive structure, focusing on incorporating climatic vulnerability in monetary policy designs.

Chapter 6: Conclusion and Policy Recommendations

This PhD thesis presented a comprehensive assessment of a novel policy trade-off in central banks in reserve-constrained economies. This trade-off, which we referred to as the “dual role dilemma”, originates from the recent expansion in the central bank reserve management function from the traditional custodial mandate of liquidity maintenance to include a portfolio management role. In this dual mandate, while the liquidity role is viewed as a powerful insurance instrument for managing exchange rate stability and supporting the monetary policy function, the portfolio management role focuses on return generation required for capital preservation and growth of reserves. This thesis examined the factors underlying this dual role dilemma and the implications it has for monetary policy in reserve-constrained economies.

We began by developing a “novel theoretical framework for the analysis of the dual role dilemma”. This theoretical framework, presented in Chapter 2, draws heavily from the Post-Keynesian currency hierarchy, and extended it to incorporate the productive structure perspective to help depict the position of reserve-constrained economies at the extreme bottom of the steep hierarchies in the world’s international monetary system and its productive structure. It theorized several constraints which are imposed on countries at such extreme bottom of the hierarchies. These included: (i) excessively volatile exchange rate and acute loss of monetary autonomy, (ii) chronically and continuously growing external obligations, (iii) acute reserve scarcity emanating from heavy reliance on volatile primary commodities with exposure to adverse climatic vulnerability, and (iv) severe erosion of reserve capital arising from the very low yields on reserve assets. Two overall contributions emerged from this theoretical analysis. First, the theoretical framework captured a more comprehensive importance of reserves beyond the self-insurance role for managing the stability of exchange rates highlighted in Post-Keynesian literature. It emphasized in addition the importance of reserves for meeting external obligations (both imports and foreign debts). Second, it brought to light that in countries seated at the extreme bottom of the deep hierarchies in the world’s international monetary system and its productive structure, central banks are forced to pursue both the liquidity and portfolio management roles in the management of reserves. This dual mandate in

the reserve management function is contrary to common wisdom which views central banks as mere custodians of reserves.

Chapter 3 complemented this theoretical consideration with an in-depth qualitative, empirical analysis of the dual role dilemma, combining insights from focus group discussions and semi-structured interviews with central bankers in three SSA: Botswana, Zambia, and Uganda. The main contributions of this chapter were to further investigate the empirical nature and manifestations, historical evolution, and both structural and country-specific factors which underlie the dilemma. The chapter confirmed the deep roots of the dilemma to a combination of the asymmetries in the international monetary system and in the global productive structure, reinforced by weak institutional characteristics of the three case study economies. These institutional characteristics included the lack of fiscal discipline and transparency in the accumulation and management of public external debts, as well as the financial sector frailties. Regarding the magnitude of the dilemma, the chapter showed that countries with extreme low level of reserves and large external debts face a higher degree of the tension between the liquidity pressure and the portfolio management constraint.

Chapter 4 then developed a mathematical model that integrates the monetary policy rule with the reserves management objective function, capturing the dual role dilemma. The main aim of the model was to provide a platform for the analysis of the monetary policy implications of the dual role dilemma in the reserve management function. The chapter made two key contributions. First, it derived the reserve management objective function that captures the specifications for both the liquidity and portfolio management roles. Second, it extended the small open economy Taylor Rule of monetary policy with the liquidity and portfolio management roles. In contrast to the existing literature, both roles acted as binding constraints on central banks of reserve-constrained economies. In that way, the model was able to demonstrate how the dual role dilemma can constrain central banks' ability in supporting currency market stability, which in turn exposes monetary policy to external vulnerability.

Finally, Chapter 5 applied macro panel econometric approaches to estimate the dual role dilemma model developed in chapter 4. A critical element in the analysis is the

expansion of the empirical specifications to include effects arising from the countries' exposure to climatic and external vulnerability. AMG estimator and the Discroll-Kraay estimator implemented with fixed effect and pooled OLS were applied on annual data spanning 2000–2019 for 13 Sub-Saharan Africa countries. Overall, the results suggested that the dual role dilemma, climatic vulnerability, and external forces significantly affect monetary policy in reserve-constrained economies. First, it was shown that an increase in the portfolio management role indicator proxied by growth in external debts- resulted in a rise in the short-term interest rate, which implied a loss of monetary policy autonomy. On the other hand, an increase in the liquidity role indicator proxied by short-term external liquidity obligations- resulted in a decline in the short-term interest rate, which implied a crucial insurance role of liquid reserves in supporting monetary policy function. Second, both climatic and external factors as well as the exchange rate volatility are associated with a rise in monetary policy rates in SSA.

A key limitation to this thesis has been the poor data in SSA which constrained the sample size, length of the period, frequency of the data and in some instances extreme values of some variables. Moreover, in some of our key variables, we relied on proxies since data on the actual variables were not publicly available. This implies that though our results were robust to different model specifications, the interpretations of those results might be affected by the proxies used.

Several policy implications emerge from this investigation. The main policy measures for reserve-constrained economies therefore are to deal simultaneously with four fundamental issues: productivity, external dependence, domestic institutional characteristics, and climatic change. The specific policy strategies are discussed below.

The first regards productivity-enhancing strategies that permit reserve-constrained economies to climb up the hierarchy of the global productive structure. Such measures entail solid strategies for strengthening technical advances and the institutional environment in which firms operate (e.g infrastructure, linkages with telecommunication system, scientific and technical system), which are needed to push those economies to attain industrial complexity and diversifying their exports. This requires supportive state policies, training, finance, and promotion of exports or new oversee markets as well as

organizational initiatives to increase productivity, new relations with foreign and local capital, and participation in regional economic blocs. Policies surrounding foreign direct investment all need to be reassessed to minimize foreign firms taking over the ownership of factors of production.

The second important policy measure involves reducing the dependence on the US dollars or currency at the centre of the international monetary system. This would require the need for a rethink of the integration to the deeply flawed international monetary and financial system (D'Arista, 2001). Our results have shown that reserve-constrained economies are characterized by a sustained high demand for US Dollars from both private importers and the governments as most trade and financial operations are denominated in the US dollars. Measures which could reduce the dependence on the Dollar could include the enhancement of the current efforts towards regional economic and financial integration, with solid support for regional payment and settlement mechanisms, and the development of domestic bond markets, ideally with the participation of core domestic institutional investors such as pension funds. Both at regional and domestic level, emphasis should be placed on strategies to lengthen the maturities of sovereign bonds, increasing the variety of financial assets, including derivatives instruments though with a focus on instruments which support hedging rather than speculation, and improvement of financial markets infrastructure that allows real time access to information and trading in the domestic financial markets. The emphasis on financial sector development and the connection with monetary policy transmission efficiency has been emphasized in recent studies (see Effiong, et al. 2017).

The third sets of measures regard coherent and stable macroeconomic policies including appropriate monetary policy designs and exchange rate policies that ensure stable inflation and interest rates that support improved economic performance. Such policy designs should take into careful consideration the deep structural features of the reserve-constrained economies associated with their subordinated position at the bottom of the steep hierarchies in the world's international monetary system and its productive structure. Key consideration in the monetary policy designs should entail a proper understanding of the deep sources of inflation, exchange rate instability arising from both

short-term volatile capital flows and acute current account vulnerability, acute reserve scarcity, and large external obligations.

The fourth set of policy measures relates to the improvement in institutional arrangements surrounding external debt accumulation and its management, mainly by fiscal authorities. This involves eliminating corruption and lack of transparency and accountability in fiscal policy. This would require joint decision making at the policy level of debt management between monetary and fiscal authorities, the separation of debt and monetary management objectives, and accountabilities. At the same time, it would need to maintain a form of consultation and information sharing between the debt managers and the central bank. The joint debt management framework should help structure debt portfolios, such that there is an effective coordination of reserves and debt management decisions in terms of the currency mix and duration (IMF, 2014; Mustapha and Prizzon, 2015 and Cangoz, etl. 2019). Monetary authority should be given some power in the debt decision making process and the broader debt sustainability analysis for effective coordination between government agencies and the central bank. In effect, this would make the central banks gain control over external debts contracting, thus enabling a joint analysis of foreign reserves and the liabilities. This would ensure that both the level and rate of growth in external public debts are on a sustainable path, and that those debts can be serviced under a wide range of circumstances, including economic and financial market stress.

Fifth, given SSA's difficulty in achieving strong productive structure and thus a continuous exposure to extreme climatic vulnerability, urgent action is needed towards national climate strategies and eco-friendly investments as well as policies to mitigate and adapt to climate. Both fiscal and monetary policy should direct greater effort towards combating climate change which is increasingly exerting a mounting challenge for African economies (Debels-Lamblin and Jacolin, 2020).

Overall, this investigation has made important theoretical and empirical contributions to the understanding of the challenges facing central banks in reserve-constrained economies. Yet, several areas of future research are very promising. First, the single-period model developed in chapter 4 can be extended to a multi-period

dynamic model. Such a model should capture the optimal level of reserves, asset classes in which reserves are held, the nature of external liabilities, current account conditions, and the different exchange rate regimes. It would also be important to empirically estimate such a model using data not only for SSA but other developing countries.

The second area for future research works is the design of appropriate monetary policy models for reserve-constrained economies that can capture the deep structural features arising from their weak productive structure and external vulnerability arising from the international monetary asymmetry. Such a monetary policy models must provide a unifying framework which brings together structural realities which determine inflation, exchange rate volatility, chronically higher external obligations, and acute reserve scarcity as well other forces that determine the monetary policy transmission mechanisms.

The third area of future research is on the links between climatic crisis with the clear conceptual monetary policy frameworks, capturing key features associated with both demand and supply side climatic-driven shocks. This would entail clear formulation of macroeconomic modelling techniques for monetary policy analysis suitable for the developing world characterized by continual climatic disruptions, especially on the supply side.

The final area involves a detailed theoretical and empirical analysis of the role of regional economic and financial integration as a mechanism for strengthening macroeconomic and financial stability, thus a possible way forwards to minimize the dual role dilemma in reserve-constrained economies.

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Appendix

Appendix A. Derivation of the Monetary Policy Rule to capture the role of foreign reserve holdings in the Taylor Rule.

There are three important equations required for showing formally how the reserve holdings can entre monetary policy rule. Beginning with the Taylor Rule formulation for a small open economy which directly incorporates the exchange rate into the monetary policy rule (see Ball, 1998; Svensson, 2000 and Taylor, 2001, given by

$$i_t = i^* + \gamma(\pi_t - \pi^*) + \lambda(y_t - y^*) + \delta(s_t - s^p) \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots .. (\text{A})$$

Where s_t^p is some sort of exchange rate target level that guide central bank's action. This can be determined to be consistent with long-term economic fundamentals represented by the inflation targets and the real exchange rate trend.

The exchange rate (s_t) takes the form of a modified UIP in which, in addition to the interest rate parity, it takes into account the risk premium and the level of the country's foreign reserves (or the fluctuations of foreign exchange reserves around their long- -term (steady-state) optimal level, given by

$$s_t = s_{t-1} + (i_t - i_t^{*}) - prem_t - (R^* - R_t) \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots . B$$

Where, the variable $prem_t$ is the premium required by investors for holding domestic securities. R_t and R^* are the actual level of reserves and optimal level of reserves respectively.

The final equation is the foreign intervention rule which says that the central bank adjusts the level of reserves in order to limit the deviations of the exchange rate changes from the parity (the level or trajectory of the exchange rate that is consistent with the inflation targets and real exchange rate in the long term). This is given by the flowing

$$\overline{R_t} - R_t = \lambda\left(s_t - s_t^p\right) \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots . \dots \dots \dots C$$

To capture the role of reserves in the Taylor Rule, there are two approaches. The first and most precise approach is to directly include the foreign intervention rule of equation (C) into the Taylor rule of equation (A) by replacing it with the deviation of exchange rate from its parity level. This yields the following equation

$$i_t = i^* + \gamma_1(\pi_t - \pi^T) + \gamma_2(y_t - y^*) + \gamma_3(R^* - R_t) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{D}$$

Equation (D) is the same specification for the extended Taylor Rule presented in equation (1.1) in section 2 of this Thesis.

The second approach would involve first incorporating the exchange rate formulation of equation (B) into the Taylor Rule of equation (1.1) but this requires a number of strong assumption regarding the nature of yield differential between the domestic and foreign interest rates, and the assumption on the determinant of the premium.

Appendix B: Descriptive Statistics

Table 4: Summary Statistics of Key Variabels

Variable	Obs	Mean	Std. Dev.	Min	Max
MPR	300	14.685	9.241165	.03	52.78
Exchange rate	300	795.971	1351.622	.12	9010.22
Gdp	300	4.5731	4.081452	-20.6	26.42
Inflation	300	11.20763	10.17111	-1.7	83.33
Cab	300	-6.552633	8.664502	-65.03	21.75
Yield differential	300	12.3814	8.801238	-.06	47.77
Portfolio flows	300	-.2228667	.8949209	-7.51	1.36
Climatic vulnerability	288	.5361806	.0345503	.44	.59
Term of Trade	292	107.9102	45.51319	33.52	306.94
Export commodity price index	264	77.85761	24.81925	16.73	128.55
Openness	300	62.83187	34.27399	11.08	186.69
Liquidity Portfolio indicator	300	1.467445	1.641913	.1442015	10.47929
Investment Portfolio Indicator	300	32.59833	17.71502	3.68	87.48
Reserves	300	10.07773	8.553665	.48	52.41
VIX	300	19.6356	5.955345	11.09	32.69

Table 5: Key Variables Correlation Matrix

	MPR	Exchange rate	gdp	inflation	cab	Yield differential	portfolio Flows	climatic vul	term of trade	ecpi	openness	liquidity constraint	investment constraint	reserves	vix
MPR	1.00														
Exchange rate	-0.19	1.00													
gdp	-0.04	0.02	1.00												
inflation	0.60	-0.14	-0.05	1.00											
cab	-0.13	-0.23	0.11	0.02	1.00										
Yield differential	0.97	-0.16	-0.02	0.56	-0.17	1.00									
portfolio Flows	-0.02	0.13	-0.06	0.02	-0.01	-0.07	1.00								
climatic vul	-0.08	0.48	-0.03	-0.12	-0.22	-0.10	0.32	1.00							
term of trade	-0.34	-0.11	0.03	-0.25	0.06	-0.32	-0.01	0.10	1.00						
ecpi	-0.19	0.30	0.09	-0.19	-0.20	-0.08	-0.18	-0.04	0.09	1.00					
openness	-0.19	0.00	0.02	-0.18	-0.37	-0.13	-0.13	-0.01	0.51	0.16	1.00				
liquidity constraint	0.05	-0.21	-0.15	0.08	-0.26	0.01	0.10	0.02	0.18	-0.36	0.39	1.00			
investment constraint	0.37	-0.02	-0.21	0.14	-0.21	0.31	0.12	0.24	0.05	-0.29	0.05	0.29	1.00		
reserves	-0.35	0.31	0.09	-0.29	-0.02	-0.24	-0.29	-0.17	0.11	0.65	0.13	-0.51	-0.36	1.00	
vix	0.00	-0.11	-0.05	-0.08	0.01	0.01	0.15	0.08	-0.10	-0.13	-0.14	0.09	-0.05	-0.14	1.00

Appendix 2: Preliminary Tests

Table 6: Cross-Section Dependence Tests

	CD-test	p-value	corr	abs(corr)
Pesaran (2004) CD test	11.21***	0.000	0.195	0.328
Pesaran (2003) CD test	8.277***	0.0000		
Friedman	52.429***	0.0004		

Table 7: showing Panel Unit Root Tests

	Pesaran (2003)		Im-Pesaran-Shin	Fisher
	Level	1st Difference	Level	
Monetary policy rate (interest rate	-2.360*** (0.002)		-3.2967*** (0.0000)	-12.9720*** (0.0000)
GDP growth	-2.104** (0.041)		-3.4168*** (0.0000)	-6.1840*** (0.0000)
Inflation	-1.854 0.271	-2.491*** (0.000)	-3.9040*** (0.0000)	-9.2503*** (0.0000)
Exchange rate	-2.358*** (0.002)		-2.9436*** (0.0000)	-1.6613*** (0.0483)
Reserves (% of GDP)	-2.709*** (0.000)		-3.2535*** (0.0000)	-4.7357*** (0.0000)
Liquidity portfolioA	-2.016* (0.089)	-2.724*** (0.000)	-3.7317 *** (0.0000)	-6.3102*** (0.0000)
Liquidity PortfolioB	-1.947 (0.151)	-2.625*** (0.000)	-3.8955*** (0.0000)	-5.9510*** (0.0000)
Investment Portfolio	-2.420*** (0.001)		-4.5421 *** (0.0000)	-9.4317*** (0.0000)
Current Account Balance	-2.116** (0.036)		-3.3623*** (0.0000)	-6.6528*** (0.0000)
Term of Trade	-2.900*** (0.002)		-2.9662*** (0.0000)	-6.4916*** (0.0000)
Yield Differential	-2.360*** (0.002)		-3.2967 *** (0.0000)	-12.9720*** (0.0000)
Climatic Vulnerability	-2.199** (0.016)		-3.3272*** (0.0000)	-0.5870 (0.2786)
Openness	-3.060*** (0.000)		-3.5590 *** (0.0000)	-4.9256*** (0.0000)

Appendix 3: Graphs for Key Variables

Figure 1: Monetary Policy Rate (1995-2019)

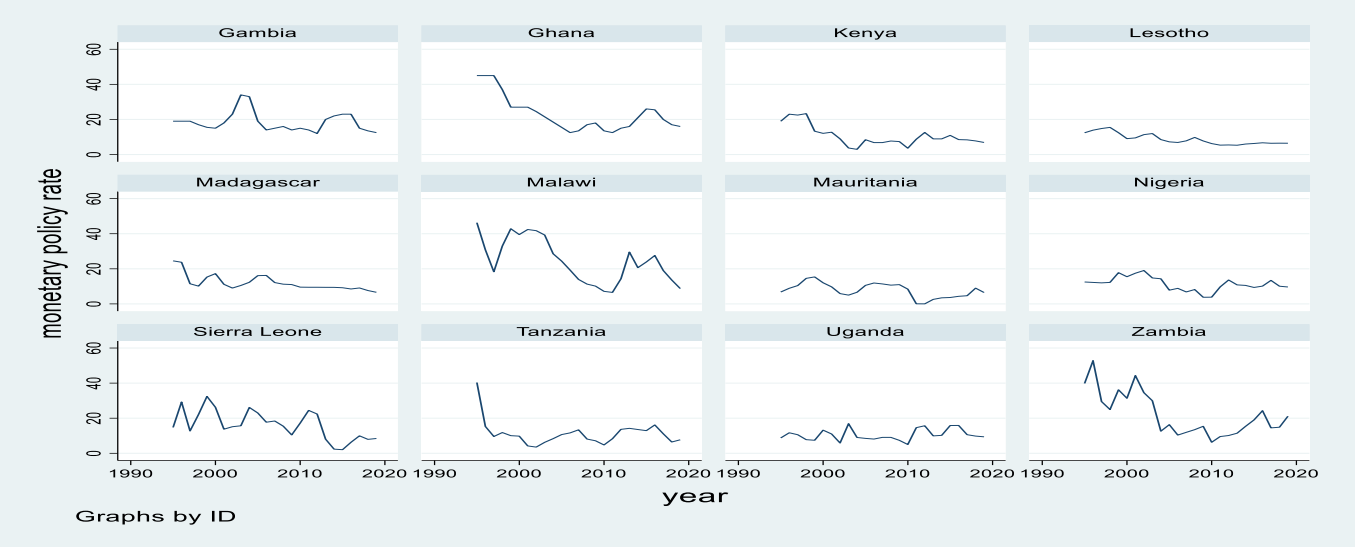

Figure 2:GDP growth for selected countries (1995-2019)

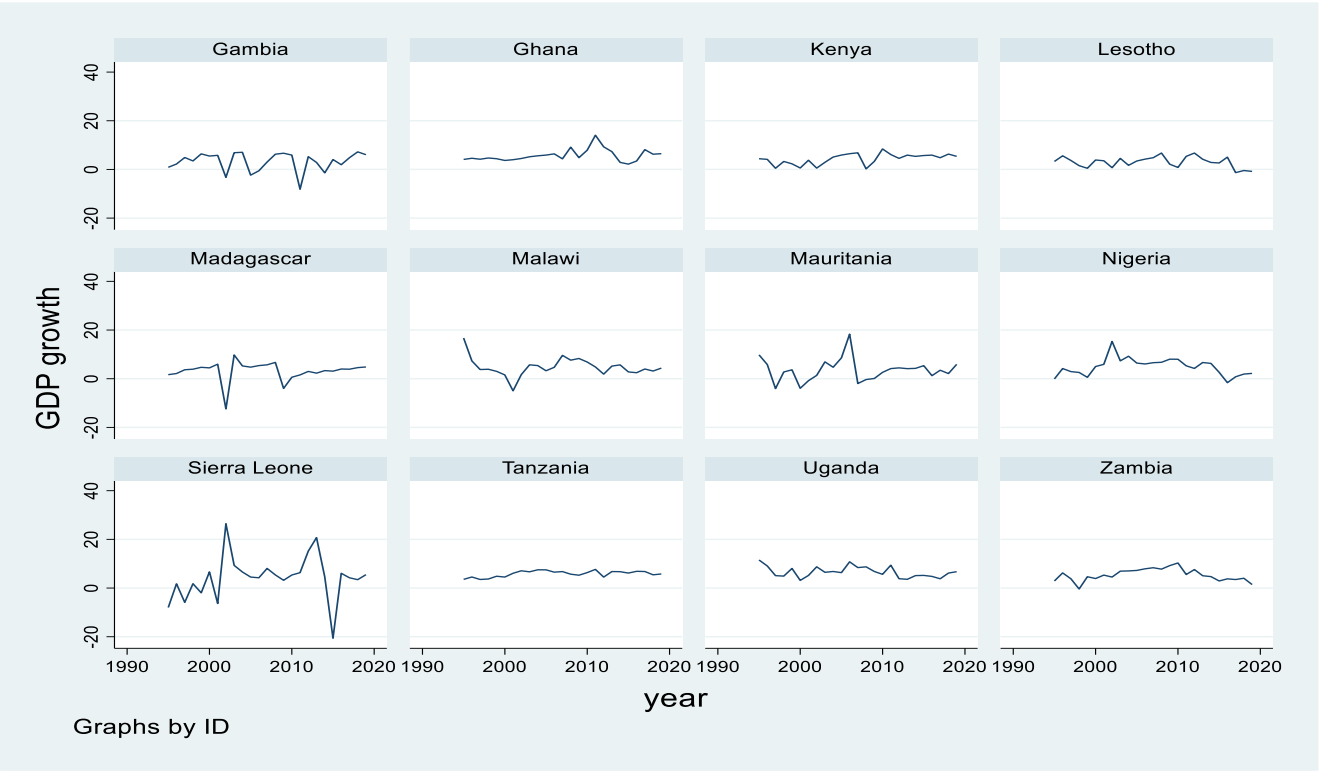

Figure 3: Inflation for selected Countries (1995-2015

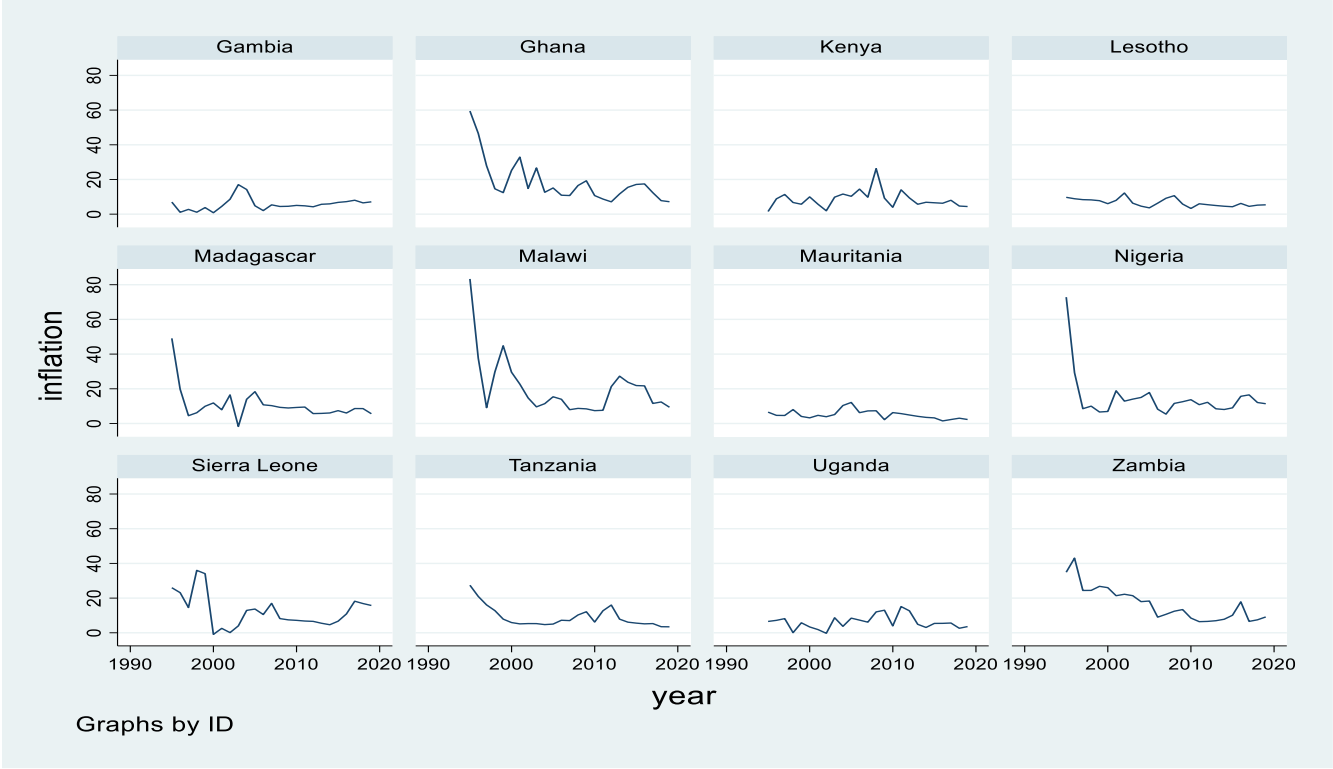

Figure 4: Foreign Reserves for selected countries (1995-2019)

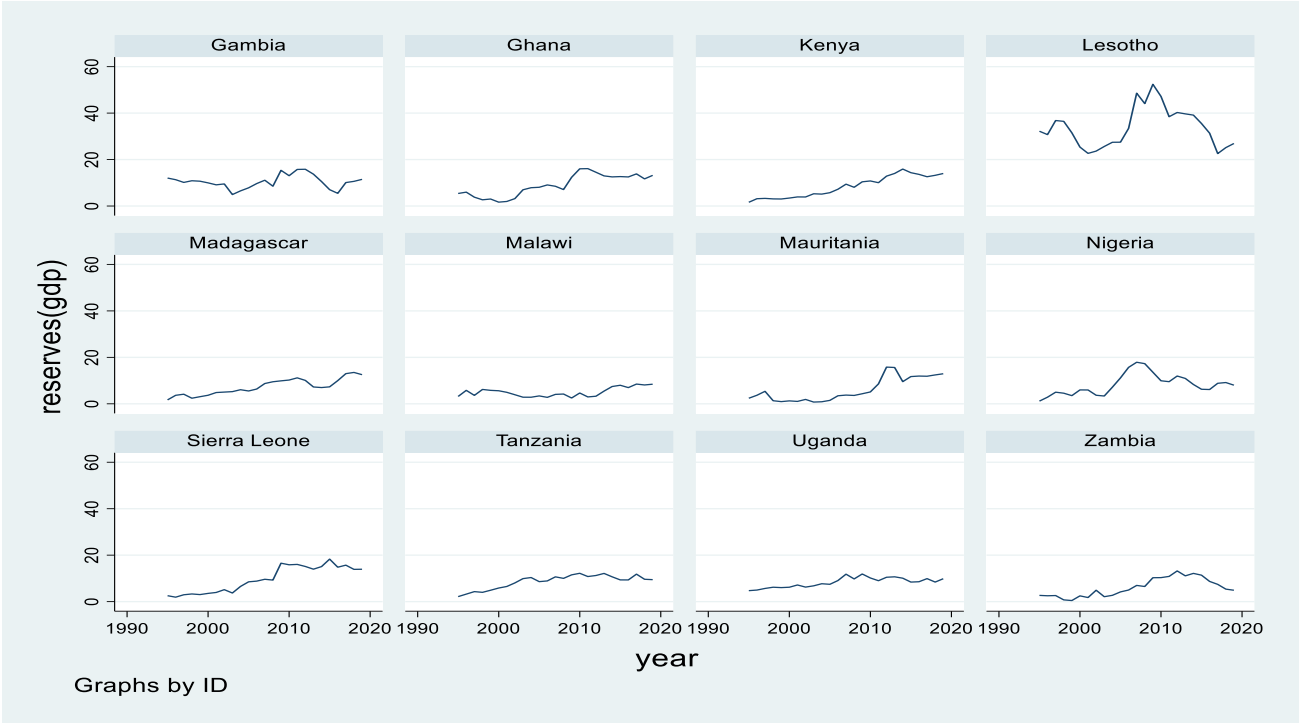

Figure 5: Proxy for Investment Portfolio Pressure (long-term external debt %GDP) :2005-2019

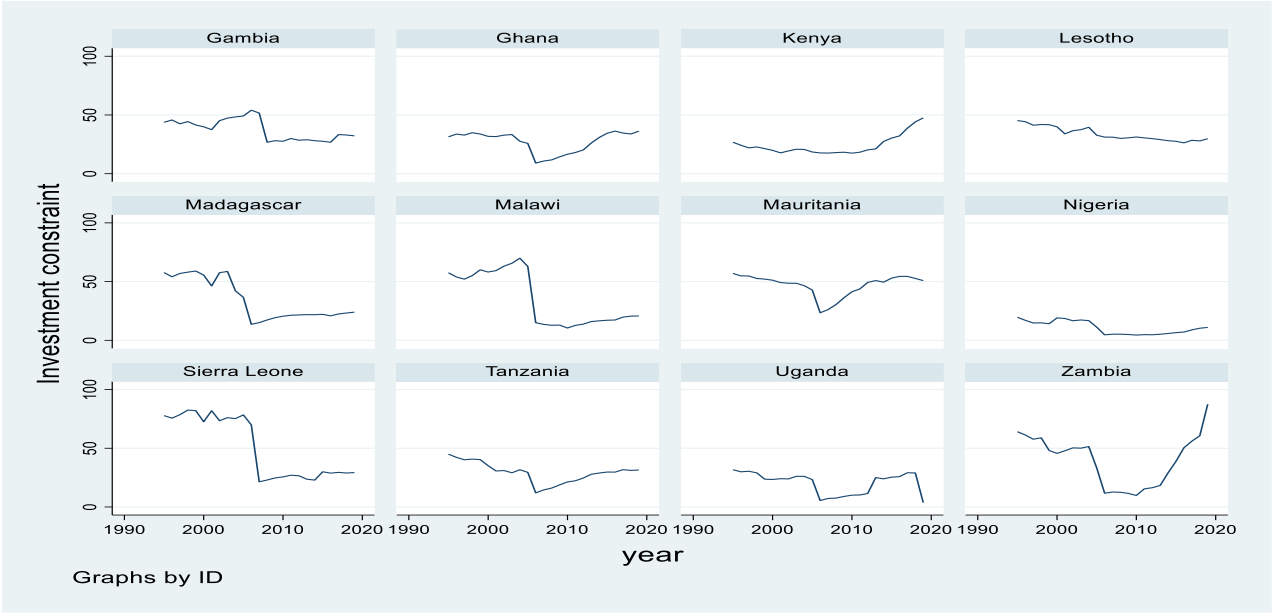

Figure 6: Proxy for Liquidity Portfolio Pressure (short-term external obligations): 2005-2019

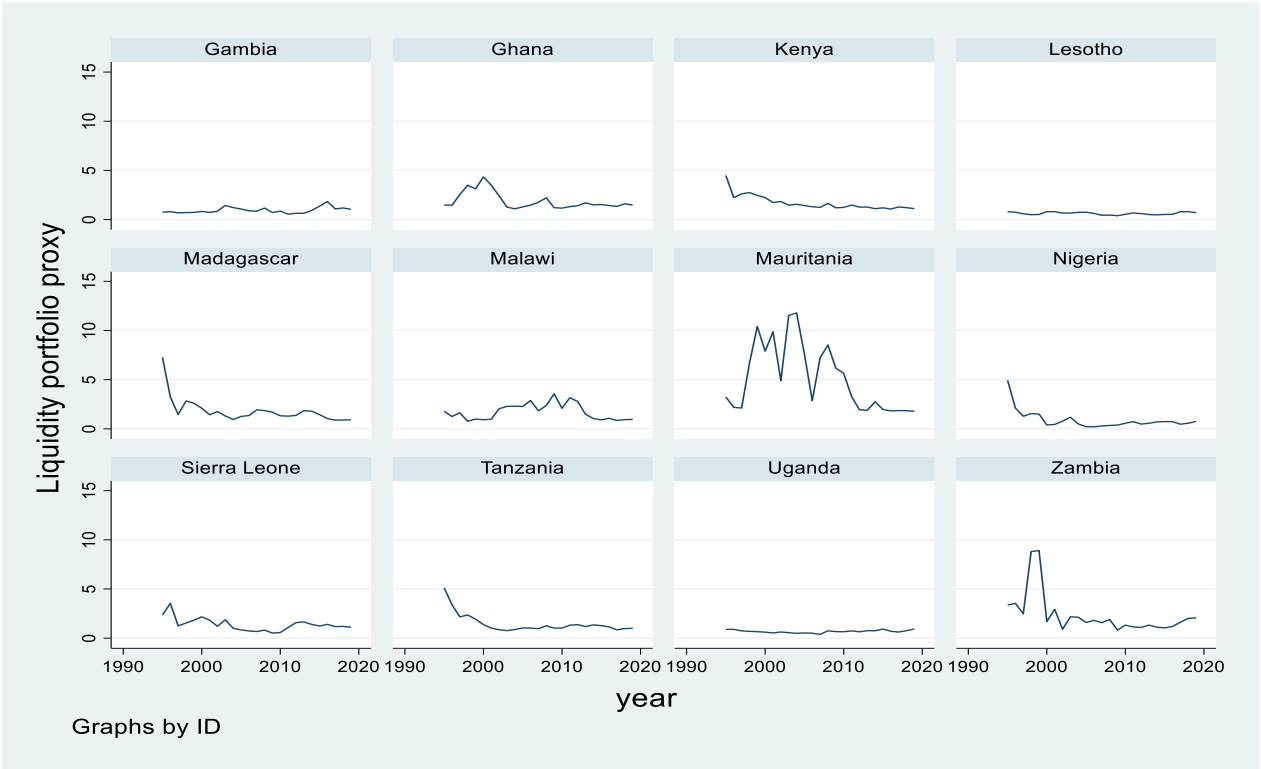

Figure 7: Yield Differential for selected countries (2015-2019).