INTERNATIONAL RESERVES, POOLING AND MACROECONOMIC STABILITY IN THE ECONOMIC COMMUNITY OF WEST AFRICAN STATES

BY

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ABSTRACT

International reserves of West African countries rose sharply by 84.3% between 1991 and 2001 and 287.1% between 2001 and 2011. However, due to high macroeconomic instability in the form of persistent asymmetric shocks, output variability and fiscal policy distortions, the reserves were inadequate and the countries in the sub-region are continually faced with the problem of balancing the costs and benefits from reserves holdings. Previous studies have paid little attention to the factors determining reserves and the prospect of reserves pooling to reduce the prevalent macroeconomic instability. This study, therefore, examined reserves determinants and the effects of a prospective reserves pooling on macroeconomic stability in the Economic Community of West African States (ECOWAS) subregion between 1981 and 2011, a period within which there was an availability of uniform time series data on the macroeconomic variables.

The buffer stock model was employed to capture the determinants of reserves (imports, external debts, government spendings, exchange rates, foreign direct investments, exports and investment) and the Optimum Currency Area (OCA) asymmetric shock framework was utilized to evaluate the impact of reserves pooling on macroeconomic stability. Data were collected from World Bank and International Monetary Fund databases. The fixed and random effects models in the panel data framework were estimated to capture the demand and supply determinants of reserves. The impulse response and variance decomposition in the domain of Panel Vector Autoregression (PVAR) were employed to estimate the impact of reserves pooling on macroeconomic stability. The PVAR estimations were undertaken in an *ex ante* counterfactual analysis and considered reserves held in an autonomous state as well as under a 60.0% pooling scheme as recommended by the West African Economic and Monetary Union (WAEMU) as the optimal pooling arrangement. Diagnostics and robustness tests (reserves optimality, PVAR stability, residual normality and cointegration tests) were carried out to ascertain the reliability of the estimates. All estimates were validated at p=0.05.

The statistically significant demand determinants of reserves in the region were imports (-0.43), external debts (-0.83), government spendings (-0.03) and exchange rates (0.94) while the supply determinants were foreign direct investments (0.09), exports (0.05) and

investment (0.02) for the Fixed Effect Model. The unbiasedness of the Random Effect Model was rejected using the Hausman test. Generalised one standard deviation innovation significantly reduced macroeconomic instability under the pooling scheme when compared to autonomous state of the individual countries as expressed in the behavioural models estimated. Percentage instability reduction from reserves pooling were external debts (22.9%), government spendings (26.8%), investments (54.8%), trade flows (56.9%), gross domestic product (58.3%) and exchange rates (60.7%). Overall, macroeconomic instability in the region was reduced by 46.7% when the countries entered into the 60.0% reserves pooling arrangement.

Adequate reserves holdings through reserves pooling arrangement insulated the economies of countries in West Africa. Therefore, monetary authorities in the region should intensify efforts towards the successful establishment of international reserves pooling.

Keywords: International reserves pooling, Fixed and random effects models, Panel vector autoregression, Macroeconomic stability, ECOWAS.

Word count: 474

DEDICATION

To God Almighty

Jehovah Jireh

The Lifter of my Head

And

In loving memory of my father

Supol. Danladi Dastu

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GLORY BE TO GOD ALMIGHTY

CERTIFICATION

We certify that this study was carried out under our supervision by Mr. Danladi, Jonathan Dastu in the Department of Economics, Faculty of the Social Sciences, University of Ibadan, Ibadan Nigeria.

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CHAPTER ONE

INTRODUCTION

1.1 General Introduction

International reserves[1] are the stocks of foreign exchange or savings acquired for international transactions between the residents of a country and the rest of the world during a given period of time.[2] The net of the receipts and expenditures of foreign exchange adds or depletes the stock of reserves depending on whether a net inflow or net outflow has occurred. Where receipts exceed expenditures, an accretion to external reserves is recorded. On the other hand, reserves are depleted when the reverse is the case.

Against the backdrop of increasing globalisation, acceleration of international capital flows and financial markets integration, the subject matter of international reserves is receiving renewed global interest among policymakers and academicians. Reserves accumulation plays a significant role as a buffer stock against external and unforeseen shocks or volatilities. This precautionary reason suggests that reserves be held by the monetary authorities to cushion external shocks that may not be easily predicted or envisaged. Having such reserves is of upmost significance as the impact of these external shocks are mitigated while remedial measures are put in place to stabilise the foreign exchange market and strengthen the external sector with some more permanent safeguard measures. Further, external obligations are often settled in foreign exchange, thus, the stock of reserves becomes very important as a source of financing external imbalances such as payment for imports and settlement of external debt. External reserves are often deployed when the market clearing exchange rate undershoots or overshoots the level

[1] Otherwise known as external reserves, foreign exchange reserves, or simply reserves (as will be used interchangeably in this study).

[2] The International Monetary Fund (IMF) (2003) defines international reserves as "consisting of official public sector foreign assets that are readily available to, and controlled by the monetary authorities, for direct financing of payment imbalances, and directly regulating the magnitude of such imbalances, through intervention in the foreign exchange markets to affect the currency exchange rate and/or for other purposes."

consistent with the attainment of the prime goal of macroeconomic stability as well as for the defense of the value of the local currency. In addition, part of the external reserves of a nation can be utilised to take advantage of high returns on investment opportunities especially when substantial and the country's portfolio of assets is well diversified. External reserves reduce a country's risks in the international market by reducing borrowing cost (Abeng, 2007). Besides, reserves can be accumulated as indirect "collateral" for guaranteeing foreign direct investment (FDI).

While reserves accumulation is desirable, there are costs associated with the holding of external reserves; these include sterilisation cost, opportunity cost and balance sheet risks (Abeng, 2007). Sterilisation cost refers to the fiscal cost, which is the difference between the returns the monetary authority earns on external reserves investment and interest payments on government borrowing. That is a fiscal cost is incurred if the rate of returns on the former is less than the cost of the latter. The opportunity cost of reserves accumulation is the foregone alternatives such as the development of infrastructure in the country or its investment in global financial markets abroad. Moreover, if external reserves create a false sense of security, it is often the case that the incentive and competency of the authorities to tackle difficult reforms and shocks may be undermined. Further, the rapid accumulation of external reserves may also lead to complications in the formulation of monetary policies especially under a flexible foreign exchange rate regime.

Most countries are usually faced with the issue of balancing these benefits and costs of reserves accumulation. One of the ways to balance these benefits and costs is through a reserves pooling arrangement among countries in the same region. Belonging to a regional reserves pooling scheme can be beneficial. It is helpful in emergencies and is expected to expand the capacity of the countries in the region to tackle any financial crisis, as well as contribute substantially to the economic stability of the region. With such a reserve pool in place, timely financial assistance can be offered any crisis-stricken economy in the pool and it will also prevent further collapse as well as spread to other economies within the pool (Fafchamps et al, 2007). In the absence of reserve pooling, countries use their reserves to self-insure themselves first against external shocks, without taking into account the effect of their actions on the welfare of their neighbours or trading partners. Notably, regional reserves pooling arrangements can internalise this externality and thereby

increase welfare for all countries involved (Ben-Bassat and Gottlieb, 1992; Jeanne and Ranciere, 2006).

Further, reserves pool can improve risk-sharing by transferring endowments across countries in advance of the production stage (Basu et al, 2010; Callen et al, 2009). As noted in Cole and Obstfeld (1991), interactions among countries through trade offer some risk-sharing properties through fluctuations in the terms of trade. The transfer of endowments can improve upon this setup by impacting on the relative output of different varieties of goods. Through this, regional reserves pooling internalises the trade externality. According to Aizenman and Lee (2006), regional reserves pooling can serve as a commitment device that can help prevent the negative externalities that exist in an environment where countries are engaged in a game of competitive devaluation. In addition, the pooling of reserves improves the diversification of idiosyncratic country endowment risk. The benefits of diversification are greater when the trade externality is internalised within a regional pool (Basu et al, 2010).

Apparently, there are costs associated with a country participating in the pooling of reserves with other members of its region. These costs include the following: first, the loss of independent monetary policy; in this regard, it can be recalled that it was earlier stated that external reserves are often deployed when the market clearing exchange rate undershoots or overshoots the level consistent with the attainment of the prime goal of macroeconomic stability. Reserves are often used for the defense of the value of the local currency. This suggests that foreign reserve is a potent tool in the hands of the monetary authorities of any economy. Thus, if a country does not have access to its own reserves, having ceded same to a union, the country becomes impotent and dependent on the monetary policy coming from the central monetary authority of a union she belongs to. Also, the economy loses seigniorage, a source of revenue to the government (Ricci, 2008; Abeng, 2007).

Second, asymmetric shocks - which encapsulate exchange rate variability, output variability, terms of trade as well as variation in consumer price index (CPI). The cost of pooling increases significantly within a group of countries in a region when they face these shocks asymmetrically. Third, fiscal policy distortions - a country belonging to a

pool becomes "responsible" for the management of the economy of other members. When a member is faced with any macroeconomic perturbation beyond its control, other members in the union are obliged to provide support and bail the ailing economy to reduce the risks of spread of the "ailment" to other members in the pool. Therefore, the pattern and size of income/revenue as well as spending of (potential) members becomes an issue of serious consideration (Masson and Pattilo, 2001; Oyejide, 2012). From the foregoing, it becomes obvious that countries belonging to a region can enter into a reserves pooling arrangement to increase resource availability and enhance their overall macroeconomic stability.

1.2 The Problem Statement

Foreign reserves accumulation has become prominent over the recent years in the Economic Community of West African States (ECOWAS) especially in this period of monetary integration and single currency contemplation for macroeconomic stability. The region has been facing macroeconomic instabilities of varying degrees. This is mainly due to the fact that the international reserves held by the individual countries in the region are not adequate to bring about the much-needed stabilisation. Reserves are held as stabilisation tool by economies in the sense that reserves are used as buffer stock, to settle external obligations such as imports and external debts as well as intervention in the foreign exchange market. If there are no reserves, the ability of the monetary authorities to cushion the adverse effects of external shocks will be seriously undermined. In the absence of reserves, countries will find it increasingly difficult to settle their international obligations such as payment for imports and debts. It is a fact that most countries in ECOWAS are import-dependent and laden with high debt burdens. Instability and uncertainty prevail in the foreign exchange market of most countries in the region especially in the West African Monetary Zone (WAMZ), though the West African Economic and Monetary Union (WAEMU) subregion has achieved some level of stability in the foreign exchange front due mainly to the operation of a fixed exchange rate.

With regards to macroeconomic instabilities in the region, specific country analysis shows that the Gambian economy is relatively weak and vulnerable to external shocks due to the volatile nature of its major sources of growth; groundnut export and tourism. Ghanaian

economy is characterised by vulnerable terms of trade shocks as exports performance of the economy largely depends on cocoa exports and gold, subject to frequent environmental and global market challenges. In Guinea, the issue of macroeconomic instability is not different as a weak agricultural base characterises the economy. The economy depends largely on mining and also on foreign aid. External grant-GDP ratio in Guinea is one of the highest in the subregion.

In Nigeria, following the period of negative growth in the early 1980s the country adopted the Structural Adjustment Programme (SAP) in order to stabilise the economy. The major source of macroeconomic instability arises due to the frequent fluctuation in the prices of crude oil. This is the mainstay of the Nigerian economy following the neglect of the agricultural sector in the 1970s. Macroeconomic stability in Sierra Leone remains fragile due to both internal and external factors. The growth of the economy has been greatly hampered by the civil war and political crises in 1991 that lasted for about a decade. During the economic recession, there was no credible economic and monetary policy instrument designed to tackle its negative impact. Civil unrest and instability also characterised the Liberian economy. Macroeconomic instability equally persists in the WAEMU subregion. Meanwhile, the region has attained some relative stability due to the fact that the countries have been operating under the Communatd Financiere Africaine (CFA) for a long time. The presumption is that negative impact of macroeconomic instabilities in the subregion would be substantially reduced if these countries have ample stockpile of international reserves. However, this is not usually attainable due to the competing demand for the reserves accumulated by these countries individually - thus the desirability of a reserve pool.

There is an ongoing debate as to why a government through the monetary authority accumulates large stock of external reserves in the midst of inadequate infrastructure, poverty, unemployment, inequality and various economic hardships especially in developing economies. This fact is vividly captured in the words of President Abdoulaye Wade of Senegal (2000-2012) about the reserves of the Francophone West Africa: “the African people’s money stacked in France must be returned to Africa in order to benefit the economies of the BCEAO (Banque Centrale des Etats de l’Afrique de l’Ouest) member states. One cannot have billions and billions placed in foreign stock markets and

at the same time say that one is poor, and then go beg for money". This issue is of a complex nature, especially in the West African context, given that the trade-off between external reserves accumulation and the de-accumulation of same is equally of a complicated nature too.

Although it is desirable that external reserves be depleted and be injected into the economies to develop and maintain infrastructure, eradicate poverty, create employment, and reduce general economic hardships of the populace, it should be borne in mind that a 'large' stockpile of external reserves could to be highly volatile and extremely unsustainable sources. These sources are subject of frequent boom and burst in the international prices of primary products in the case of most of the countries in the zone and crude oil prices in the case of Nigeria.[3] The prices of these products are often at the mercy of international price volatilities, which can fall sharply any time, as it is the case and experience during the economic meltdown era. This can lead to macroeconomic complications not envisaged ab initio by these economies. This was the case and experience of most emerging Asian economies in the 1990s. Thus, quickly depleting external reserves stocks (especially if it is largely to address domestic issues) may not be an optimal option after all, as foreign reserves are supposed to be assets or insurance held against the volatile and uncertain future course of making balance of payments and other global and unpredictable international transactions.

The puzzle here therefore is that most economies are in dilemma of whether to continue to accumulate reserves for precautionary purposes (to serves as buffer stock against unforeseen international macroeconomic shocks) or deplete their reserves (to finance government purchases and meet several other demands and be at risk of any shock, instability and vulnerability that may come internally or externally). This problem raises some pertinent questions that include the following: is there any way in which the liquidity yields from holding external reserves can be preserved and guaranteed among the group of countries in the region without the need for the individual countries to continually accumulate them thereby exposing their economies to external and internal macroeconomic perturbations? Put differently, can they pool their external reserves and

[3] Crude oil export, for instance, accounts for more than 90% of Nigeria's revenue.

reap the benefits of scale economies in the face of the above dilemma? What are the determinants of international reserves in the region? Would external reserves pooling arrangement bring about the much anticipated macroeconomic stability in the region? This thesis seeks to answer these questions.

1.3 Objectives of the Study

The broad objective of this study is to determine the relationship between reserves pooling and macroeconomic stability in the ECOWAS region. The specific objectives of the study are to:

a. Estimate the international reserves supply and demand determinants for the region;

b. Evaluate the potential impact of reserves pooling on macroeconomic stability in the region.

1.4 Justification for the Study

There is relative paucity of evidence in the literature on reserves pooling for the ECOWAS subregion; particularly covering a rigorous empirical study that attempts to evaluate the demand and supply determinants of international reserves and examine the impact of a reserves pooling arrangement. The review of relevant literature on the determinants of reserves reveals that most of the studies in this area are largely country-specific thereby requiring country-specific methodologies and analysis while other panel analyses are done for other regions of the world, not the West African subregion, as in Elhiraika and Ndikumana (2007), Drummond and Dhasmana (2008), Gosselin and Parent (2005), Nda (2006), Okorie (2007), Shamsuddeen (2005), Abeng (2007), Obaseki (2007), Egwaikhide (1999).

Most of these studies have attempted to examine foreign reserves accumulation with some identifiable implications for economic growth. However, they are inadequate in terms of sound theoretical backbone and empirics. Thus, a study that would provide adequate theoretical framework for understanding and empirically investigate the determinants of international reserves in the region becomes paramount.

The ECOWAS region has been bedeviled by the prevalence of macroeconomic instability and this study envisages that a reserve pooling arrangement may largely address this problem. One of the objectives of this study is to determine the impact of a reserve pooling arrangement on macroeconomic stability in the region. To the best of the researcher's knowledge, the stability of fundamental macroeconomic variables arising from a possible reserve pooling arrangement has not been accounted for and properly examined by previous studies. Thus, an important contribution of this study stems from the evaluation and analysis of the impact of a reserve pool on macroeconomic stability.

In the area of macroeconomic shocks and stability, the concentration has been on the wider subject matter of monetary integration and testing for other viable options for a single currency for the region (Bayoumi and Ostry, 1997; Masson and Patillo, 2001; 2004; Ogunkola, 2005; Ogunkola and Jerome, 2005; Nnanna et al, 2007; WAMI, 2008; Okafor, 2011). This study addresses the viability of the monetary union through the core subject of reserves pooling by examining whether countries can gain from a pooling arrangement and whether this can reduce macroeconomic shocks and enhance macroeconomic stability in the region. Thus, a study that would provide adequate basis for understanding and empirically investigating the relationship between international reserves and macroeconomic stability for the subregion under a pooling and non-pooling arrangement may be crucial to the region. The expected findings of this study will be useful for policy formulation and implementation to the monetary authorities that manage the external reserves of the countries in the sub-region.

In the light of the foregoing, this study aims at extending the frontier of knowledge in terms of methodological and empirical contributions to the reserves (pooling) literature as little evidence exists on the potential impact of a possible reserves pooling for the ECOWAS region, especially in the face of increasing contemporary speculations for an optimum currency area (OCA). In addition, the tools of analysis employed, findings and recommendations that emerge from the study are expected to enlighten and stimulate other researchers to further studies.

1.5 Scope of the Study

The focus of this study is on international reserves pooling and macroeconomic stability in the ECOWAS subregion. The countries that make up the ECOWAS are: Benin, Burkina Faso, Cape Verde, Cote d'Ivoire, The Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone and Togo. In general, the scope of this study spans from 1981 to 2011. The choice of the period is largely informed by the availability of uniform time series data on the variables of interest.

CHAPTER TWO

RESERVES MANAGEMENT AND ECONOMIC PERFORMANCE IN THE ECOWAS

2.1 Historical and Contemporary Issues in Reserves Pooling in the ECOWAS

This section provides a historical and contemporary overview of issues with respect to reserves management and pooling in the West African subregion. The exposition covers the arrangements as they were in the Francophone and Anglophone regional subdivisions.

2.1.1 Francophone Historical Arrangement (1900-1980)

The creation, maintenance and pooling of reserves in the Francophone African economies are the products of a long period of French colonialism and the learned dependence of the African states. According to Busch (2009), limited powers are allocated to the central banks of most Francophone African countries. There can be no trade policy without reference to currency; and investment without reference to reserves. Fiscal and monetary policies as well as reforms for the promotion of economic growth and trade are irrelevant except with the consent of the French Treasury that rations their funds and guarantees their convertibility. This system of dependence is a direct result of the colonial policies of the French government.

According to Hogendorn and Gemery (1988), the sole bank of issue for French West Africa was founded in 1901. It was called the Banque de l'Afrique Occidentale (BAO). The currency circulated by the Bank, Franc, was at par with the French Franc until 1945 at which time; the CFA (Colonies Francaises d'Afrique, later Communautd Financiere Africaine) Franc was established. In the immediate post-war period after the signing of the

Bretton Woods Agreement in July 1944, the French economy urgently needed to recover from the several disasters of the Second World War.[4]

Following the devaluation of the French Franc, it was naturally expected that the currency, which was also circulating in Francophone Africa, would also be devalued. Instead, France decided to create a new currency for its African colonies on 26 December 1945. The newly created CFA was however not devalued but overvalued. In deciding to overvalue the new currency, the CFA zone economies were effectively excluded from the international market as their products became too expensive on the competitive global market. There remained only one market for the CFA zone, and that was France their colonial master. This enabled Metropolitan France to appropriate to itself the raw materials needed for its post-war and young industries. The colonies were tied hand and foot to serve metropolitan France as other markets closed their doors to their expensive products. Thus through the new CFA currency, France economically re-colonise its African colonies that had earlier been cut off from Paris as a result of the War.

The French allowed the independence of its colonies but at the price of a strict continuing control over their economies after Sekou Toure's of Guinea voted "no" in the 1958 referendum to create a Franco-African Community that stopped short of total independence. Soon after, they agreed at independence to be bound by the “Pacte Colonial”. The result of which was an agreement signed between France and its newly-liberated African colonies which locked these colonies into the economic and military embrace of France. This Colonial Pact is the genesis of the institution of the CFA franc and the Franc zone. This pact also created a legal mechanism under which France obtained a special place in the political and economic life of its colonies. The pact also maintained the French control over the economies of the African states as well as it took possession of their foreign currency reserves (Busch, 2009).

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[4] To assist in this process, it set up the first CFA amongst its African colonies to guarantee a captive market for its goods. Also, France needed the currencies of its colonies to support its competitiveness with its American and British competitors.

Under the CFA zone, there are two prominent monetary unions: The West African CFA zone, known as WAEMU or UEMOA which comprises of Benin, Burkina Faso, Côte d'Ivoire, Guinea Bissau, Mali, Niger, Senegal and Togo and the Central African CFA zone[5], comprises Cameroon, Central African Republic, Chad, Equatorial Guinea, Gabon, and the Republic of the Congo.[6] The WAEMU and CAEMC zones each have a common central bank: Banque Centrale des Etats de I'Afrique de l'Ouest (BCEAO) and Banque des Etats de l'Afrique Centrale (BEAC), respectively. WAEMU has a common pool of reserves which under an agreement are kept with and managed by the French Treasury (Ebi, 2002). Figure 2.1 shows the total reserves of the WAEMU countries and the change in reserves within the period. A careful look shows that the reserves fluctuate significantly with the lowest in 1977 where reserves fell from $725.1 million to $445.1 million, representing a deficit amounting to $280 million.

The WAEMU CFA franc was originally pegged at 100 CFA for each French franc but, after France joined the European Community, Euro zone, at a fixed rate of 6.65957 French francs to one Euro, the CFA rate to the Euro was fixed at CFA 665,957 to each Euro, maintaining the 100 to 1 ratio. It is important to note that it is the responsibility of the French Treasury to guarantee the convertibility of the CFA to the Euro. The monetary policy governing such a diverse aggregation of countries is uncomplicated because the French Treasury in fact, operates it, without reference to the central fiscal authorities of any of the WAEMU states.

[5] known as CAEMC

[6] They operate almost identically

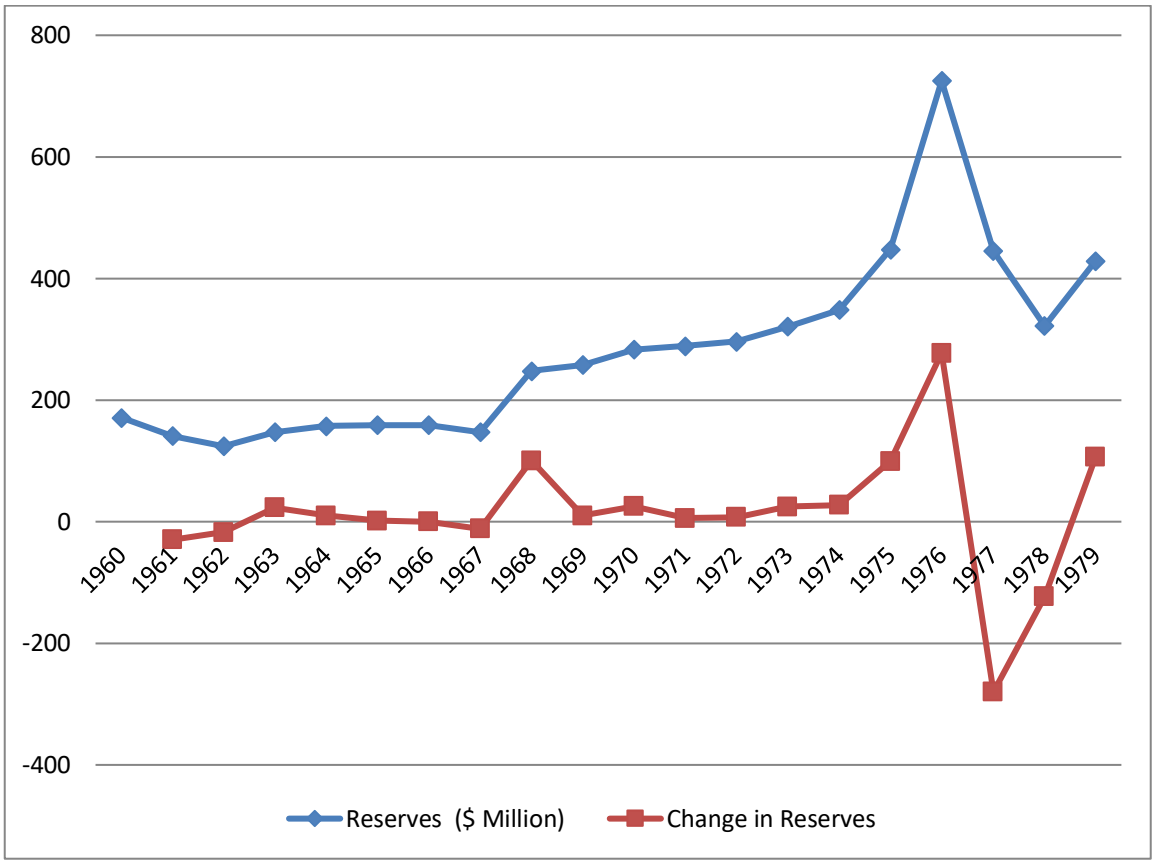

Figure 2.1. WAEMU Total Reserves and Change in Reserves (1960-1980)

Source: Author's Computation, WDI (2011)

Under the terms of the agreement which set up these banks and the CFA, the Central Bank of each African country is obliged to keep at least 65% of its foreign exchange reserves in an operations account (or compte dâ operation) held at the French Treasury, as well as another 20% to cover financial liabilities.

The CFA central banks also impose a cap on credit extended to each member country equivalent to 20% of that country public revenue in the preceding year. Even though the BCEAO has an overdraft facility with the French Treasury, the draw-downs on that overdraft facility are subject to the consent of the French Treasury. The final say is that of the French Treasury which has invested the foreign reserves of the African countries in its own name on the Paris Bourse. The central banks of these two zones: the BCEAO for WAEMU and the BEAC for CEMAC have supranational status.[7]

This fixed exchange rate regime draws its credibility from monetary agreements with France, via the Treasury, that guarantees the convertibility of the CFA franc and provide the central banks an overdraft facility (compte dâ operation) to meet liquidity needs. The reserves must amount at least to 20% of central bank short-term liabilities. If the reserves are below this level (or if the compte dâ operation is in debit) for more than one quarter, the central banks must take corrective measures (interest rate increases, credit rationing, and seizure of foreign exchange available in the zone).[8]

The two CFA banks are African, but have no monetary policies of their own. The countries themselves do not know, nor are they told, how much of the pool of foreign reserves held by the French Treasury belongs to them as a group or individually. The earnings on the investment of these funds in the French Treasury are supposed to be added

[7] For each zone, the reserves of member states are pooled; members have no independent monetary policy and no possibility of undermining the central bank's independence or monetising public deficits.

[8] More than 80% of the foreign reserves of these African countries are deposited in the operations accounts controlled by the French Treasury.

to the pool but no accounting is given to either the banks or the countries of the details of any such changes. The limited group of high officials in the French Treasury, who have knowledge of the amounts in the operations accounts where these funds are invested, whether there is a profit on these investments, are prohibited from disclosing any of this information to the CFA banks or the central banks of the African states. Therefore, at all times, no decision can be approved to be valid at the BEACO without the French. France is, therefore, in a position to block any major decisions taken by these banks. So if a decision by any of the countries within the zones does not favour and tally with French interests, the French administrators have the power to block it (Busch, 2009). The way these central banks function, therefore, legalise and perpetuate the direct intervention of France in the CFA zone economies. Even the appointment of the governor of the BEACO, must be approved by Paris which seeks to ensure that the governor is malleable and ready to dance to French tunes. This makes it impossible for these Francophone West African members to regulate their own monetary policies. The most inefficient and wasteful countries are able to use the foreign reserves of the more prudent countries without any meaningful intervention by the wealthier and more successful countries (Busch 2009).

2.1.2 Francophone Contemporary Arrangement (1980 – present)

With the signing of a new UMOA treaty in 1973, a new cooperation agreement and a new operational account convention with France were put in place. A new administrative structure was put in place, which includes the appointment of Adoulaye Fadiga as the first African governor of the BCEAO as well as the transfer of the headquarters of the BCEAO from France to Dakar, Senegal. In line with its mission, the BCEAO decides on an annual basis the total amount of currency to be allocated to each member country. In order to do this, it takes into account movements in production prices, the monetary situation, and the state of each country's balance of payments as well as the other objectives that had been set by the UEMOA council of ministers as regards external assets and liabilities held by the union and by each member state (Fajana, 2011). In 1994, with the devaluation of the CFA Franc, the Union became the West African Economic and Monetary Union

WAEMU or UEMOA (in French). Nothing much has changed over time in the WAEMU especially in term of operational issues.[9]

The role of the BCEAO in the contemporary setting has not changed much over the years compared to the early years. Its major function in the contemporary setting includes serving as the bank where the pooled reserves of the zone are deposited. The reserves were held in the operations account at the French Treasury. Subsequently, there was an amendment to this practice which made it possible for BCEAO to invest part of its foreign exchange reserves in certain types of negotiable bonds, which matured within two years and was issued by international financial institutions of which all BCEAO states were members. After the amendment, member states were investing part of their foreign reserves in short term bonds which was issued by the World Bank. Also, the BCEAO still performs some credit creation functions within the framework of rediscount ceilings, which are the principal means used to extend both short term and medium term credit.[10] Short term credit was granted was by the BCEAO for periods not exceeding six months but could be extended for an additional five months for financing public contracts while medium term credits were granted for periods not exceeding five years (Fajana, 2011).

Figure 2.2 shows the reserves of the WAEMU in the contemporary era as well as the change in the reserves for the period 1981 to 2012. It can be observed that the reserves maintained a steady rise through to the end of the period. The only observable fluctuation in the trend of the reserves of the WAEMU is seen around the period of the global and financial crisis witnessed around the late 2000s.

According to William, Polius and Hazel (2001), the institutional framework in the CFA franc zone makes it possible for member states to use pooled reserves in counterpart of local currency. Within these arrangements, fiscal imbalances of member countries, unless

[9] The French Treasury guaranteed the convertibility of the CFA Franc.

[10] Short term credit was extended in the form of rediscount of short term paper and temporary advances against private and government paper as well as direct advances secured by either gold or foreign exchange and securities acceptable to BCEAO.

funded by other members within the pool, can result in a decline in the foreign assets of the respective central banks. Each central bank is obliged to maintain 65% of its official reserves in the operations account as a counterpart to the guarantee of the French treasury. For the usage of the reserves, each country draws down its own account of pooled and unpooled reserves in the first instance and then may use other country's pooled reserves once these are fully drawn down as there is no statutory limit on a member country's use of another's reserves. When the reserves of an individual country are exhausted, an alarm is not raised at this instance since that country can still benefit from the pooled reserves of other countries but an alarm is raised and a crisis management scheme takes over when the BCEAO reserves fall below the prescribed threshold.

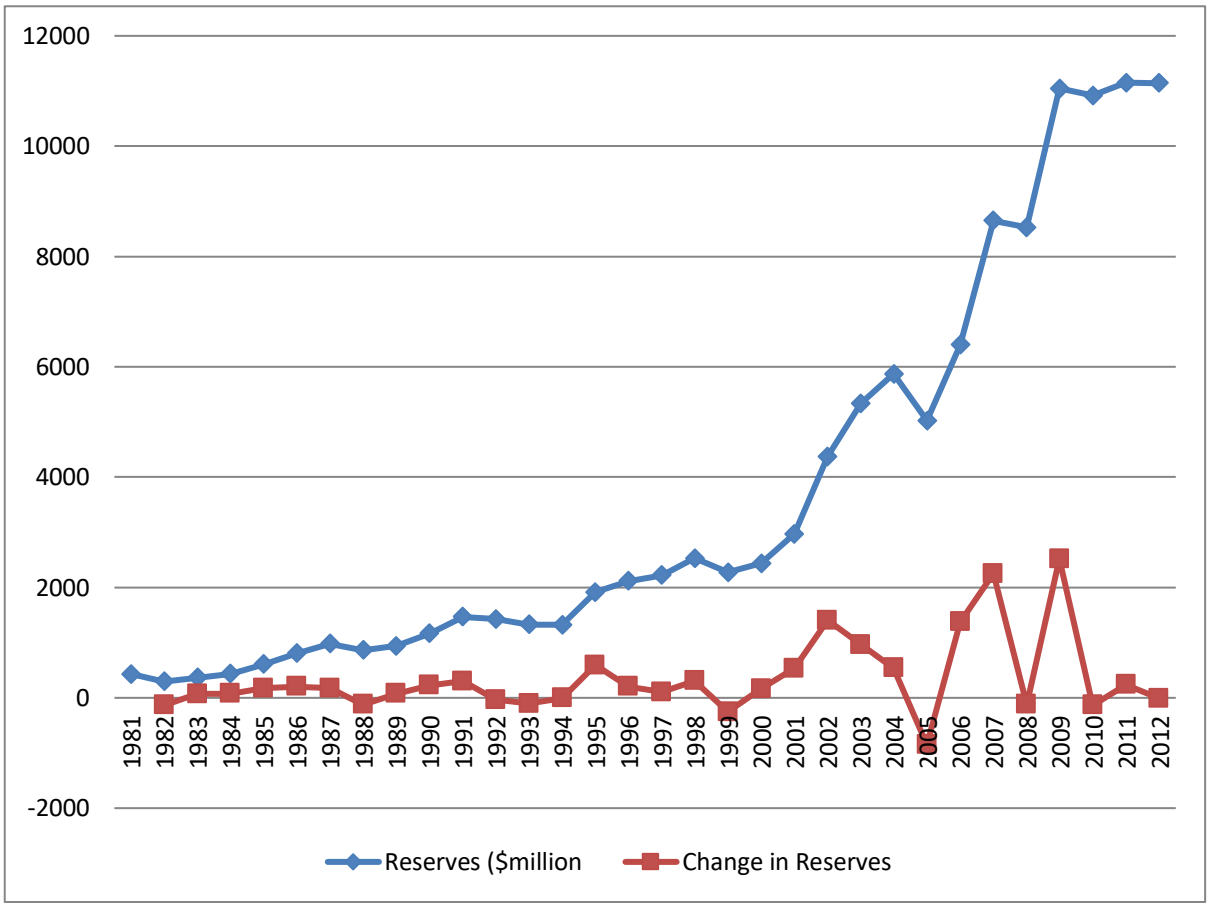

Figure 2.2. WAEMU Total Reserves and Change in Reserves (1981-2012)

Source: Author's Computation, WDI (2011)

Two institutional factors contribute to some members in the CFA franc zone using more resources from the pool than they contribute. First, the French treasury's guarantee of the central banks' operations account relieves them of having to monitor their reserves position and credit creation using the fiscal borrowing and sight liabilities rules. Second, the fact that each country has unrestricted access to the pooled reserves of other members makes governments more inclined to monetize budget deficits. Countries are also less inclined to monitor their balance of payments situation. This feature of the arrangement is one of the institutional problems in the formation of clubs that attempts to mitigate the costs of bargaining among members. In essence, it allows for an upper and lower limit within which bargaining in the form of access to the common pool of reserves can occur.

According to Fajana (2012), by contemporary definition, the UEMOA can be seen as a complete monetary union. Not only is there complete pooling of monetary reserves and the issuing of a common currency among the participating countries, there is also a substantial integration of their financial markets and obstacles to internal payments and transfers are removed. Furthermore, UEMOA through the operations of BCEAO facilitates the coordination of other economic policies of its members with regard to trade and economic development in general. The French Treasury guarantees the reserve pool available in the CFA franc zone. This ensures a degree of credibility of the regional financing facilities.

2.1.3 Anglophone Historical Arrangement (1900 – 1980)

The role of international reserves became prominent in the colonial monetary system in British West Africa when the West African Currency Board (WACB) was established in 1912. According to Hopkins (1970), the Board presided over a monetary system, which was effectively an extension of that of the British system. The currency of the colonies was visually distinct and was backed by its own reserves, but it was held at parity with and was readily convertible into the currency of the ruling power, the British Sterling.

The currency boards served three main purposes: the issue of local currency, the maintenance of its convertibility into sterling at a known rate of exchange, and the provision of some revenue to the colonial governments, through their shares in the profits

from the coinage, and from the investment of the Board's assets (Abdel-Salam, 1970).The currency board was more of large-scale money changing centre, also overseeing the reserves of the colonial British West Africa, investing the reserves of the colonial currency as well as the distribution of the profits derived from these investments and the seigniorage on coins issued for the British West Africa. It can be seen that the role of the Board in terms of reserves pooling was not pronounced when compared to the Francophone zone.[11].

Hogendorn and Gemery (1988) observe that the currency notes and coins issues of the WACB were also made against exports. The Board issued its coins and currency at Accra, Bathurst, Freetown, and Lagos, against the exact equivalent in sterling lodged with the Board in London. However, WACB notes and coins were convertible into sterling on payment of a service charge. The convertibility was guaranteed only on presentation at the West African centres, with the payment of sterling made in London. It was the annual export of produce that in effect provided the wherewithal for the new West African coins and currency. Only when exports exceeded commodity imports (plus or minus any capital transactions in the balance of payments) would there be earnings of sterling or other currency convertible into sterling that could be lodged with the WACB as a backing for the West African notes and coins issues.

The sterling acquired as a reserve was invested mainly in UK national and local government bonds and securities; in practice the WACB did not buy the bonds or securities of its constituent territories. The result was such that the reserves of the currency board were largely unavailable for development purposes in the area where the original saving had been made to acquire the new transactions balances. The amount of currency issued was substantial; £10 million was reached in 1923, £15 million in 1928, just under £20 million in 1937, £25 million in 1944, £40 million in 1947, and £67 million only two years later in 1949. Against these sums the Board's reserves, held in sterling balances were

[11] Criticisms levelled against the currency board system were being operationally rigid and institutionally limited

invested in the UK. The result was a loss to West Africa of most of the seigniorage on the issue of currency.[12]

Reasons for the marginal return included the following: first, the investments were largely short and medium term, with interest rates lower than on long-term bonds. For instance, 44% of the WACB's invested reserves carried maturities of less than 5 years in 1950; 75% had maturities less than 10 years; second, no payout of interest was made to the constituent territories unless reserves were at or above the target figure of 110%. Third, the Board covered its operating costs, including the printings of paper notes, the minting of coin, transport, distribution, and administrative expenditures from the interest earned on reserves. At 19% of interest income in 1950 (and 86% of that due to the manufacturing costs of currency) these costs were not negligible. These operating costs were not, however, excessive and would have had to be met in any case by any substitute system. It was for the first two reasons, primarily, that interest returns were a weighted average of only 1.22%between 1923 and 1950, at a time when the average yield on British consoles was nearly three times higher at 3.60% (Hogendorn and Gemery, 1988).

Figure 2.3 shows WACB reserves and the annual change in reserves without subtraction for expenses. Thus, during this period only a small fraction of the available seigniorage was transferred back to the colonial territories as interest income on the invested reserves. The seigniorage losses to West Africa involved with the WACB currency were thus in concept closely akin to those involved with the earlier West African moneys, in that they all represented full-bodied currencies with a pound-for-pound outlay of exports equal in value (or even greater considering the WACB's 110% reserves) to the entire value of the money supply. With the pre-colonial moneys, the outlay closely matched real resource costs including transport in the production and delivery of the currency. With the colonial notes and coins, the outlay was a transfer to the colonial power of the seigniorage involved in the money issue.

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[12] This loss was in part offset by the distributions to the colonial governments of interest on the invested reserves, which was very small.

The colonial monetary system was not without its advantages. It assisted the development of trade between West Africa and the United Kingdom, while at the same time relieving the mother country of all responsibilities towards the currency of the colonies. The currency board system gave stability and confidence to the colonial currency by linking it with the Sterling; it practically eliminated the risk of inflation by providing strict control over the currency issue. It also corrected any tendency towards the accumulation of deficits in the balance of payments by ensuring that the local currency and sterling were automatically convertible, provided some additional revenue that had not been available to the colonies before 1912. However, the major drawback associated with the colonial monetary system was that it tended to impede structural economic change since additional domestic trade could only be financed when the balance of payments was favourable.

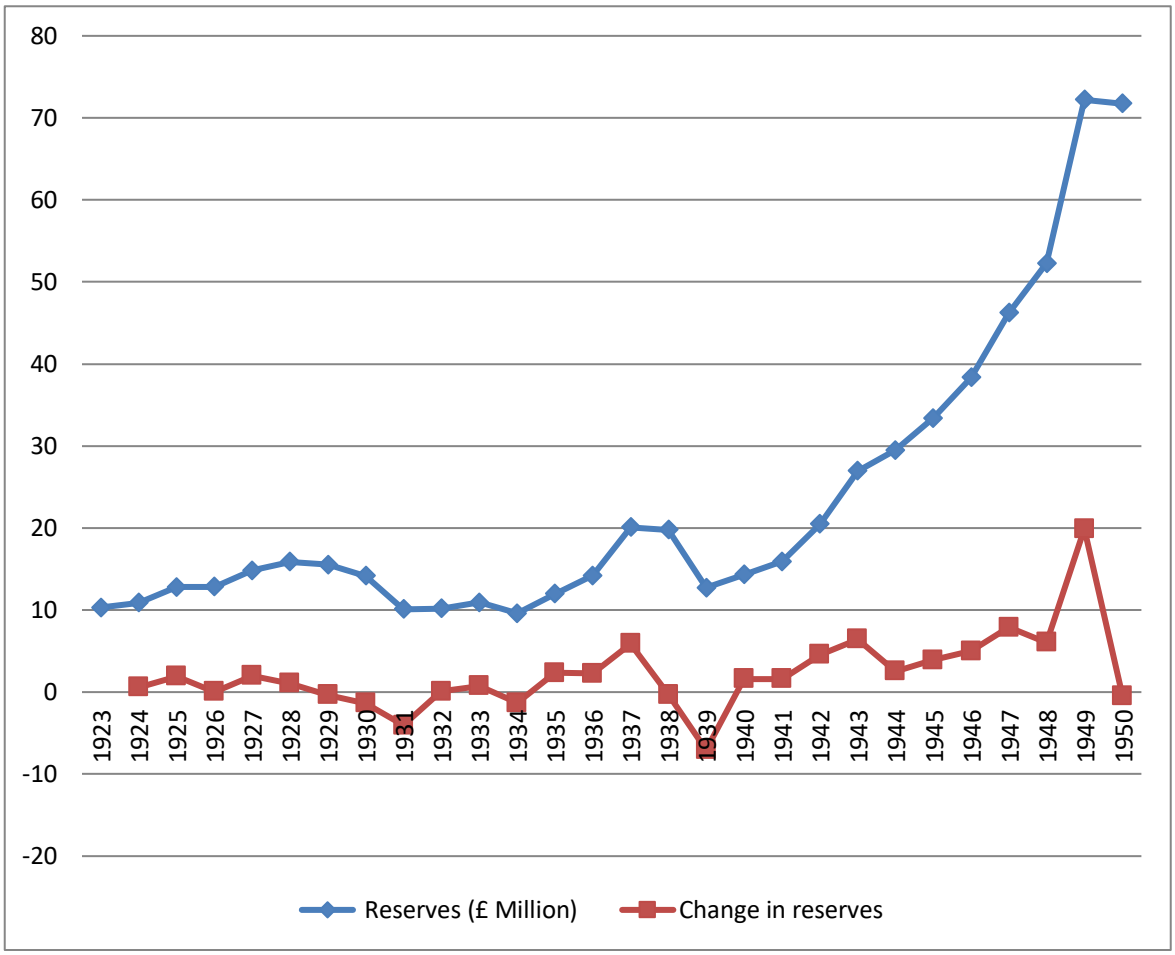


Figure 2.3. Non-WAEMU Reserves and Change in Reserves (1923-1950)

Source: Hogendorn and Gemery (1988)

With the attainment of political independence, each of the former British West African colonies opted to establish their own monetary system managed by a central bank. The WACB inevitably became redundant (Hopkins 1973).From the foregoing exposition, the functions of the currency board were more of issuance of the local currency and money changing activities. Reserves pooling in the WACB area of West Africa was in the form of sterling balances which constituted a net loan to Britain from Africa (that is Britain guaranteeing convertibility of reserves).[13] That being the case, it was preferable to invest in securities with higher yields, which could be readily mobilised into liquid assets (Abdel-Salam,1970).

From figure 2.4, the reserves position of the non-WAEMU region started soaring from the period 1997 and reached its peak around 2007 before recording a steady decline. This can largely be attributed to the global and financial crisis of 2007 where the reserves of most countries were largely drawn down in order to cushion the negative effects of the depression.

[13] Reserves pooling was in the form of investment of any country's reserves in the securities of any other country represents in essence a loan by the former to the latter.

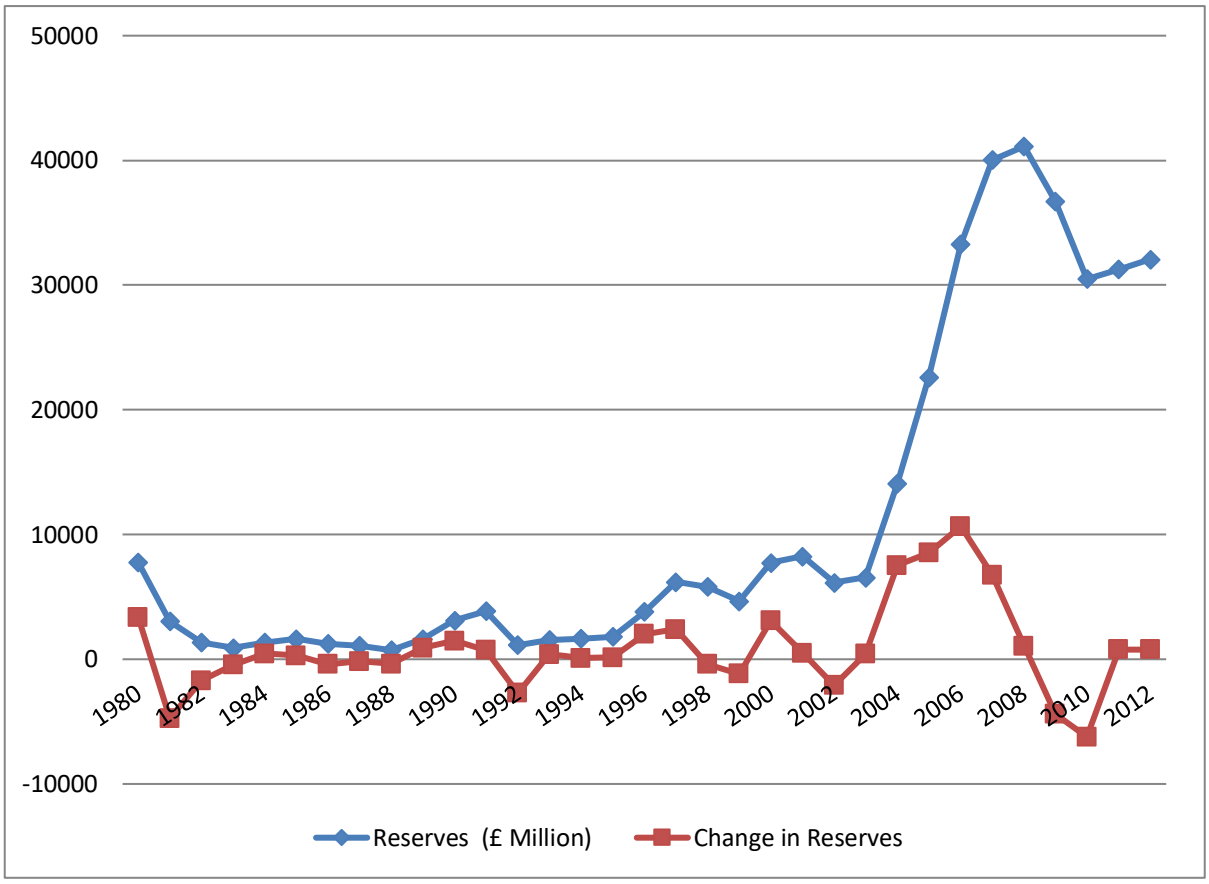


Figure 2.4. Non-WAEMU Reserves and Change in Reserves (1980-2012)

Source: Author's Computation, WDI (2011)

2.14 Contemporary Issues in WAMZ's Monetary Integration (1980 – present)

According to Ebi (2002), it was the failure of the ECOWAS integration process to make significant progress since its inception in 1975 that motivated the increasing quest for monetary integration in the Anglophone West African subregion. It was generally felt that the non-existence of parallel and competing monetary arrangements in the sub-region had been a major factor militating against the movement towards a single monetary zone.

While the CFA zone has appeared to be a solid arrangement, especially with the backing of France and the European Union, the countries outside the CFA zone have different national currencies. The challenge of accelerated integration in the subregion has therefore fallen more on these latter countries. Consequently, the political commitment to renewed economic cooperation spearheaded by Ghana and Nigeria since December 1999, and accepted by Guinea, the Gambia, Sierra Leone and Liberia, made the idea of the fast track approach to integration a feasible proposition. The idea has crystallised into the formation of the West African Monetary Zone (WAMZ) with the aim of merging it with the CFA zone subsequently. At a mini-summit of heads of states and government of member countries in Bamako in late 2000, the critical decisions were adopted with the intention to formally establish the WAMZ, with a common central bank, and to introduce a single currency in the zone by 2003.

According to Tarawalie (2012), The West African Monetary Institute (WAMI) was established in 2000 and commenced operations in Accra, Ghana in March 2001.[14] The monetary union was scheduled to commence operation in January 2003, after a convergence process. However, the launching of the union was postponed to July 1st 2005, due to the poor status of macroeconomic convergence. Following the poor macroeconomic performance by member countries and the non-achievements of the convergence criteria by the end of 2004, the launch date was further postponed to December 1st 2009. In January 2009, WAMI prepared a status report on the WAMZ programme and it was clear from the report that considering the effect of the global

[14] It was primarily mandated to undertake policy and technical preparations for the launch of a monetary union for the WAMZ and the establishment of a WACB.

recession on the economies of the member states, it was highly improbable for the member states to achieve the benchmarks for macroeconomic convergence by December 2009. Based on the recommendation contained in the report, the Authorities once again postponed the launch date of the second monetary union until (on/before) January 2015. The mandate of the WAMI was clear: undertaking of policies and technical preparations for the eventual establishment of the WACB and the introduction of a single currency - the ECO (Tarawalie, 2012). The country that would be eventually selected by political considerations to host the headquarters of the WACB (Ghana, Nigeria and Guinea have applied) was urged to be committed to implementing open sky policy as defined in the "Yamoussoukro Agreement" (Ebi, 2002).

The primary economic policy objectives of WAMZ are to ensure price stability, sound fiscal and monetary conditions and a sustainable balance of payments in the member states. To this end, the WAMZ is enjoined to adopt a regional economic policy for the zone through effective coordination of member states' economic policies, conduct the regional economic policy in the context of an open market economy and specifically design and implement common monetary and exchange rate policies in the zone. The WAMZ is also to put into force a multilateral surveillance system to ensure close coordination of member states' economic policies and sustained convergence of economic indicators of member states. To undertake this function, the key institutions of the WAMZ - the Convergence Council, Technical Committee, WAMI and the West African Central Bank - are to formulate broad guidelines for the design of economic policies of member states.

It is planned that before the WAMZ would merge with the CFA zone, thus creating the long-awaited single monetary zone in the sub-region, the member states of the WAMZ are to comply with some convergence criteria, which will ensure macroeconomic stability and reasonable growth in the member states. The quantitative primary convergence criteria are:

- single digit inflation rate;
- budget deficit (excluding grants) of not more than 4%;

- central bank financing of budget deficit to be limited to 10% of previous year's tax revenue; and
- gross external reserves to cover at least three months of imports.

In addition, there are six secondary criteria, which will be observed in support of the primary criteria. These are:

- prohibition of new domestic debt arrears and liquidation of all existing arrears;
- tax revenue to be more than 20% of GDP;
- wage bill to be less than 35% of total tax revenue;
- public investment to be more than 20% of tax revenue;
- maintenance of real exchange rate stability; and
- maintenance of positive real interest rates.

2.1.5 Issues in Monetary Integration at ECOWAS-Wide Level (1975 – date)

As stated earlier, ECOWAS was founded in 1975 by all the West African countries.[15] The ECOWAS Monetary Cooperation Programme (EMCP) is the most prominent scheme for monetary integration in the West African subregion. It was originally scheduled for between 1991 and 1994, but was extended to the year 2000. It was further extended in December 1999 to 2004. The specific objectives of the EMCP were to be implemented in three phases. In the short term, the aim was to strengthen the existing payment mechanism of the West African Clearing House through the settlement of outstanding payment arrears in the clearing mechanism; introducing new payment instruments such as the traveller's cheque; introducing a credit guarantee fund facility to support the clearing mechanism; and removing all non-tariff barriers that tend to restrict the use of national currencies to effect payments for some current transactions such as hotel bills and air tickets.

In the medium term, the EMCP was expected to achieve limited regional convertibility of national currencies by removing existing restrictions on their use. In the long run however, the ultimate goal of the EMCP is the establishment of a single ECOWAS monetary area

[15] This includes the Francophone (WAEMU) countries, the Anglophone countries (the Gambia, Ghana, Guinea, Liberia, Nigeria and Sierra Leone) and Portuguese-speaking Cape Verde.

involving the use of a common convertible currency, the establishment of a common central bank, the pooling of foreign exchange reserves and the negotiation of an external convertibility guarantee with an appropriate international agency. To facilitate these objectives, member states were to embark on an economic policy reform programme to achieve macroeconomic convergence. The policy reform programme was to embrace:

- realignment of exchange rates and the adoption of a market-based exchange rate policy;
- removal of exchange control regimes; and
- minimising of fiscal deficits and their financing through the rationalisation of government expenditure and tax reform.

The short-term objectives of the EMCP have not been fully achieved, as exemplified by the failure to clear the arrears in the clearing house mechanism, the delay in introducing new payment instruments, the problems with the newly introduced ECOWAS traveller's cheques and the unwillingness of members to remove non-tariff barriers to intraregional trade and other transactions. The medium- to long-term objectives of the EMCP have also not been fully attained, leading to the deferral of the establishment of the single monetary zone.

The need for the second monetary union arose largely as a result of inadequate political will to forge a strong monetary integration between the CFA zone and the non-CFA zone under the aegis of the EMCP. The emergence of the WAMZ as a successful monetary union is thus likely to prevent a total collapse of the EMCP. It may indeed facilitate the movement towards a single monetary zone in the sub-region since negotiations will take place between two groups of countries in contrast to the current situation characterised by uncertainties about the integration process of the sub-region. Even if the eventual merger of the two monetary zones takes more time to materialise than presently envisaged, the convergence of the two groups of countries will be less cumbersome than the convergence of many countries with various currencies. The initiative of the second monetary zone - by which the Anglophone West African countries would forge a monetary union which would later merge with the CFA franc zone - is therefore a welcome development. So far,

it has been pursued with a reasonable degree of political commitment on the part of the member states. Apart from the political will demonstrated in the execution of the project, the economic potential of the zone is a great advantage. The zone accounts for over 70% of the population of ECOWAS, about 64% of its total GDP, about 66% of total exports and 60% of total imports of goods and services. Altogether, the zone accounts for about 76% of the gross foreign exchange reserves of the West Africa sub-region. The challenges facing the establishment of the second monetary zone are daunting. As a result, member countries need to sustain their current economic policy reforms, implement faithfully the agreement and statutes of the zone and support the zone's institutions, particularly WAMI. The WAMZ countries are trying hard to comply with the statutes of the zone and operate strictly on macroeconomic policies that will facilitate the realisation of the WAMZ convergence criteria and its eventual merger with the existing CFA zone (Ebi, 2002).

2.2 ECOWAS Region Macroeconomic Performance and Stability Assessment

The performance of the ECOWAS countries based on some relevant macroeconomic indicators is assessed. This assessment is pertinent in order to draw lessons for macroeconomic stability of the region.

2.2.1 Foreign Reserves: Months of Imports Cover

Figure 2.5 shows the trend of foreign exchange reserves of the WAEMU and non-WAEMU countries in terms of months of imports cover. The months of import cover is a standard indicator for measuring foreign reserves adequacy in the reserves literature.

As shown in figure 2.5, WAEMU countries experienced varying trends and levels of foreign reserves holdings in terms of months of imports cover. This is also observed for the non-WAEMU countries in figure 2.6. In the 1980s, Cape Verde, Ghana and Togo were the leading countries in terms of reserves hoarding with an average of 5.9 months, 4.4 months and 5 months of coverage respectively. In this period, a rise in demand for reserves couple with lower demand for imports had driven their capacity to pay for imports to higher levels than other countries.

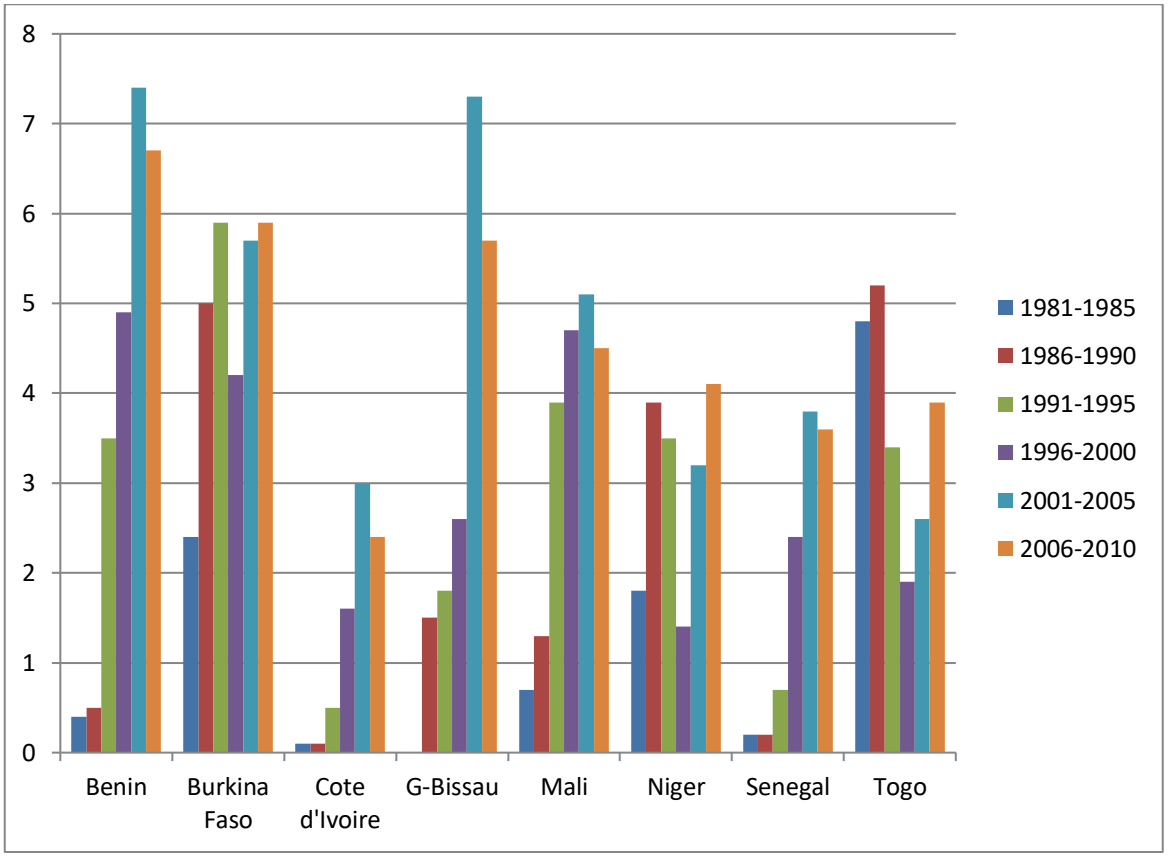


Figure 2.5. Trends of Foreign Reserves for WAEMU (Months of Imports Cover)

Source: Author's computation from WDI (2011)

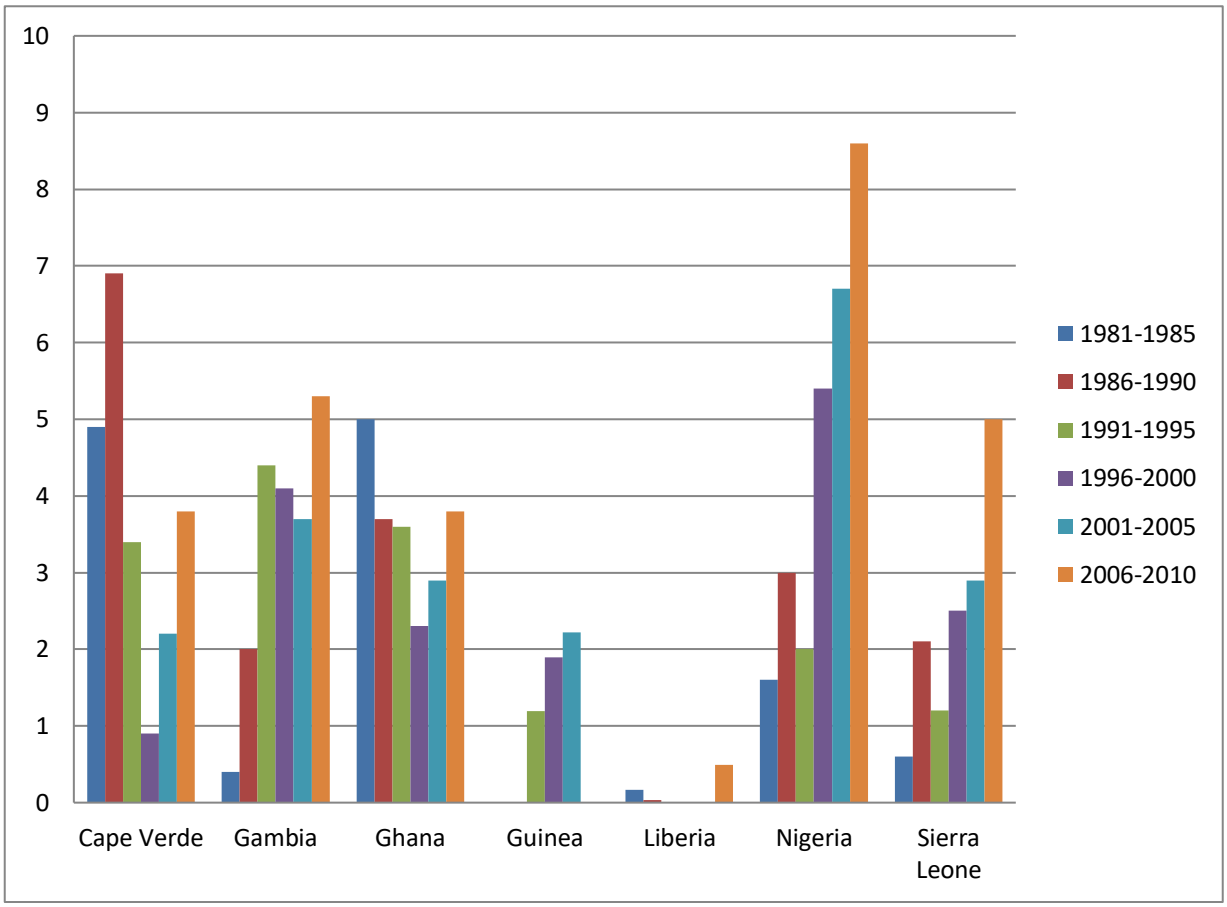


Figure 2.6. Trends of Foreign Reserves for non-WAEMU (Months of Imports Cover)

Source: Author's computation from WDI (2011)

More recently, Benin, Guinea-Bissau and Nigeria have been leading other countries of the region in the hoarding of reserves with an average of 7 months, 6.5 months and 8 months respectively. These countries have, of late, experience rise in their exports. For Nigeria, the price of crude oil rose sharply in the early and mid 2000s before the beginning of the economic recession which started in late 2007. It is observed that on the basis of one of the WAMZ convergence criteria, only Cote d'Ivoire is yet to meet its target (on the basis of at least 3 months of import coverage). A careful consideration of figures 2.1 and 2.2, show that the WAEMU countries have more stable and adequate amount of reserves in terms of month of imports cover from reserves over the entire period. The reserves of the member countries show an even spread compare to the non-WAEMU counterparts with Guinea and Liberia among the countries responsible for the uneven spread.

2.2.2 External Reserves and External Debt

The ratio of external reserves to external debt in the sub-region is apparently on a relatively steady increase from their values in the 1980s. This is an indicator of positive economic performance. For Cape Verde, this ratio was falling until the early 2000s where it started to rise again. Nigeria's case appears to be somewhat phenomenal especially in the late 2000s as shown in table 2.1. This ratio rose from 51% to 536%. The reserves position of the country rose astronomically to an unprecedented $60.0 billion as at April, 2008. This positive out-turn in external reserves position was accentuated by a conglomeration of factors including but not limited to high crude oil prices in the global market, disciplined fiscal and monetary policy stance and low debt service burden precipitated by the external debt deal.

Table 2.1. Total External Reserves as % of Total External Debt for WAEMU

	1981-1985	1986-1990	1991-1995	1996-2000	2001-2005	2006-2010
Benin	3.1	1.8	18.1	23.1	41.6	130.3
Burkina Faso	23.8	37.9	30.6	22.8	27.2	59.8
Cote d'Ivoire	0.3	0.2	0.9	4.6	11.9	22
G-Bissau	na	2.2	2.1	3.9	7.1	11.8
Mali	2.6	3.7	10.9	12.9	23.5	61.7
Niger	8.2	14	10.8	3.7	10.2	58.7
Senegal	1	0.7	2.7	9.8	23.9	61.7
Togo	22.2	26.9	15.2	8.1	12.6	32.7

Source: Author's computation from WDI (2011)

Table 2.2. Total External Reserves as % of Total External Debt for non-WAEMU

	1981-1985	1986-1990	1991-1995	1996-2000	2001-2005	2006-2010
Cape Verde	68.9	58.9	36.4	9.6	24.3	54
Gambia	1.9	8	22.8	23	15.4	32.2
Ghana	20.6	12.9	12.9	9.5	17.4	na
Guinea	na	3.9	4.9	6.3	na	na
Liberia	0.8	0.1	0.3	0.0	0.3	8.1
Nigeria	15.9	6.7	6.7	23.4	51.2	536.4
Sierra Leone	1.9	0.7	1.9	3.2	6.5	40.1

Source: Author's computation from WDI (2011)

This made the country's debt stock to tumble from an overwhelming $35.9 billion in 2004 to $3.1 billion only in 2007 (Soludo, 2007). Figure 2.7 shows the total external reserves as % of total external debt for all the ECOWAS countries (except Nigeria). As observed above, Nigeria is an outlier with respect to this macroeconomic indicator due to its 2006-2010 average figure which dwarfs all others hence, its exclusion. In this figure, there is an uneven spread among the countries with Benin, Burkina Faso, Togo and Cape Verde recording percentages that are above average while the reverse is the case for countries like Liberia, Sierra Leone, Guinea, Guinea-Bissau and Cote d'Ivoire where low percentages are recorded. This reveals that even in the face of reserves pooling, some of the WAEMU are languishing due to the prevalence of high external debt which is characterizes most African countries thereby making their reserves to debt ratio to be low. On the average, it can be observed that most of the countries record significant improvement with respect to this indicator in the recent periods (2006-2010) with Benin recording the highest percentage of 131.5%.

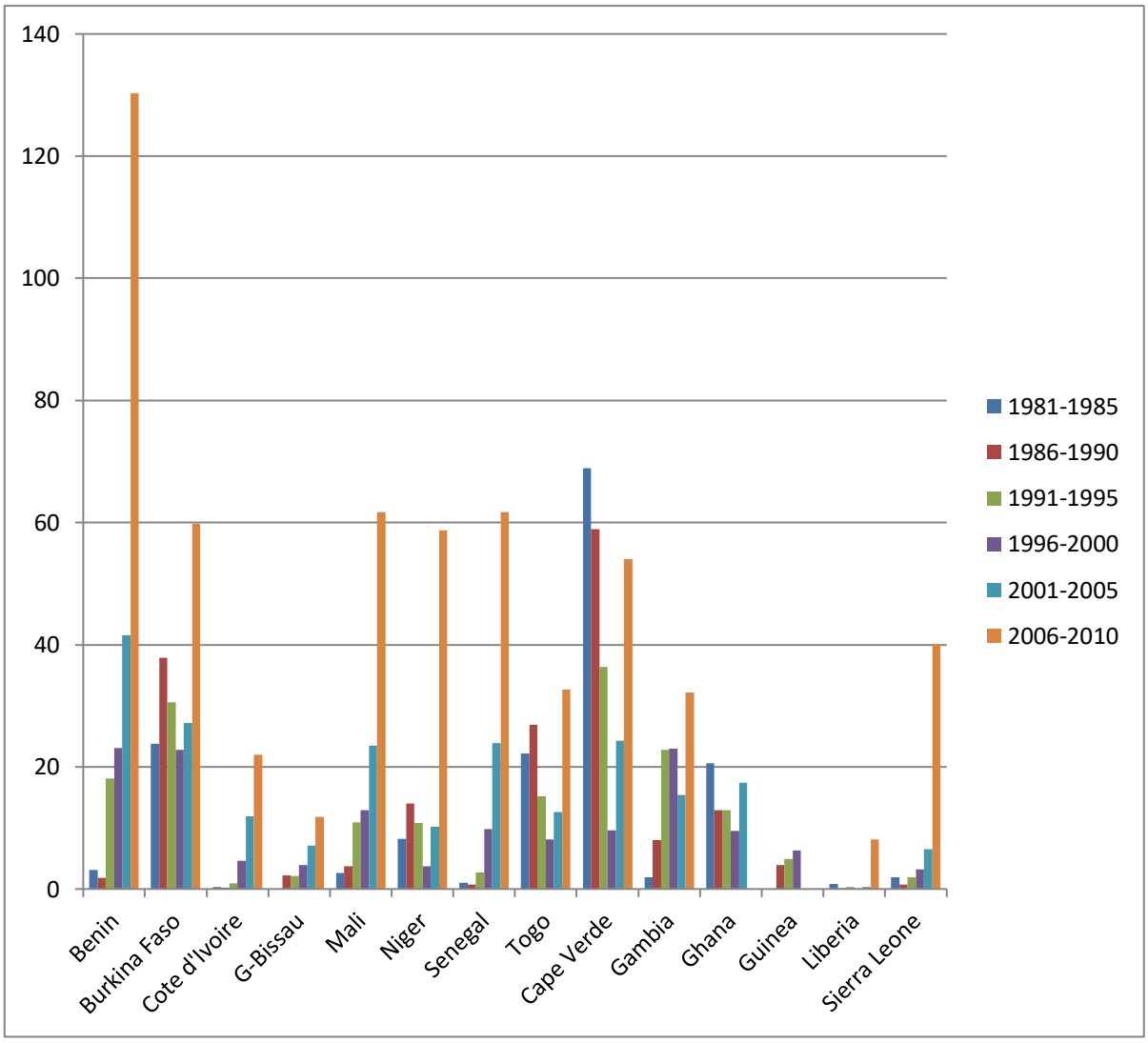


Figure 2.7. Total External Reserves as % of Total External Debt for the ECOWAS Countries (except Nigeria)

Source: Author's computation from WDI (2011)

2.2.3 Gross Domestic Product

An analysis of the GDP per capita of the ECOWAS countries shows varying trends. In the 1980s countries in the WAEMU zone display elements of poor growth relative to their non-WAEMU counterparts with an average of $250 per head except for Senegal and cote d'Ivoire that were far above this average. This poor performance of WAEMU zone countries can be attributed to changes in the world economy, persistent current account deficits and the inability of these economies to adjust. According to Ogunkola (2005), the growth performance of the CFA zone West African economies did not improve until after the 1994 devaluation of the CFAF. This slow or negative growth in per capita GDP of the CFA zone countries was attributed to worsening balance of payments, debt crises, declining competitiveness and, more importantly, an apparent failure to adjust to the changes in their environment.

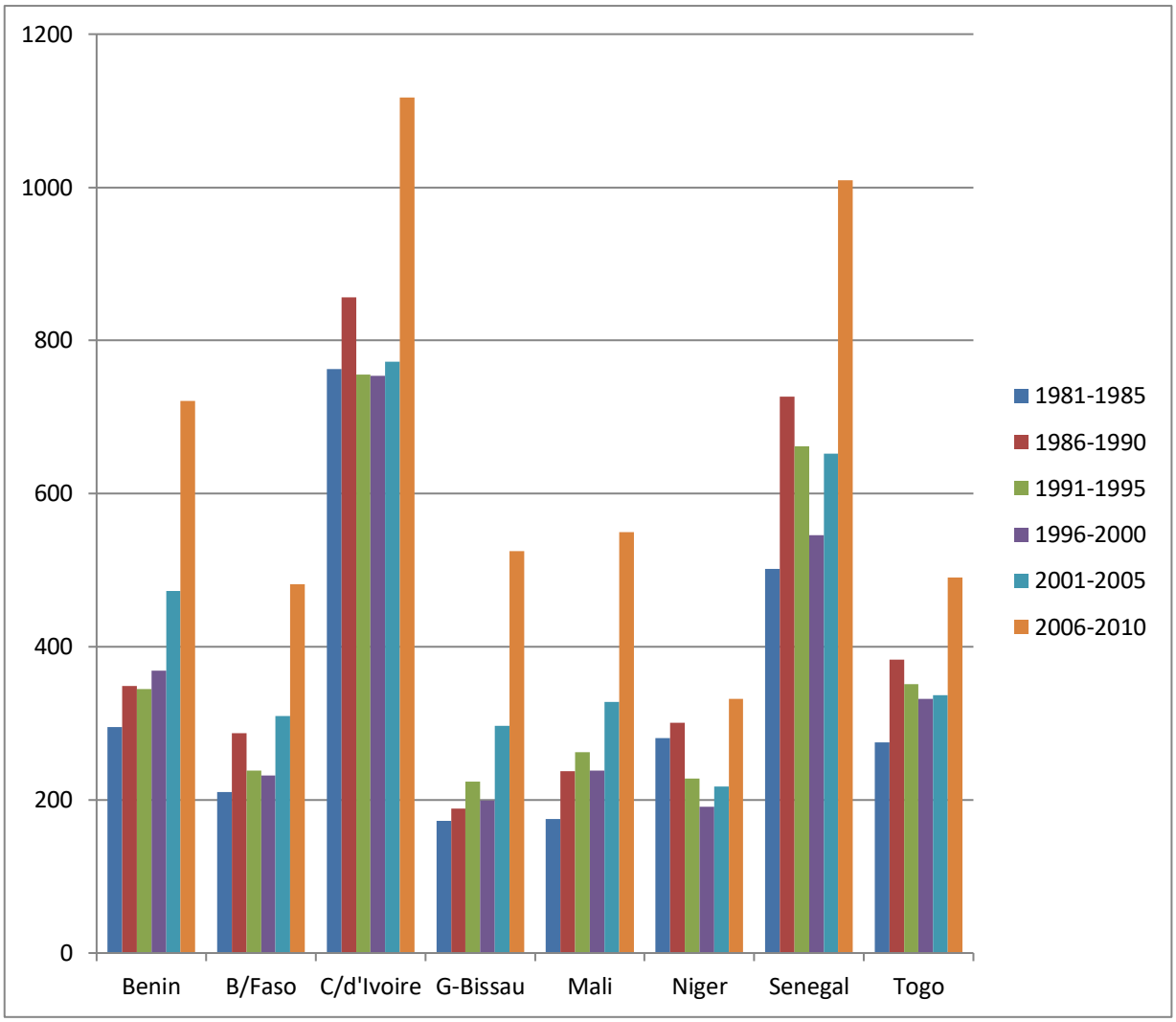


Figure 2.8. GDP Per Capita (Current US$) for WAEMU

Source: Author's computation from WDI (2011)

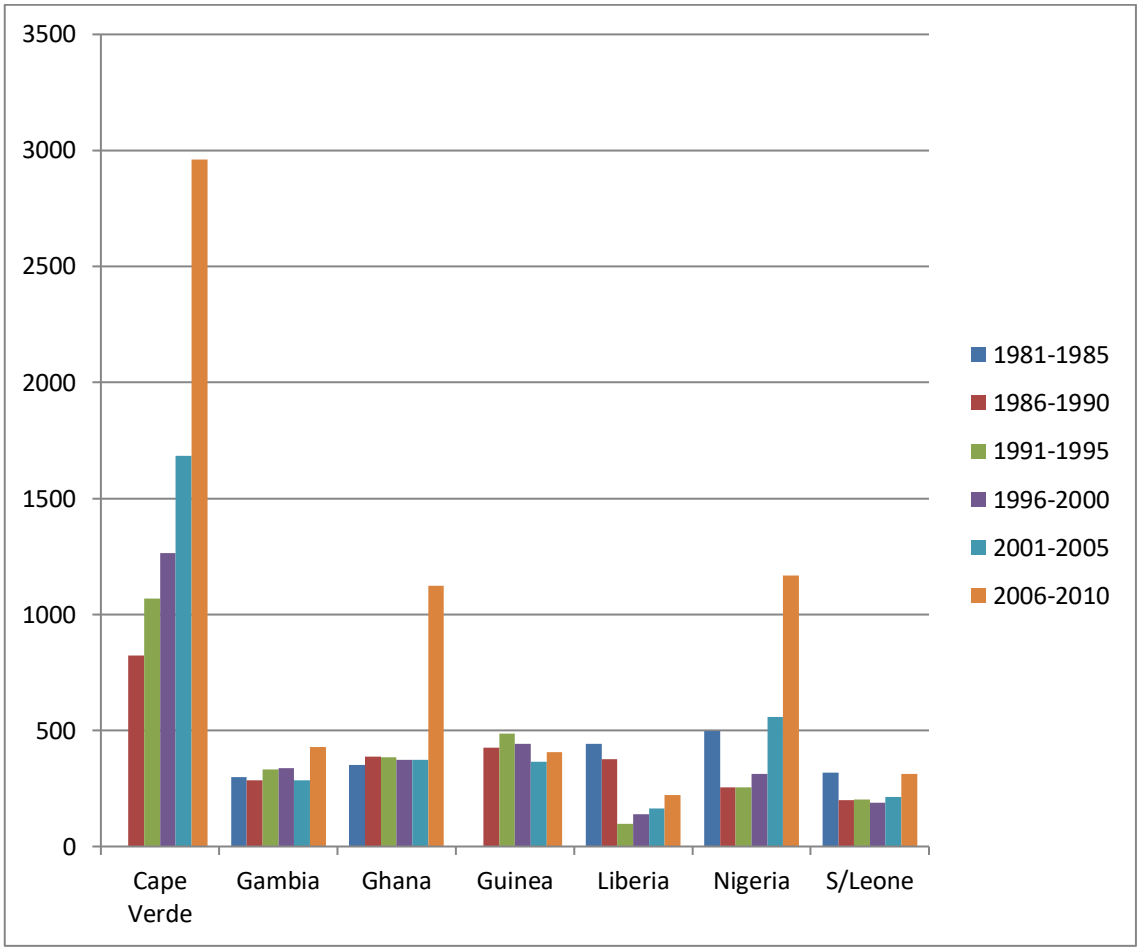


Figure 2.9. GDP Per Capita (Current US$) for non-WAEMU

Source: Author's computation from WDI (2011)

Over the years, no other country in the sub-region has been able to rival Cape Verde Island in terms of this economic performance indicator. It has been a stand-alone, recording an average of about $3000 per head in the year 2000s. This dwarfs that of Nigeria (considered to be the next highest in term of growth per capita in the region) by almost 200%. This high and steady growth can be attributed to fiscal prudence, high export and political stability. Sierra Leone GDP per capita has been the lowest all through the years after an initial relative high in the early 1980s. This low performance is largely attributed to the persistent civil wars and political instability hampering growth in the country. This low growth is also witnessed in Niger Republic. Here, desert encroachment (taking over arable land) and political instability are attributable factors. Due to observed scaling difference with figure 2.8 and 2.9, a combined graph of all the countries together is shown in figure 2.10.

In this figure, it can be observed that on the average, with the exception of Cape Verde, the WAEMU countries show a slightly higher GDP per capita than the non-WAEMU counterparts. The average for the WAEMU countries is $427.9 while for the non-WAEMU (with the exception of Cape Verde which is an outlier here) is $371.6. Overall, the countries show a higher GDP in the latter period (2006-2010) than the previous period.

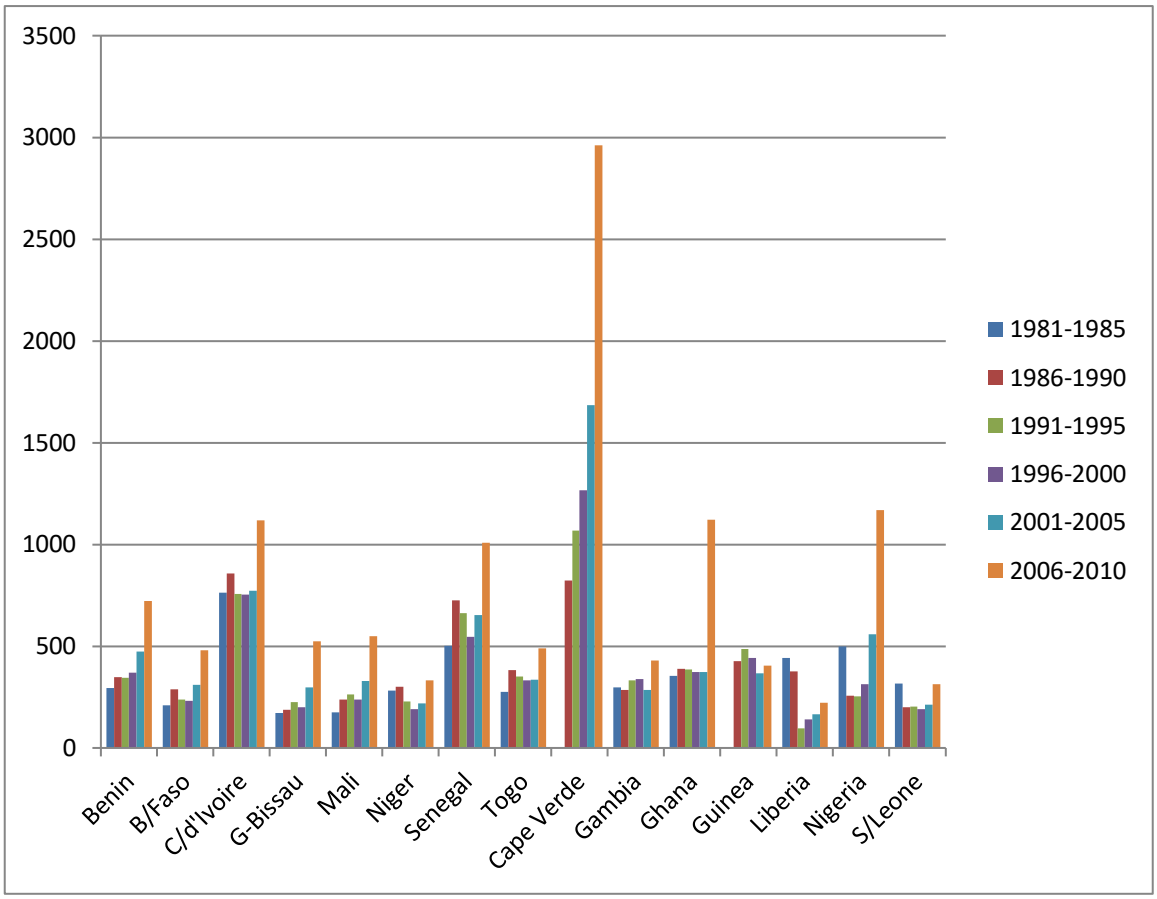


Figure 2.10. GDP Per Capita (Current US$) for the Countries combined

Source: Author's computation from WDI (2011)

2.2.4 Inflation

In the 1980s, Ghana and Sierra Leone recorded high inflation trends among the countries. These countries experienced hyper-inflation. Nigeria experienced such high rate of inflation in the early 1990s as a result of high budget deficit accompanied by fiscal mismanagement excessive government spending. This was a similar case to that in Guinea-Bissau. Most countries in the WAEMU zone witness a rise in their inflation rates in the mid 1990s. This can be duly explained by the CFA devaluation within that period. The change in the exchange rate parity of the CFA Franc in 1994 is the main shock that led to a generalized simultaneous rise in prices within these CFA ECOWAS countries. This high inflation was brought under control by the Bretton Woods institution and other sub-regional organization in the succeeding years (Dramani 2010).

In the recent years monetary authorities in the ECOWAS countries have been combating the menace of high inflation. This has shown the beginning of convergence, that is, this is in view of their respective desires to meet the convergence criteria of 3% and single digit inflation rate in the WAEMU and WAMZ zones respectively.

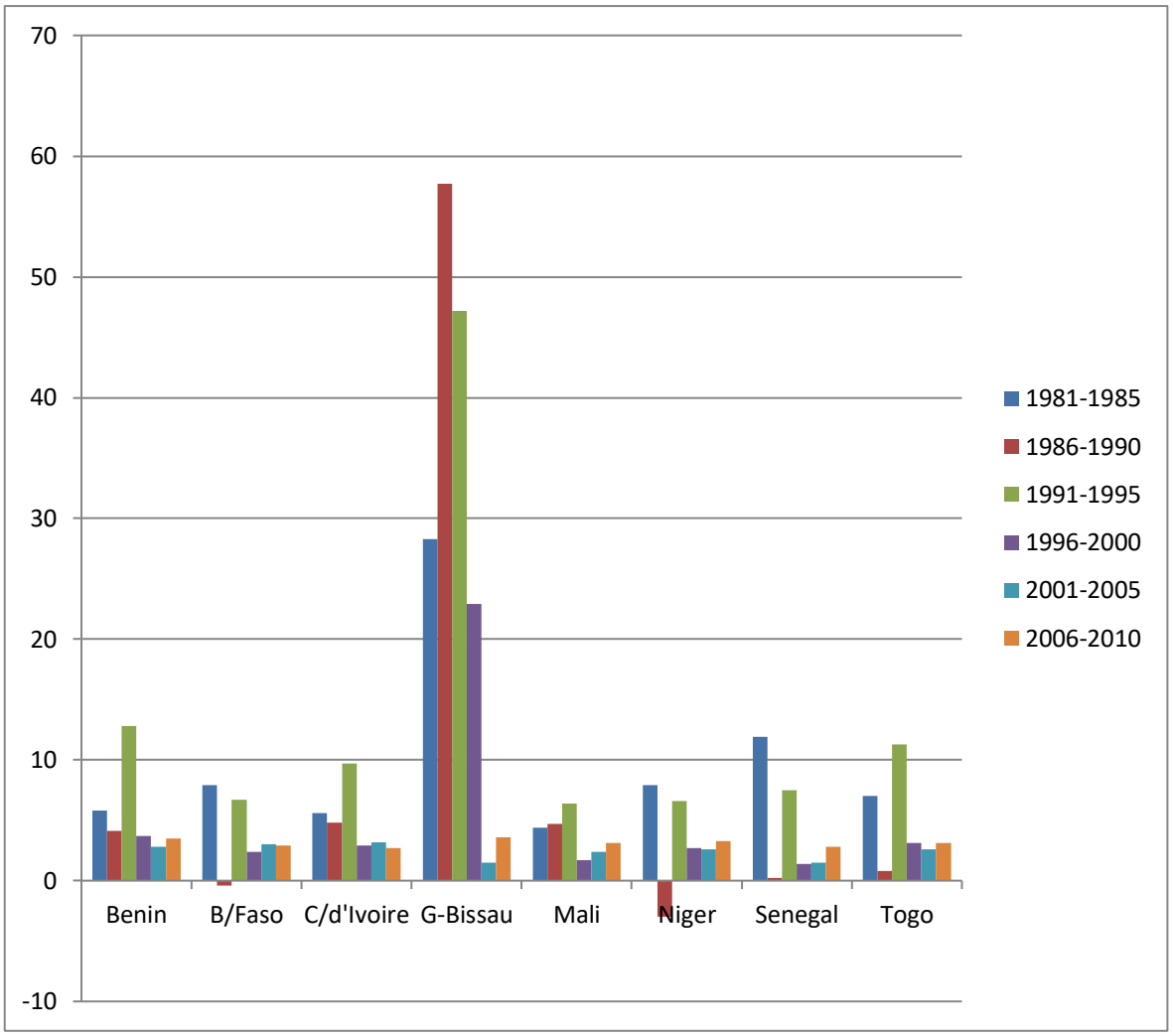


Figure 2.11. Inflation (Percentage of Consumer Prices) for WAEMU

Source: Author's computation from WDI (2011)

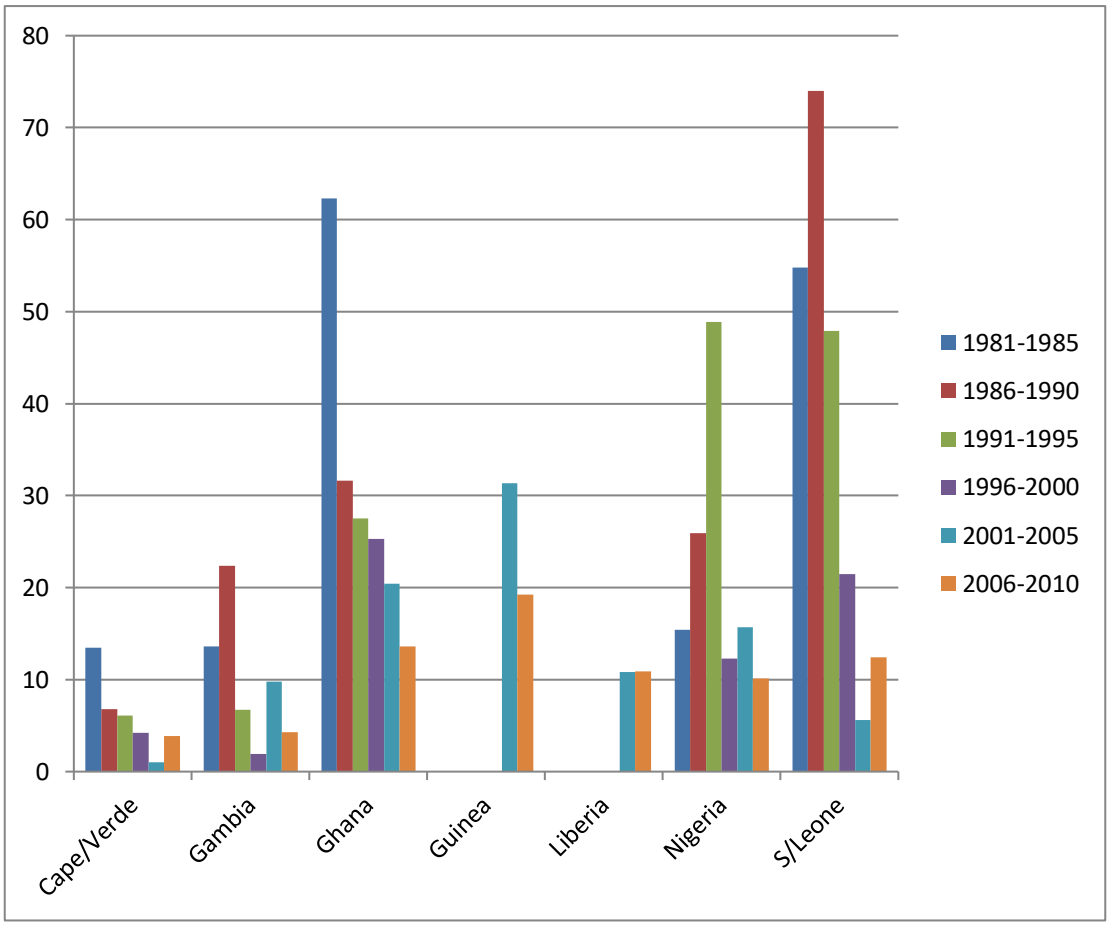


Figure 2.12 Inflation (Percentage of Consumer Prices) for non-WAEMU

Source: Author's computation from WDI (2011)

Form figure 2.11 and 2.12, it can be seen that inflation is most prevalent among the non-WAEMU countries. Inflation among the WAEMU countries has been low over the entire period of the analysis. For these countries, inflation has been largely below 10% over the entire period of this analysis. The only notable exception has been Guinea –Bissau where inflation has been high; with the highest point being 57.5 within the period 1986-1990. The country is a stand-alone among the WAEMU countries due to the fact that it was not a French colony before but Portuguese and its currency was not pegged within the CFA ambit until 1997 when it decided to join the CFA zone. Among the non-WAEMU countries, Cape Verde and Gambia have maintained a relatively low inflation rate compare to the other countries in the group. Nigeria, Sierra Leone and Ghana are the countries with the higher prevalence with Sierra Leone being the highest.

2.3 Lesson for Macroeconomic Stability

In the West African region, the WAEMU sub-region has demonstrated more determination and effort towards integration into the global economy. As noted earlier, the integration within WAEMU has a multilateral surveillance mechanism whose ultimate goal is to ensure the convergence of member economies. Convergence can generally be achieved through two distinct patterns: nominal convergence, which focuses on the evolution of nominal variables, and real convergence which requires the approximation of living standards. WAEMU countries, adopting an approach similar to that of the European Union, have opted for a convergence of nominal variables and assuming that nominal convergence will lead to real convergence. In addition, theorists of optimum currency areas argue that in a monetary union, the focus should instead be put on real convergence that will eventually lead to nominal convergence. Furthermore, looking for a nominal convergence can be very costly, especially for the poorest countries that are often remote from nominal objectives adopted, and could even lead to real divergence raising behavior of "free Ridding" in response to asymmetric shocks. To avoid this, WAEMU countries found it necessary to adopt a Pact of Convergence, Stability, Growth and Solidarity. The implementation of this pact is supposed to stabilize the economic situation and the macroeconomic policies of the Union to ensure the harmonious development of member countries.

As can be observed from figure 13, the change in reserves in the non-WAEMU region is greater suggesting greater instability and the frequency of resorting to reserves for stabilization. This is also observed in the inflation rate figure and the other macroeconomic variables/indicators discussed above. Therefore, it can be concluded that the WAEMU zone is faring better than the non-WAEMU zone in terms of macroeconomic stability and performance convergence. This is mainly due to the fact that the WAEMU members have been together as a union since after the colonial era. They were established by France and survived after independence. This was not the case with the non-WAEMU members. In the case of the latter, the WACB gave way to individual central banks soon after the colonial era. The countries in the Anglophone area disintegrated and stood independently without recourse to the WACB after each of their respective political independence. Nevertheless, the issue of a common currency contemplation, complimented by a common history and culture under the British colonial era is fostering the economic and monetary integration processes in the non-WAEMU.

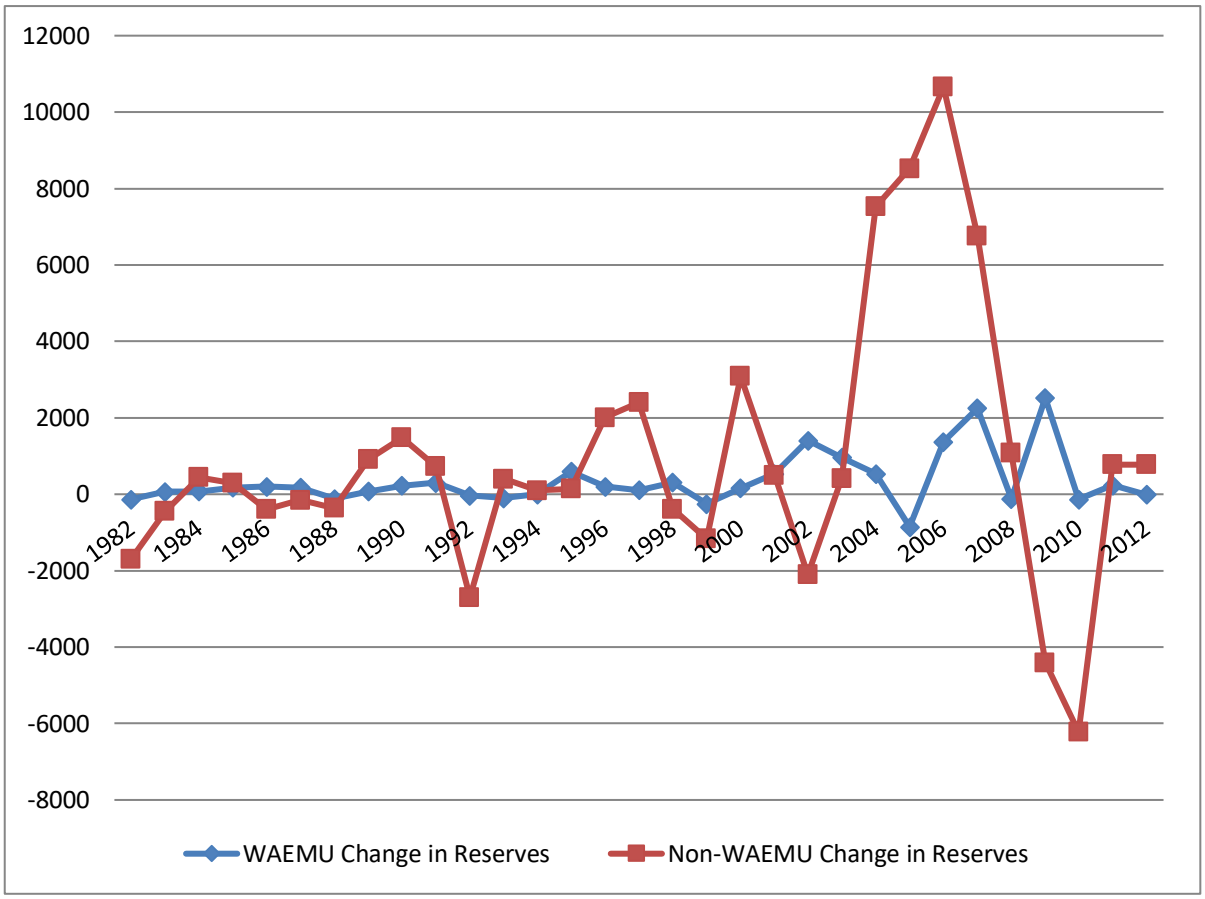


Figure 2.13. Change in Reserves for WAEMU and non-WAEMU (1982-2012)

Source: Author's computation from WDI (2011)

2.4 Lessons from the Euro Zone Crisis for Macroeconomic Stability

Monetary cooperation among the European countries started with the establishment of the European Monetary Society (EMS) in March 1979 with the aim of gaining closer monetary cooperation which was supposed to result in monetary stability among the member nations. There were three major stages in the integration process. The first stage commenced in 1990 with the goal of strengthening both monetary and non-monetary cooperation within the existing framework. The second stage commenced in 1994 with twin aims of the preparation for the establishment of the European Central Bank (ECB) and the achievement of economic convergence. The third stage was the launch of the monetary union. The EMS became the EMU at the beginning of 1999 with the introduction of the Euro and a common monetary policy by the ECB.

The crisis started due to the fact that the Euro zone is characterized by countries with both strong and weak fundamentals. Some of the countries in the zone long suffered from domestic instability that prevented them from meeting the pre-requisites for entry into the EU. Belgium had a huge amount of debt that was over 100% of GDP; Italy had a history of political instability and frequent change of government which led to the accumulation of large fiscal deficits that weakened their local currency; Greece, Spain and Portugal (also known as the peripheral countries) have long history of dictatorship which ended in 1974, 1975 and 1976 respectively which left them with fiscal, currency and monetary problems (Okafor, 2010; Nindi, 2011).

The currency union did not result in deeper economic integration as initially envisaged due to harmonization issues between the core countries and the peripheral countries. This resulted in an unbalanced Euro zone with its members having divergent fiscal and economic policies and wildly differing economic growth rates. Greece Italy, Spain and Portugal misrepresented their economic performance to give the impression of their readiness for union. This meant that these countries entered the EU when they were not ready for monetary union. As the tide of the global economic crisis became stronger, the lack of macroeconomic stability in these countries subsequently led to the sovereign debt

crisis as their economies could not withstand and sustain the strict monetary and exchange rate policy of the EMU.

The discussion on the root causes of the EU crisis raised some important lessons for macroeconomic stability if the prospect of a reserve pool in ECOWAS will be a success. Given that there are countries with strong and others with weak macroeconomic fundamentals in the region just as it was with the EU, it is crucial that measures must be taken to bring about relative harmony within the region as polarised development between the core and peripheral countries in the EU turned out to destabilised the EU. Moreover, the success of a pool will require an ex ante harmonization of monetary policies of member states and accurate growth rate preconditions while any form of misrepresentation as it was with Greece, Italy, Spain and Portugal will adversely jeopardized the success of the pool.

CHAPTER THREE

LITERATURE REVIEW

3.1. Review of Theoretical Literature

In this subsection, three main theories are reviewed. They are the theory of demand for reserves otherwise known as the buffer stock model, the optimum currency area and the theory of club. These theories cover a large spectrum of framework that are of interest to this study. The theory of demand for reserves is central to the examination of the determinants of international reserves; the theory of club goods is on issues of reserves pooling and optimum currency theory forms the basis for the analysis of issues central to macroeconomic stability. These theories are discussed extensively in the following sub-sections:

3.1.1. Theory of Demand for Reserves: The Buffer Stock Theory

Traditional theory describes external reserves holding as a function of variations in the balance of payments, the opportunity cost of holding reserves, the scale of the economy, trade openness, etc. Heller, 1966; Frenkel and Jovanovic, 1981; Lane and Burke, 2001; Flood and Marion, 2002; Frenkel, 1978; Ben-Bassat and Gottlieb, 1992). The main reason why countries hold foreign exchange reserves is to smoothen unpredictable and temporary imbalances in international payments. Traditional views in the literature on external reserves emphasize the role of three main variables: (i) the benefit of building up reserves stocks which is calculated by the reciprocal of the marginal propensity to import; (ii) the opportunity cost of hoarding reserves which is the spread between interest rate earned by reserves and the alternative social use of these resources; and (iii) the volatility of balance of payments, to take into consideration the degree of synchrony between external flows.

According to Frenkel and Jovanovic (1981), optimal level of international reserves for a country depends on the variability of international transactions. This dependence stems from the notion that reserves serve as a buffer stock with role of accommodating

fluctuations and adjustments in external transactions. The basic assumptions of the theory are that the optimal stock of reserves depends positively on the extent of these fluctuations (adjustments); and that the optimal stock of reserves depends negatively on the market rate of interest so that the extent that international reserves earn a return that is lower than the market rate of interest, reserve holdings entail forgone earnings on reserve holdings. Thus, the optimal stock of reserves is determined by considering two components of cost: (i) the cost of adjustment which is incurred once reserves reach an undesirable lower bound, and (ii) forgone earnings. In view of these, the monetary authorities choose the stock of reserves which balances the potential macroeconomic adjustment costs incurred in the absence of reserves with the opportunity cost of international reserves holding.[16]

The cost of adjustment, which is assumed to depend on the frequency of adjustment and on the fixed cost per adjustment, stems from the need to reduce expenditures relative to income so as to yield the desired balance of payments surplus that is necessary for the accumulation of reserves. The exact mechanism through which real expenditures are reduced and the adjustment is effected depends on the circumstances. It may take the form of a decline in real income due to a deterioration of the terms of trade, or it may take the form of a decline in the real value of nominal assets due to a rise in the price level that accompanies the deterioration in the terms of trade or that may be the result of a devaluation (in which case the cost might include the perceived political cost that is frequently associated with having a depreciating currency).[17] The optimal stock of reserves yields the optimal combination of being able to finance a deficit by drawing on reserves and of having to adjust in the face of a deficit by reducing expenditures relative to income. Since, due to the postulated stochastic process, reserve holdings are random, we assume the optimal stock is obtained by minimising the sum of the expected value of both components of cost

[16] That is, a country chooses a level of reserves to balance the macroeconomic adjustment costs incurred if reserves are exhausted (the precautionary motive) with the opportunity cost of holding them (IMF, 2003).

[17] These two components of cost are interrelated: a higher stock of reserves reduces the probability of having to adjust and thereby reduces the expected cost of adjustment, but this additional security is acquired at the cost of higher forgone earnings.

In the original version of the theory by Heller (1966), the central bank chooses a level of external reserves to balance the macroeconomic adjustment costs incurred in the absence of reserves with the opportunity cost of holding reserves so that the total cost of adjustment is therefore given by:

$$TC_a = \Delta B/M \qquad (1)$$

Where TC_a is the total cost of adjustment, ΔB is the amount of external imbalance and M, the propensity to import. The avoidance of these adjustment costs would be beneficial to the country involved and it is very possible to avoid the adjustment to an external disequilibrium if the monetary authorities of the country have resources at its disposal which can be used to finance the external disequilibrium thus rendering the adjustment unnecessary. The resources which are at the disposal of the monetary authorities and which can be used for such contingencies are the liquid international reserves.[18] These reserve assets could have been invested productively. The differential between the social yield on capital invested and the yield on liquid international reserves is the appropriate concept of the opportunity cost of holding liquid international reserves. Thus, neglecting the effects of portfolio composition, the opportunity cost of holding a given amount of liquid international reserves is a function of its volume, and is given by:

$$TC_f = r.R \qquad (2)$$

Where TC_f is the opportunity cost of holding the liquid international reserves, r the differential between the social rate of return on capital and the return (if any) on the reserves and R the volume of liquid international reserves held.

The government of every country has the responsibility as well as the incentive to maximise the welfare of its residents. In the expected effort by the government (monetary authorities) to shift the community indifference curve to a higher level because they are rational, the costs of adjusting to an imbalance in the international accounts and the costs of financing have to be compared to each other. Ultimately, the least expensive way of handling an international disequilibrium would be chosen.

[18] Liquid international reserves held by the monetary authorities are part of the total capital resources of a country.

In order to determine an optimal level of international reserves, which the monetary authorities may wish to hold for precautionary motives, three important parameters are investigated: the cost of adjusting to an external imbalance; the cost of holding liquid international reserves; and the probability that there will actually be a need for reserves of a given magnitude. The marginal cost of adjusting national expenditure (MC_a) such that the external imbalance is eliminated is given by

$$MC_a = 1/M \qquad (3)$$

which is the first derivative of equation (1), and which gives the total loss of income due to an adjustment to a given imbalance. The total cost of holding a given amount of international reserves is given by equation (2), and the marginal cost of holding one additional dollar of reserves (MC_f) is therefore the first derivative of equation (2):

$$MC_f = r \qquad (4)$$

The optimal level of international reserves is given by the amount which minimises the total cost of adjusting and/or financing an external imbalance. At this point, the marginal cost of adjusting has to be equal to the marginal cost of financing.[19] The probability that adjustment will have to be used as a means of providing for external balance is defined by π. So that

$$MC_f = r = \pi \,.\, 1/M = MC_a \qquad (5)$$

With both r and m parameters known, π can thus be calculated:

$$\pi = r \,.\, M \qquad (6)$$

Frenkel and Jovanovic (1981) hypothesise that reserves movements between the occasional restockings are generated by an exogenous 'Wiener process'. This is a process where the incremental change in reserves in a small time interval is distributed normally. Frenkel and Jovanovic (op.cit) also assumed that the deterministic part of the incremental change in reserves is a negative drift while the stochastic part is without drift. They set the lower bound for reserves at zero. In the special case of no reserves drift between stock

[19] Yet, while the cost of holding additional reserves is incurred with certainty, the cost of adjusting is incurred only in the case that a cumulative balance-of-payments deficit of a certain magnitude actually occurs.

adjustments, a second-order Taylor-series approximation of optimal reserve holdings yields the following approximation of optimal initial level of external reserves holdings.

$$Ro = \sqrt{\frac{C\sigma}{r^{0.5}}} \qquad (7)$$

Where R0 is the optimal starting level for international reserves after restocking, C is a country-specific nominal constant capturing the fixed cost of adjustment, σ is the standard deviation of the 'Wiener‟ increment in the reserves time-series process operating between stock adjustments and r is the opportunity cost of holding reserves. Equation 7 shows that, in the buffer stock model, optimal reserve holdings increase with the volatility of reserves (σ). Higher volatility means that reserves hit their lower bound more frequently. The reserves authorities are therefore willing to restock a larger amount of reserves and tolerate greater opportunity costs in order to incur the adjustment cost less frequently. This equation also shows that a larger adjustment cost increases optimal reserves holdings while a higher opportunity cost reduces them. This equation is written in the familiar square root form and the log transformation version which is more applicable in empirical work can also be obtained.

3.1.2. The Theory of Optimum Currency Area (OCA)

The pioneering work in the theory of the OCA started with the works of Mundell (1961), Mckinnon (1963) and Kenan (1969). Despite being advanced over 50 years, the OCA theory attracted much attention only in recent years due to the impetus provided by the debate over European monetary unification. The traditional OCA theory generally asserts that economic efficiency is maximised within a geographical space if the region as a whole is economically integrated; that is the stronger the linkages between member nations of a geographical area, the greater the potential gains to be realised if the economies are integrated (Bayoumi and Eichengreen, 1997).

In the literature, the presence of the OCA criteria make the adjustment of the exchange rates between the national currencies unnecessary as an absorption mechanism when member nations are exposed to shocks. This would therefore, minimise the costs of joining an OCA (Araujo and Leon, 2004). Accordingly, the literature on the OCA theory came to light in the early 1960s: a period characterised inter alia by the Bretton Woods

fixed exchange rate regime, capital controls in many countries and the incipient process of European integration. Various OCA properties or criteria emerged; the OCA criteria are reviewed next.

i. A High Degree of Factor Mobility

According to the OCA literature, one of the basic characteristics of an OCA is the maintenance of a permanently fixed exchange rate between member nations. Mundell (1961) therefore, suggests that the costs of an OCA are minimised when factors of production (especially labour) can move freely within the area. The argument is that if productivity or other shocks affect one nation/ region, resulting in a decline in its output and real wages, factors of production may migrate to places of excess demand within the currency area. The movement of factors of production avoids the need to adopt distinct monetary policies by individual countries when shocks affect member countries differently. High factor market integration within a group of partner countries can reduce the need to alter real factor prices and the nominal exchange rate between countries in response to disturbances. Trade theory has long established that the mobility of factors of production enhances both efficiency and welfare. Such mobility is likely to be modest in the very short run and could display its effect over time.

ii. A High Degree of Trade Openness

Changes in exchange rate are often transmitted to the price of tradables and hence the domestic economy. As such, consumers tend to be wary of any changes in the exchange rate and thus, there is little money/exchange rate illusion by wage earners. The result of this is that nominal wages and prices tend to react quickly to the devaluation of the currency thus making it less effective (McKinnon, 1963). The advantages of fixed exchange rates will increase with economic openness, while those of flexible rates decline. It is therefore noted that a high degree of trade openness prior to forming an OCA increases the benefits and reduces the costs of doing away with the exchange rate as an adjustment tool. Also, a devaluation would be more rapidly transmitted to the price of tradables and the cost of living, negating its intended effects. Hence the nominal exchange rate would be less useful as an adjustment instrument. Economic openness needs to be assessed along several dimensions, including the overall openness of a country to trade

with the world; the degree of openness vis-à-vis the countries with which it intends to share a single currency; the share of tradable versus non-tradable goods and services in production and consumption; and the marginal propensity to import. These dimensions of openness overlap but are not synonymous. The literature has shown that monetary integration catalyses openness further that is, the "endogeneity of OCA". (Frenkel and Rose, 1998; McKinnon, 1963).

iii. A High Decree of Product Diversification

Product diversification ensures that an economy has a degree of insulation against a variety of shocks. High diversification in production and consumption, such as the "portfolio of jobs", and correspondingly in imports and exports, dilutes the possible impact of shocks specific to any particular sector. Therefore, diversification reduces the need for changes in terms of trade via the nominal exchange rate and provides "insulation" against a variety. Nations ought to have highly diversified economies prior to forming an OCA (Kenan, 1969; Nindi 2011). If a nation that produces a variety of goods is hit by a shock, the subsequent changes in the prices of the goods would also vary differently. Hence, if the shock is specific to a good or industry, there is a possibility that the economy as a whole will not be adversely affected as that particular good or industry (Araujo and Leon, 2004). Vaubel (1978) and Bayoumi and Ostry (1997) note similarly that if trade between members of an OCA is highly diversified, the law of large numbers implies that the probability and the size of changes in each country's terms of trade is reduced when hit by an economic shocks.

iv. Price and Wage Flexibility

When nominal prices and wages are flexible between and within countries contemplating a single currency, the transition towards adjustment following a shock is less likely to be associated with sustained unemployment in one country and/or inflation in another. This will in turn diminish the need for nominal exchange rate adjustments (Friedman, 1953). Alternatively, if nominal prices and wages are downward rigid some measure of real flexibility could be achieved by means of exchange rate adjustments. In this case the loss of direct control over the nominal exchange rate instrument represents a cost (Mongeli, 2010).

v. Financial Market Integration

Ingram (1973) noted that financial integration can reduce the need for exchange rate adjustments. It may cushion temporary adverse disturbances through capital inflows – e.g. by borrowing from surplus areas or decumulating net foreign assets that can be reverted when the shock is over. With a high degree of financial integration even modest changes in interest rates would elicit equilibrating capital movements across partner countries. This would reduce differences in long-term interest rates, easing the financing of external imbalances but also fostering an efficient allocation of resources. Financial integration is not a substitute for a permanent adjustment when necessary: in this case, it can only smoothen this process. Temporary financial flows may induce a postponement of real adjustment and render it more difficult at a later stage. Some authors also warn that financial integration might lead to destabilising capital movements (Mongeli, 2008).

3.1.2.1 The OCA Asymmetric Shocks and Macroeconomic Stability Determinants

The OCA theory (Mundel, 1961; McKinnon, 1963; Kenan, 1969; Mongeli, 2002; Debrun, Masson and Patillo, 2005; Ricci, 2008) identifies the sources of asymmetric shocks to an economy to cover a wide spectrum in the literature. These include exchange rate variability, output variation, variation in terms of trade and trade flow and variation in consumer price index. Also, in the literature, asymmetric shocks are traced to fiscal policy distortions resulting from public expenditure, deficit financing and investment. High inflation, volatile export revenues, or variable economic growth add to the risks faced by agents and thereby worsen the prospects of economic activities that pay off in the future. These uncertain environments are therefore detrimental to investment, skills learning, and in general he development of businesses. Empirical studies have indeed found a significant statistical relationship between inflation and growth, even after controlling for fiscal performance, wars, droughts, population growth, openness, human and physical capital and after allowing for simultaneity bias. Output variability and exports or terms-of-trade volatility are the other commonly used measures of macroeconomic stability.

According to Satyanath and Subramanian (2004), there are a number of different ways in which macroeconomic instability can be the consequence of distributionally-motivated actions by governments or others in power. First, in early (Marxian) analysis of business

cycles, the expansion of bank credit during booms was seen as providing extra purchasing power for business to finance investments beyond that would have been possible without inflation. This inflationary financing of an investment boom is made possible by implicitly depressing private consumption (consequent upon the real wage decline that accompanies inflation) and thereby increasing savings. Second, inflation is an instrument par excellence for redistributing wealth: for example, from creditors to debtors and away from those that hold money and other assets (unskilled human capital) that cannot be hedged against inflation.[20]

Third, while Marxian analysis of inflation tend to stress the conflict between wage-earners and capitalists, in many developing countries, particularly in Latin America and Africa, the fissures run as much between sectors as classes. The cleavage is often between urban wage earners employed in nontradables and those that derive income from resource-intensive export sectors. Any loosening of monetary and fiscal policies has inevitable and intended redistributional effects. Often fiscal expansion takes the form of wage increases granted to public sector employees in the urban sector. The rise in urban real wages consequent upon these policies squeezes profits in the primary sector. Macroeconomic expansion thus has distributional intent and consequences. Occasionally, inflation through selective credit expansion serves to favour some industries over others (in Brazil in the mid-1960s, this was deployed to favour the automobile sector at the expense of basic and consumer goods).

A fourth case relates to borrowing and rising government indebtedness, which often substitutes for inflation as a means of financing unsustainable spending plans and hence promoting the interests of a particular group in society. Much of the reason for high inflation and external instability results from the vast overhang of external debt. The reasons for this debt accumulation are complex, but include both domestic factors (including populist policies). Thus, borrowing and indebtedness are simply another manifestation of nominal instability and hence related to the same underlying causes.

[20] For example, in Chile in the 1870s, land owners were accused of orchestrating inflation to permit them to repay their loans in depreciated paper money.

Finally, another adverse impact of polarisation within society on macroeconomic stabilisation has been analysed. If countries need to pursue costly stabilization in the wake of shocks and different interest groups disagree on the allocation of the burden of adjustment, a struggle ensues between them, with each trying to make other groups pay for the adjustment. Successful stabilisations are then delayed until one group consolidates its position and prevents the others from vetoing the stabilisation plan. Thus, latent conflict in society leads to greater macroeconomic instability.

The sources of shocks identified by the OCA are critical to this study as they form the bases for the macroeconomic variables employed. Debrun et al (2005) and Ogunkola and Jerome, (2005) stressed that the region face shocks asymmetrically due to the differences in their terms of trade and most especially the differing content of their respective exports.

3.1.3 The Theory of Clubs

James M. Buchanan developed club theory[21] in his 1965 paper, "An Economic Theory of Clubs"[22]. He wrote that there was an "awesome Samuelson gap between the purely private and purely public good". This gap contained goods that were excludable but shared by more people than typically share a private good but less people than typically share a public good. The goal of his theory was to address the question of determining the "size of the most desirable cost and consumption sharing arrangement". An example of private goods that Buchanan offered to illustrate this concept was the used of a pair of shoes by a group of people. Two people cannot wear the same exact pair of shoes at the same time. However, two or more people can take turns wearing them. As the number of people sharing the same pair of shoes increases the amount of utility each person derives from the shoes diminishes. As more persons are allowed to share in the enjoyment of the facility of a given size, the benefit evaluation that the individual places on the good will, after some point, decline. There may, of course, be both an increasing and a constant range of the total benefit function, but at some point congestion will set in, and their evaluation of the good falls. But each new member or co-owner helps reduce the cost of the club good so there will be some optimal size of the good that maximizes the benefit for its members.

[21] The study of club goods in economics

[22] There were latter modifications by Dodsworth (1975) and Ng (1975).

Assumptions of the Theory of Clubs

i. Differing Utilisation Pattern (Asymmetric Utilisation)

The demand and utilisation pattern of the club's resources by members should not be similar. This assumption is necessary to avoid crowding and congestion in the use of the resources. Club goods have artificial scarcity. By this, it means that congestion can reduce access to the resources by the members when demands are made at the same time as congestion takes the form of a non-excludable public "bad" within the club. This is one assumption that distinguishes a club good from a pure public good which is considered to be fully non-rivalrous. The non-rivalrous[23] property in public economics holds when the use of a unit of the good by one consumer does not preclude or diminish the benefit from another consumer using the same unit of the good. Thus, there is jointness in consumption of the good - one unit of the good produced generates multiple units of consumption. Rivalrousness is a more continuous concept. The degree of rivalrousness can be defined by the size of the marginal opportunity cost of an additional user attempting to use the resources at the same time two or more other members are using it. Zero is one extreme. Therefore, as much as possible, the members of a club must differ their utilisation of the resources of the pool as to even out over crowding at a particular point in time.

ii. Finite and Optimal Size

In the theory of clubs, it is assumed that the size of the members is finite. The dynamics of the situation would suggest that a small membership size is optimal. This is to suggest that there has to be a limited degree of publicness as additional members beyond the optimal membership size will impose a cost on existing members. As with the case of the reserves pool, congestion may arise due to "infinite membership" thereby reducing the marginal utility of existing members. According to Ng (1975) the relevant Pareto optimality condition requires that any individual in the club must derive a total benefit in excess of the aggregate marginal cost imposed on all other consumers in the club. So the Buchanan-Ng theory is to optimise the membership while considering the degree of congestion or

[23] Non-rivalrous implies that the opportunity cost of the marginal user is zero just as in the case where one consumer's listening to a broadcast does not diminish another's ability to benefit from the same broadcast

overcrowding to be equally important.[24] However Buchanan (1965) opines that a club should admit more members so as to maximise the difference between total benefits per person and total costs per person due to the club.[25] The club facilities should be increased until the added marginal benefit per person is equal to the additional total cost of making the facility bigger.

iii. Non-excludability and Unrestricted Access

It is assumed that members of the club have unrestricted access to the common resources of the club. However, other members of the general public are excluded from accessing the resources of the pool. In the case of a reserves pool, each member has unconstrained access to the pool. Since the pool belongs to all members, it is believed assumed that whenever in need in terms of a financial constraint or macroeconomic instability in the country, the member can so resort to drawing from the pool. Resources from a club are sort of public goods that are non-rivalrous, at least until reaching a point where congestion occurs among members.

In common property regimes, access to the resource is free to members however, common-pool resources are not public goods. While there is relatively free but monitored access to the resource system for community members, there are mechanisms in place which allow the community to exclude outsiders from using its resource. Thus, in a common property regime, a common-pool resource appears as a private good to an outsider and as a common good to an insider of the community. The resource units withdrawn from the system are typically owned individually by the appropriators. A common property good is rivaled in consumption.

iv. Non-discrimination

Here it is assumed that costs and benefits from the operation of the club are shared equally among the members of the club. It is assumed that there is no discrimination in the distribution of gains. Further, the theory of clubs assumes that the cost of reduction of additional entry is split equally among the club members and that the added loss in benefit

[24] Club theory has many interesting applications in the analysis of congestion and in establishing the optimal group size for (say) a local golf club to a local community.

[25] That is, the club should admit more members so long as the reduction in costs per person is greater than the reduction in benefits per person due to increased costs of congestion.

resulting from additional entry is also evenly shared. That is, no one needs to pay a disproportionately large fraction of the costs, and different people do not have different levels of sensitivity to crowding. Coase (1960) proposes a mechanism by which beneficiaries of a public good band together and pool their resources based on their willingness to pay to create the public good. If the transaction costs between potential beneficiaries of a public good are sufficiently low, and it is therefore easy for beneficiaries to find each other and pool their money based on the public good's value to themselves, then an adequate level of public goods production can occur even under competitive free market conditions.

v. Non-profligacy

This assumption attempts to place restriction on the extravagance that can arise from the wasteful behaviour of some members of the club. Even though the use of resources of a club is seen to be non-rivalrous this can only be up to a point. This assumption is synonymous with the issue of free-riding in the provision of public goods. As with public goods, club goods also provide a very important example of market failure, in which market-like behaviour of individual gain-seeking does not produce efficient results. If private organisations do not reap all the benefits of a public good which they have produced, their incentives to produce it voluntarily might be insufficient. Consumers can take advantage of public goods without contributing sufficiently to their creation. This is called the free rider problem because consumers' contributions (marginal cost) will be far less than the marginal benefit they are getting from the club. If too many members decide to “free-ride”, private costs will exceed private benefits and the incentive to provide the good or service disappears. The club (market) thus fails to provide a good or service for which there is a need. The free rider problem depends on a conception of the human being as homo-economicus: purely rational and also purely selfish-extremely individualistic, considering only those benefits and costs that directly affect him or her. Public goods give such a person an incentive to be a free rider. Therefore, if some people crowd more than others, they can be charged more to compensate for the reduction of the benefits they bring about. If club owners are allowed to price-discriminate, they will not need to categorically exclude anyone from joining.

vi. Common Arbitrator

In the theory of clubs, it is assumed that there is a common regulator/arbitrator who monitors and controls the use of the resources of the pool. The regulator is responsible for the preservation, maintenance, and consumption of the common-pool resource. The need for an arbiter arises so that members cannot act independently to threaten the total net benefit from the common-pool resource. So in order to maintain the resource system, these arbiters coordinate their strategies to keep the resource as a common property, instead of dividing it up into bits of private property. They typically protect the core resource and allocate the fringe through complex community norms of consensus decision-making. Common resource management has to face the difficult task of devising rules that limit the amount, timing, and technology used to withdraw various resource units from the resource system. Setting the limits too high would lead to overuse and eventually to the destruction of the core resource, while setting the limits too low would unnecessarily reduce the benefits obtained by the users.

The theory provides the basis for which reserves pooling decisions can be related to the institutional and structural characteristics of a given federation. The main idea in the theory of clubs is that if the utilization patterns of members of a club are not highly positively correlated, then the members could be better off by sharing each others' facilities so as to even out crowding. The club is assumed to still be in the planning stage and membership as well as the cost sharing scheme are still the subject of bargaining. The setting here is a group of countries (or regions) formed in a federation which facilitates some type or group decision-making. Each country in this group is supposedly part of an optimal club with a central authority.

The subject of the club theory is a common-pool resources also called a common property resource. It is a type of good consisting of a natural or human-made resource whose size or characteristics make it costly, but not impossible, to exclude potential beneficiaries from obtaining benefits from its use. Unlike pure public goods, common pool resources face problems of congestion or overuse, because they are subtractable. A common-pool resource typically consists of a core resource which defines the stock variable, while providing a limited quantity of extractable fringe units, which defines the flow variable. While the core resource is to be protected or nurtured in order to allow for its continuous

exploitation, the fringe units can be harvested or consumed. Because their core resources are vulnerable, common-pool resources are generally subject to the problems of congestion, overuse, pollution, and potential destruction unless harvesting or use limits are devised and enforced.

The use of many common-pool resources, if managed carefully, can be extended because the resource system forms a positive feedback loop, where the stock variable continually regenerates the fringe variable as long as the stock variable is not compromised, providing an optimum amount of consumption. However, consumption exceeding the fringe value reduces the stock variable, which in turn decreases the flow variable. If the stock variable is allowed to regenerate then the fringe and flow variables may also recover to initial levels, but in many cases the loss is irreparable.

According to Dodsworth (1975), the institutional problem for the central authorities of the federation is to devise a cost sharing scheme which would attract unanimous support from members of the group. Each country in the federation is faced in a time period, t, with financing a level of payments, D_t. This it does from current receipts, C_t, which are geared towards an average or forecast expenditure. The expenditure, (if it is greater than current receipt) is financed from a contingency reserves fund, R. The size of this reserves fund will depend primarily on some measure of dispersion of D_t above C_t, and on a risk factor:

$$w = pr\left[\sum_{t=1}^{n} D_t > (\sum_{t=1}^{n} C_t + R)\right] \qquad (8)$$

In this formulation receipts and outgoings are taken as given and remained unchanged whether the country is in or out of the club. While for the three remaining variables, R, w and n, the choice of any two determines the third, or, alternatively, the choice of one, say, R, determines a set of combinations of w and n. The number of time periods involved will depend on the type of fund being considered. If recourse can be made easily to higher governmental units, then n may be quite small. However, if the untypical case of international reserves where confidence is all important is taken, n would generally be expected to be very large and w, correspondingly, very small. The determination of the

common risk factor is of interest here as choice must be made between the public and private benefits of the club.

According to Medhora (1992), under an international reserves pooling arrangement, a common central bank must be in operation; one of whose main responsibilities is to oversee the external operations of the member countries so that the existence of a common pool of official international reserves provides a service with potential benefits for some or all of the members. A crucial requirement for the success of any pooling scheme is one of non-profligate behaviour on the part of all its members. If one or more member(s) change their pattern of reserves use after pooling, then (a) any ex ante gains will not be realized as forecast, and therefore, (b) the pooling arrangement might break down. More specifically, if one member inflates inappropriately after pooling, and thus draws down the common reserves knowing that it now has access to more reserves than before, then the other members might be tempted to do the same, or opt out of the pool. Thus, the presence of a controlling central bank can checkmate such profligate member. And a single country cannot continuously draw down the pool without evoking a warning signal from the central monetary authority or response from the other member countries.

In the case of the WAEMU zone, each country maintains a separate account with the common central bank called the BCEAO. In the first instance, each country draws down its own account of pooled and unpooled reserves. If these are fully drawn down, the other countries' pooled reserves may be used. The French Central Bank oversees the operation of the BCEAO and it augments the Operations Account only when all the Union's reserves have been fully drawn down. Also, no limit is placed statutorily on a member country's use of the entire pool. A crisis management scheme is immediately employed by the central bank only when the entire pool falls below a particular threshold (Medhora 1992).

As stated earlier, the club model provides a framework in which gains from a possible reserves pooling can be assessed. The assumptions here are as discussed earlier to include differing utilisation pattern, non-excludability and unrestricted access, non-discrimination among members, non-profligacy, common arbitrator and finite and optimal size of the

club. In an early application of the theory of clubs to reserve pooling, Dodsworth (1975) describes the gains this way:

> *"so long as the risk of abnormal demands on the reserve position is proportionately less when spread over a number of countries, then reserve economies are possible. Either total reserves required can be reduced or individual countries can benefit from an increased level of insurance cover."*

This is the fundamental pillar on which gains from pooling can be assessed. The potential gains from pooling reserves arise from the lower risk that results when reserves that show different patterns of use are combined among a group of countries. Similar gains arise from a range of pooling schemes whether it is unemployment insurance funds, health plans, or mineral reserves. By belonging to a reserve pool, the member countries have unconditional access to the others' reserves during times of need. At the same time, by pooling, each country is accountable for and "taken upon itself" the variability of the entire pool, rather than just the variability of its own reserves. Starting with the proposition that variability, as a proxy for risk, is undesirable, then a scheme that potentially reduces variability and increases access to reserves offers greater protection for the same level of risk, or alternately, requires fewer resources for the same level of protection as before; this is how the idea of "coverage" is born. In customary policymakers' parlance and in the context of international reserves, the term coverage refers to the number of weeks/months of imports they can pay for. In the context of risk aversion among holders of international reserves, it is more appropriate to consider coverage as the ratio of reserve holdings to their variability.

According to this formulation, coverage will increase if there is an increase in access to reserves or a decrease in reserves variability. Coverage in country *i* is defined as

$$C_i = \frac{PR_i}{Var(PR_i)} \qquad (9)$$

Where PR_i is the average level of reserves during a time period and $VAR\ (PR_i)$ is their variability during the same time period (for each country); and for reserves pool, PR =

$\sum PR_i$. This formulation above encompasses two potential sources of gains in reserve pooling: (i) access to increased reserves holdings; (ii) possible reduction in reserves variability. In both cases, coverage will increase. Variability is represented by the coefficient of variation of the reserve during a specified time period.

3.2 Benefits and Costs of Reserves Pooling

Belonging to a regional reserves pooling scheme can be beneficial. It is used in emergencies and is expected to expand the capacity of the countries in the region in order to tackle any financial crisis, as well as contribute substantially to the economic stability of the region. With such a reserve pool in place, timely financial assistance can be offered to any crisis-stricken economy in the pool and it will also prevent further collapse as well as spread to other economies within the pool (Fafchamps et al, 2007).

According to Basu et al (2010), the existence of trade linkages among countries means that self- insurance strategy by one country has externalities for other countries so that a crisis in one country reduces the demand for goods produced by its trading partners, and therefore is also costly for neighbouring countries. In the absence of reserve pooling, countries use their savings to self-insure themselves first against external shocks, without taking into account the effect of their actions on the welfare of their neighbours or trading partners. However, regional reserves pooling arrangements can internalize this externality and thereby increase welfare for all countries involved.

Countries can be subjected to two broad categories of shocks: financial and business cycle shocks and the transmission of such shocks to other countries is possible in this globalization era (Basu et al, 2010). For the purposes of a reserves pooling arrangement, financial shocks are regarded as exogenous while business cycle shocks as an endogenous outcome of the policies pursued by the reserves pool. This observation should inform how intraregional and inter-regional shock correlations be measured. The higher the correlation of financial/business cycle shocks within rather than across regions, the less attractive is a regional pool. The stronger the terms of trade effects of shocks within a specific region, the more attractive is such a pool (Cole and Obstfeld, 1991;Tesar, 1993; van Wincoop, 1999;Athanasoulis and van Wincoop, 2000).

There are other benefits associated with moving from self-insurance to a reserves pooling arrangement within a region: the unification of budget constraints results in a single borrowing limit for the reserves pool as a whole and this improves welfare by expanding the set of feasible allocations. Furthermore, the pooling of reserves improves the diversification of idiosyncratic country endowment risk. The benefits of diversification are greater when the trade externality is internalised within a regional pool (Basu et al, 2010).

There are costs associated with a country participating in the pooling of reserves with other members of the region. These costs include the following: first, the loss of independent monetary policy; in this regard, it can be recalled that it was earlier stated that external reserves are often deployed when the market clearing exchange rate undershoots or overshoots the level that is consistent with the attainment of the prime goal of macroeconomic stability. Reserves are often used for the defense of the value of the local currency. This is supposed to suggest that foreign reserves are potent tools in the hands of the monetary authorities of any economy. Thus, if a country does not have access to its reserves, having ceded same to the union, then the country becomes impotent and dependent on the monetary policy coming from the central monetary authority of the union at large. This fear of the loss of power to affect a national money supply is legitimately a great one since in an integrated market, all member countries will jointly control their monetary policy. Typically, the loss of a country's ability to use the exchange rate and monetary policy for stabilization was considered to be the most important cost of joining a currency area. However, this is surely not the case for small open economies, because it is impossible to maintain free capital mobility and an independent monetary policy together. Such countries link their currencies to their main trading partners in order to gain higher exchange rate stability. This lowers the independence of monetary policy (Horvath and Komarek, 2002).

Second, the economy loses seigniorage, which comes as a source of revenue to the government. Seignorage is the revenue the government obtains by financing its budget deficit through printing money rather than selling debt. That is why at full employment printing money would lead to inflation. Seignorage is frequently also called the 'inflation tax'. It is largely a policy question how seignorage would be distributed in the case of

monetary union. In Western Europe only in some southern countries seignorage was estimated to be more than one percent of GDP and the ratio is rapidly decreasing in time (Oyejide, 2012; Ricci, 2008; Abeng, 2007).

Third, asymmetric shocks; this cost encapsulates exchange rate variability, output variability, terms of trade as well as variation in consumer price index. If the movements of exchange rates reflect feelings, speculation etc., then high volatility could lead to misallocation of resources. The cost of pooling increases significantly within a group on countries in a region when they face these shocks asymmetrically.

Fourth, fiscal policy distortions; some centralization of fiscal policies could serve as one of the mechanisms in adjusting to asymmetric shock, however, the centralization of budgets often leads to an increase in spending. Also, a country belonging to a pool becomes "responsible" for the management of the economy of other members. When a member is faced with any macroeconomic perturbation beyond its control, other members of the union are obliged to provide support and bail the ailing economy out so as to reduce the risks of spread of the "ailment" to other members in the pool. Therefore, the pattern and size of income/revenue as well as spending of (potential) members becomes an issue of serious consideration (Masson and Pattilo, 2002).

3.3 Methodological Review

A major concern of this study is the assessment of gains for member countries of ECOWAS if their international reserves are to be pooled together. A review of the literature shows that the concept of coverage, which dovetails from the theory of club goods, has commonly been deployed to explain and test for the presence gain/loss when a group of countries are to pool reserves together. In the context of risk aversion among international reserves holders, coverage is appropriate considered to be the extent to which an economy can be shielded by its available foreign reserves from both domestic and external macroeconomic perturbations. This methodology has been used in the studies by Williams, Polius, and Hazel (2001) where a comparison of the gains from the pooling of reserves, and hence reserve variability, in the Eastern Caribbean Currency Union (ECCU) and the CFA franc zone was presented. This methodology is employed when Rajan,

Siregar and Bird (2003) examines the case of reserves pooling in East Asia. The study is an investigation of the gains, if any, to be reaped if the East Asian economies were to pool their reserves. In a related study, Rajan and Siregar (2004) applied the method of coverage in their work on centralized reserve pooling for the ASEAN plus three (APT) countries.

Medhora (1992) investigates the case of reserves pooling in the CFA zone and the method of coverage was applied. In a related study, Callen, Imbs and Mauro (2009) constructed a list of country pools from a large sample to study risk pooling. Here, the volatility of pool-wide gross domestic product growth was computed and compared with the volatility in each country individually. The viability of a single monetary zone in ECOWAS was evaluated by Ogunkola (2005). An estimation of the costs and benefits of a monetary union in the region was carried out using the real exchange rate (RER) variability model. This methodology is used to show that West African countries are closer to forming a single monetary union now than before.

Elhiaraka and Ndikumana (2007) have examined issues of reserves accumulation among African countries using the methodology of panel cointegration and error correction mechanism where they attempt is made to identify the sources, motivations and effects of such reserves accumulation in Africa. Ruiz-Arranz and Zavadjil (2008) examine whether foreign exchange reserves in emerging Asia have grown beyond what is needed to support financial stability. They use a threshold model and assess the benefits of reserves in terms of reduced borrowing spreads. They adopt the insurance model of optimal reserves as a framework, based on the work of Jeanne (2007) which has it that reserves enable an economy to cushion the impact of a sudden stop in capital flows on domestic consumption and output by providing a ready source of liquidity. They estimate spreads-reserves elasticities for a panel of 34 emerging economies for the period 1997–2006. By applying this methodology, they endogenously determine the threshold level(s) of reserves and confidence intervals at which the relationship between reserves and spreads changes where they show that most of Asia can still benefit from higher reserves in terms of reduced borrowing costs.

In the examination of the question of adequacy of reserves in sub-Saharan Africa (SSA) in the light of the shocks faced by these countries, Drummond and Dhasmana (2008) extend

the Jeanne and Ranciere (2006) reserves model of consumption smoothing and applies it to experiment reserve holdings in SSA in the light of likely shocks. The authors, in their methodology, make use of simulation. The country simulations considered here take into account various aspects of vulnerability. They consider a Small Open Economy (SOE) model with two goods- one tradable and another non-tradable. The use of this model allows for the simulation of the optimal level of reserves across a broad spectrum of shocks and output costs, but this level is sensitive to the choice of key parameters such as the risk aversion, the term premium and the probability of shocks, and results in the paper are illustrative of model simulations for a given set of parameters.

The time consistency model framework is adopted by Lin and Wang (2005) to show how the intervention of the monetary authority influences the domestic economy in five East Asian economies: Japan and four Tigers (Hong Kong, Korea, Singapore and Taiwan). They analyze the relationship between foreign exchange reserves and inflation rate through the operations of the foreign exchange market. This study is an extension of the time consistency model developed by Kydland and Prescott (1977) to incorporate exchange rate stability in the policymaker's objectives. A regression model is set for the empirical study where inflation rate is measured as the annual change in Consumer Price Index (CPI) and estimated with a correction for serial correlation using Cochrane-Orcutt method. In a related study, Gosselin and Parent (2005) conduct an analysis of foreign exchange reserves in Emerging Asia. They attempt to measure how far the current level of reserves is from that predicted by the standard macroeconomic determinants in Asia. They adopted the buffer stock model as a framework and then use Pedroni's (1999) panel cointegration tests as the basis for the estimation of a long-run reserves demand function in a panel of eight Asian emerging-market economies: China, India, Indonesia, Korea, Malaysia, the Philippines, Singapore, and Thailand.

By way of summary of the methodological review undertaken, it is observed that the coverage index has commonly been deployed to explain and test for the presence of gain/loss in a reserves pooling scheme. As mentioned earlier, coverage is considered to be the extent to which an economy can be shielded by its available foreign reserves from both domestic and external macroeconomic perturbations. This methodology was employed in the study by Williams, Polius, and Hazel (2001). Also, it is employed when Rajan, Siregar

and Bird (2003). The study is an investigation of the gains in a reserves pooling arrangement in the East Asian. In a related study, Rajan and Siregar (2004) applied the coverage index in their work on centralized reserve pooling for the ASEAN (Association of South-East Asian Nations) Plus Three (APT) countries. Medhora (1992) investigates the case of reserves pooling in the CFA zone and the method of coverage was applied.

For the estimation of macroeconomic shocks, the correlation shocks and the vector autoregressive framework (VAR), and by extension the structural VAR (SVAR), are prominent methodologies widely employed in the monetary integration literature. The VAR approach places minimal restrictions on how shocks from variables affect the economy. This methodology is widely thought to be informed by the standard technique in measuring shocks as pioneered by Blanchard and Quah (1989).

The review shows wide application of this methodology: Vaubel (1978), Bayoumi and Eichengreen (1992), Erkel-Rouse and Melitz (1995), Frankel and Rose (1998), WAMI, 2005, Ogunkola (2005), Ogunkola and Jerome (2005). Masson and Patillo (2001) employed the correlation of shocks to examine whether the ECOWAS region and the West African Monetary Zone can be seen as a candidate for an optimum currency area. Ogunkola (2005) and Ogunkola and Jerome (2005) constructed the real exchange variance, as a yardstick, to determine the degree of asymmetric shock in West Africa where the VAR framework is employed to estimate the real exchange variability as a measure of shock. In spite of its wide application, most econometrician and analysts have put forward that the VAR framework assumes interrelationships and interdependence among economic aggregates without perspicuous recourse to theory. Other methodologies widely employed are the ordinary least squares and the instrumental variable techniques (Nnanna et al, 2007; Debrun, Masson and Patillo, 2005; Elhiraika and Ndikumana, 2007).

3.4 Empirical Review

There are no ample empirical evidences on reserves pooling specifically. Therefore it is

necessary to state that most of the investigations in the literature focus on issues surrounding monetary integration as a whole and not purely on reserves pooling. However, few studies have examined reserves pooling for some of the regions of the world. Williams, Polius, and Hazel (2001) present a comparison of the gains from the pooling of reserves, and hence reserve variability, in the Eastern Caribbean Currency Union (ECCU) and the CFA franc zone. The results show that countries from the two regions benefit from external reserves pooling. It was shown that countries within the ECCU area have achieved greater balance of payments protection than the CFA zone countries from the pooling of reserves. Unanticipated changes in the terms of trade lowered reserves in the CFA zone relative to the ECCU, which may reflect a greater reliance on primary commodities in the CFA compared with services in the ECCU.

In the study examining the case of reserves pooling in East Asia, Rajan, Siregar and Bird (2003) investigate the gains, if any, to be reaped if the East Asian economies were to pool their reserves. The highest overall average for the coverage index with pooling is found to be at a 10 percent commitment; it implies a significant gain from pooling. They estimate the coverage index for every 1 percent from 0 to 10 percent and then from 10 to 20 percent to locate the level of pooling that will most benefit the East Asian economies as a group. Results show that based on the highest overall average of coverage index, as a group, the economies stand to benefit most by committing to a one percent pooling arrangement. Rajan and Siregar (2004), in a separate study, finds that before the Asian financial crisis, countries in the ASEAN (Association of South-East Asian Nations) plus three (APT) nations are better-off if they are to commit themselves to a partial pooling scheme than a complete pooling as 50% pool coverage indices are in general higher than those for the 100% pooling. For the post-crisis period, the results for benefit of pooling are less conclusive as the result reveals that the advantages from reserves pooling are not self-evident. The decline in the benefits of pooling after the crisis vis-a-vis before the crisis can be largely explained by both significant increases in the average reserves levels as well as the sharp declines in the variability of the reserves after the crisis relative to the pre-crisis.

Ogunkola (2005) evaluates the viability of a single monetary zone in ECOWAS and finds that West African countries are closer to forming a single monetary union now than before. An evaluation of the costs and benefits of a monetary union in the region shows

that there are significant potential benefits to be reaped in the form of significant savings on foreign exchange as a result of reduced exchange rate risk, increased intraregional trade as well as increased investments among others even though the benefits come at the cost of loss of seigniorage and custom duties. Ogunkola and Jerome (2005) also support the findings of possible gains. The results also show that the CFA zone has achieved greater stability in general compared to its non-CFA counterpart in the ECOWAS subregion. However, the results also reveal that the Structural Adjustment Programmes (SAP) in the sub-region brought about stability in real exchange rate shocks to non-CFA ECOWAS countries compared to its CFA counterparts.

A list of country pools from a large sample was constructed by Callen, Imbs and Mauro (2009) to study risk pooling where the volatility of pool-wide gross domestic product growth was computed and compared it with the volatility in each country separately. The results suggest that there are potential diversification gains and, ultimately, the welfare gains associated with international risk sharing. Many small pools, involving relatively volatile economies, yield large risk-sharing gains and the potential marginal gains decline quickly for groups beyond six or seven members. The largest gains are attained among countries that are diverse in terms of business cycles characteristics, institutional quality, income level, and geographic location.

In Medhora (1992), reserves pooling in the CFA zone is examined. Gains from reserves pooling are evaluated using the idea of coverage. The results show that pooling reserves in the zone has not benefited all members equally. Also it is found that in each period, one country would have been better off outside of the pool but that belonging to the pool is part of a package that involves other aspects of belonging to the monetary union. Drummond and Dhasmana (2008) examine the question of adequacy of reserves in sub-Saharan Africa (SSA) in the light of the shocks faced by these countries. Using a two-good endowment model for an economy facing terms of trade and aid shocks, they derive an optimal level of reserves by comparing the cost of holding reserves with their benefits as an insurance against a shock in which they find out that the optimal level of reserves depends upon the size of these shocks, their probability, and the output cost associated with them. The simulations results suggest that a few SSA countries do not currently carry reserves consistent with the expected output costs associated with expected terms-of-trade

or aid shocks. Sustaining adequate level of reserves is a key policy consideration for SSA countries. These countries continue to face risks arising from abrupt changes in the terms of trade and aid flows, which contribute to a higher volatility in aggregate output and, in extreme cases, to economic crisis. Countries with very low level of reserves are more strongly affected by exogenous shocks than the others.

Ruiz-Arranz and Zavadjil (2008) look at whether foreign exchange reserves in emerging Asia have grown beyond what is needed to support financial stability. They try to give reasons for the sharp increase in reserves holdings in emerging Asia over the past decade: reserves are held to provide liquidity in case of temporary shortfalls in exports or capital inflows, and thus avoid disruptive changes in the exchange rate, or investment and consumption; reserves can protect the domestic banking system from outflows of domestic or external resources and finally that the build-up of reserves in Asia was a natural response to the disruptions and the disastrous impact of the 1997-99 crises on the economic, political, and social fabric, which has understandably increased risk aversion. In their results, they find out that external reserves in emerging Asia cannot be considered as being excessive except in China and possibly Malaysia when compared to what would be optimal from a precautionary motive standpoint. However, there are notable exceptions; the model can only explain about half of the reserve accumulation that has taken place in China. Similarly, reserve levels in Malaysia at the end of 2007 had exceeded by more than twice the optimal levels predicted by the model. This suggests that factors other than insurance motives may be at play in these economies. On the other hand, the current level of reserves in Indonesia seems to be lower than predicted by the model, suggesting scope for further accumulation from an insurance motive point of view alone. The results also contradict those in Jeanne and Rancière (2006) and Jeanne (2007) who find reserves in Asia to be significantly above optimal.

Hashimoto (2008) attempts to find out whether the recent foreign reserves accumulation in Asian economies has been too extraordinary to recover the moderate level of reserves which was depleted as at the time of the currency crisis in 1997-1998. The model attempts to estimate the threshold level of reserves that would avoid speculative attacks in the foreign exchange market. If the level of reserves at the time of crisis in 1997 was well below the estimated threshold, it is interpreted that the country had too little reserves and

was vulnerable to speculative pressure in the foreign exchange market. Result show that although most Asian economies appeared to have larger reserves than the estimated threshold at the time of the crisis of 1997, reserves in terms of short-term external debt were apparently not sufficient to avoid speculative attacks. That the estimated thresholds of reserves are less than the traditional rule of thumb on reserve holdings of three months imports, or the Guidotti rule of coverage of short-term external debt, which is an indicator for the adequacy of foreign reserves measured as the ratio of short-term external debt to reserves. Although the actual values of these reserve indicators at the second quarter of 1997 in some countries did not meet the traditional rule or the Guidotti rule criteria, they were larger than the estimated threshold value of reserves. Therefore, Asian countries had not always run short of reserves, but it is hard to interpret that Asian economies had enough reserves before the crisis of 1997.

Gosselin and Parent (2005) conduct an empirical analysis of foreign exchange reserves in Emerging Asia. The authors attempt to measure how far the current level of reserves is from that predicted by the standard macroeconomic determinants in Asia. Following the estimation, their result shows that controlling for economic size is not sufficient to remove the upward trend in reserves. One potential reason for this is increasing openness to trade renders the economy more vulnerable to external shocks since imbalances in payments can be more substantial. While the authors find evidence of a positive structural break in the demand for international reserves by Asian central banks in the aftermath of the financial crisis of 1997 1998, their results indicate that the actual level of reserves accumulated from 2003 to 2004 was still in excess relative to that predicted by the model. Therefore, as long as historical relationships hold, a slowdown in the rate of accumulation of reserves is likely even if exchange rate policies in this area remain unchanged. Taken alone, this factor implies potential downward pressures on the US dollar.

In a study on reserves accumulation in Africa, Elhiraika and Ndikumana (2007) show that the increase in foreign exchange reserves has no significant impact on inflation, but a significant positive effect on the price level in the long run. Their empirical results suggest that African countries may want to reconsider their external reserves management strategies within a broader economic development policy framework. They also pointed out that the recent reserves accumulation cannot be justified by portfolio choice motives,

that is in terms of returns to assets, or stabilisation objectives given the low world interest rates and the high rates of returns to domestic assets in African countries that is high domestic real interest rates. Therefore, reserves accumulation can carry a high opportunity cost for African countries and imply cheap financing of the deficits for reserve asset countries.

An investigation as to whether holding higher reserves may reduce the volatility of the real exchange rate independently of the influence of the choice of exchange rate regime or of the role of foreign exchange intervention was undertaken by Hviding, Nowak and Ricci (2004). In order to investigate the role of reserve adequacy in reducing volatility of the real exchange rate, they analyze how such volatility is affected in turn by the volatility of macroeconomic fundamentals, variables describing policy actions to stabilize the exchange rate, and other variables that could be expected to influence market sentiment. The paper finds strong evidence of a negative non-linear effect of reserves on the short term volatility of the real effective exchange rate. The impact of reserve adequacy on exchange rate volatility does not appear to operate through intervention in the foreign exchange market but rather operates through signaling a greater potential for foreign exchange intervention in a crisis situation or a generally increased "comfort level." The result also shows that other policy actions may, however, be at least as powerful as reserve accumulation in reducing real exchange rate volatility.

Choi, Sharma, and Strömqvist (2007) examine the sensitivity and interaction between capital flows and international reserve holdings in the context of increasing financial integration where they noted that global holdings of international reserves have increased rapidly in recent years. Their analysis and findings shows that the sensitivity of the stock of reserves to capital flows has changed dramatically over time for emerging markets, and their reserve holding pattern has been quite different from that of advanced countries. That in the 1980s, reserve holdings were negatively associated with capital flows for emerging markets, while such a negative link was less pronounced for advanced countries but that the reverse is the case in recent years. This suggests that for emerging markets, capital flows were used to finance current account deficits in the 1980s while they have been used to build up reserves buffers in recent times. With increasing financial integration and the experience of capital account crises in the developing world, this buildup is attributable to

heightened concerns about the risks of "sudden stops". Thus, using measures of financial globalization, evidence abound in this analysis that the sensitivity of reserves to net capital flows increased with globalization for emerging markets while it decreased for advanced countries.

Lin and Wang (2005) analyze the relationship between foreign exchange reserves and inflation rate through the operations of the foreign exchange market in Japan and four Tigers (Hong Kong, Korea, Singapore and Taiwan). This study is an extension of the time consistency model developed by Kydland and Prescott (1977) to incorporate exchange rate stability in the policymaker's objectives. Their results reveal that on average, a 1% rise in foreign exchange reserves leads to about 0.0034% to 0.0130% fall in inflation rate. The inflation rate in Japan has a significantly negative trend, while the trends in the other four economies are not quite obvious. The empirical result with respect to each country shows that the relationship between the change in foreign exchange reserves and inflation rate is negative for Japan and is positive for Korea and Taiwan, while this relationship is insignificant for Hong Kong and Singapore. It is shown that when the foreign exchange reserves increase, the inflation rate will be rising while the exchange rate effect is strong. On the other hand, the inflation rate will be reduced when the monetary surprise effect is more powerful and the weight placed on output stability is not large.

A departure of this study from related ones is that the study will seek to evaluate whether the region can achieve the desirable and greater macroeconomic stability under a pooling and non-pooling arrangement. Even though there is a paucity of evidence on this particular issue, related studies have examined the case of reserves and its relationship with a range of macroeconomic performance indicators.

By way of summary of the empirical review undertaken, most of the studies in the literature focus on the wider subject matter of monetary integration and not purely on reserves pooling. As noted earlier, few studies have examined reserves pooling for some of the regions of the world. Williams, Polius, and Hazel (2001) present a comparison of the gains from the pooling of reserves, and hence reserve variability, in the ECCU and the CFA franc zone. The results show that countries from the two regions benefit from reserves pooling. It was shown that countries within the ECCU area have achieved greater balance of payments protection than the CFA zone countries from the pooling of reserves.

Similar results are gotten by Rajan, Siregar and Bird (2003) where reserves pooling is considered for East Asia. Rajan and Siregar (2004), find that before the Asian financial crisis, countries in the APT are better-off if they are to commit themselves to a partial pooling scheme than a complete pooling as 50% pool coverage indices are in general higher than those for the 100% pooling. While for the post-crisis period, the results for benefit of pooling are less conclusive.

In the domain of macroeconomic shock and macroeconomic stability, Bayoumi and Ostry (1997) examine the impact of asymmetric shock on output in African economies using VAR. Their study finds evidence of lower correlation of shocks to output growth at around 0.26%, 0.31% and 0.28% for ECOWAS, COMESA and SADC respectively and conclude that shock correlation may not be the appropriate basis for the existence of monetary union in Africa. However, Horvath and Grabowski (1997), using the Blanchard-Quah decomposition of shocks find evidence of high asymmetric shocks due to supply shocks in Africa. Their findings corroborates the findings of Devarajan and de Melo (1987) who find evidence of positive and high output shocks correlation in the CFA zones. On the impact of monetary integration on trade, Masson and Patillo (2005) show that monetary union would increase trade among the African countries, nonetheless, by a small magnitude. However, Frankel and Rose (1998) and DeGrauwe (2000) indicate that monetary integration has high positive effects on trade. They show that due to the effect of monetary integration, intra-regional trade would increase by three times more than it would have been; this is known as the Rose effect. Ogunkola (2005) and Ogunkola and Jerome (2005) use the real exchange rate (RER) variance as a benchmark to determine the degree of asymmetric shocks in ECOWAS. Their results show that intra-CFA RER shocks range from 0.0311 to 0.0505 and from 0.0176 to 0.0463 during the pre-SAP and the post-SAP periods, respectively while for the non-CFA West African counterpart countries, the range is from 0.857 to 0.227 and from 0.09 to 0.115 for the pre-SAP and post-SAP periods, respectively. They are able to conclude that the region is closer than before for monetary integration and that monetary integration could be beneficial to the region.

CHAPTER FOUR

THEORETICAL FRAMEWORK AND METHODOLOGY

The specific objectives of this study as noted earlier are to estimate the supply and demand determinants of international reserves and to evaluate the potential impact of reserves pooling on macroeconomic stability in the ECOWAS region, thus, incorporating two aspects of the reserves literature. For the theoretical framework of the study, the theory of the demand for reserves captures the first objective, which hinges on the determinants of reserves while the asymmetric shock model, based on the Optimum Currency Theory (OCA) significantly explains the second objective, which relates the issue of reserves pooling with macroeconomic stability.

4.1 Theoretical Framework

4.1.1. Theory of Demand for Reserves: The Buffer Stock Model

The buffer stock model is a widely applied analytical framework for explaining changes in reserves holding of a country. Heller (1966) as well as Frenkel and Jovanovic (1981) are among early authors to propound the theory. The theory centres on the principle of inventory management, which captures the literature on transactions and precautionary demand for money. The first element determining optimal reserves holdings is the stochastic process governing payments and receipts where it is assumed that changes in reserve holdings *dR(t)* can be characterised by the following stochastic equation:

$$dR(t) = -\mu dt + \sigma dW(t);\ R(0) = R_{0,}\ \mu \geq 0 \qquad (10)$$

Where *W(t)* is the standard Wiener process with mean zero and with variance t; the change in reserves in a small time interval *dt* is a normal variate with mean $-\mu d$t and variance $\sigma^2 dt$ and is temporally independent. The standard Wiener process is a continuous time

analogue to the simple random walk. At each point in time, the distribution of reserve holdings *R(t)* is characterised by

$$R(t) = R_0 - \mu t + \sigma W(t) \tag{11}$$

and

$$R(t) \sim N(R_0 - \mu t, \sigma^2 t) \tag{12}$$

Where Ro is the initial stock of reserves, taken to be the optimal level, and μt denotes the deterministic part of the instantaneous change in reserves. In the special case for which (on average) the balance of payments is balanced, μ is zero and the stochastic process that governs changes in reserves is without a drift. They characterised the distribution of the reserves holdings. As noted in the theoretical literature earlier, the model assumes that adjustment is necessary whenever the stock of reserves reaches a lower bound. This assumption is consistent with the typical pattern of adjustment to balance of payments and reserve crises. In the face of crises the division of the burden of adjustment is known to be asymmetric: typically adjustment is forced on countries with persistent balance of payments deficits rather than on countries with persistent surpluses. Without loss of generality it is assumed that the lower bound is set at zero. Nonetheless, for analytical convenience, it is useful to separate the expected cost into the part which is incurred prior to the date at which the first adjustment is necessary and the part that is incurred thereafter. Thus, the expected forgone earnings during the period up to the date of the first adjustment is considered first. This is summarized in 13.

$$J_1(R_0) = r\int_0^\infty e^{-rt}\left[\int_{R=0}^\infty Rh(R,t \setminus R_{0,}\, 0)dR\right]dt, \tag{13}$$

Equation 11 is interpreted as the present value of expected forgone earnings up to the first adjustment. At period *t* the instantaneous forgone earnings are *rR(t)* (where *r* denotes the percentage cost of holding reserves per unit of time) and the present value of this cost is $rR(t)e^{-rt}$. Since *R(t)* is a random variable, so are forgone earnings. Let $h(R,t\backslash R_0, 0)$ be the probability that reserve holdings *R(t)* which at period zero were at the optimal level *Ro*,

have not reached zero (the lower bound which necessitates adjustment) prior to period t at which reserve holdings are *R*.

Taking

$$\alpha = \int_0^{\infty} e^{-rt} f\left(R_{0,}t\right) \tag{14}$$

Whereα is the Laplace transform of the first passage probability of a Wiener process through a linear boundary, and

$$\alpha = \exp\left\{-\frac{R_0}{\sigma^2}\left[\left(\mu^2 + 2r\sigma^2\right)^{1/2} - \mu\right]\right\} \tag{15}$$

So that equation (11) can be transformed into

$$J_1(R_0) = R_0 - (r-\alpha)\frac{\mu}{r} \tag{16}$$

Considering the part of cost that is incurred following the first adjustment and denoting the present value of total cost by $G(R_0)$ (which excludes the fixed cost of adjustment *C* that is associated with acquiring *Ro*) and letting *f(Ro, t)* be the probability that reserve holdings which at period zero were at the optimal level *Ro* reached the lower bound for the first time at period t, then the present value of the expected cost following the first adjustment is

$$J_2(R_0) = \int_0^{\infty} e^{-rt}\left[C + G\left(R_0\right)\right] f\left(R_{0,}t\right)dt \tag{17}$$

which can also be rewritten as

$$J_2(R_0) = \alpha\left[C + G\left(R_0\right)\right] \tag{18}$$

Given that

$$\alpha = \int_0^{\infty} e^{-rt} f\left(R_{0,}t\right) \tag{19}$$

Adding equations (16) and (18) yields *G(Ro)* which is the present value of total expected cost:

$$G(R_0) = R_0 - (1-\alpha)\frac{\mu}{r} + \alpha\left[C + G(R_0)\right] \tag{20}$$

$$= \frac{R_0 + \alpha C}{1-\alpha} - \frac{\mu}{r} \tag{21}$$

By minimising the expected cost with respect to *Ro* we obtain equation (22) as the necessary condition for optimality

$$(1-\alpha) + (R_0 + C)\frac{\partial \alpha}{\partial R_0} = 0 \tag{22}$$

and solving for the optimal stock of reserves yields

$$R_0 = \sqrt{\left[\frac{2C\sigma^2}{\left(\mu^2 + 2r\sigma^2\right)^{1/2} - \mu}\right]} \tag{23}$$

A necessary requirement for the estimation of equation (23) is the additional assumption that observed reserves are proportional to optimal reserves up to an error term that is uncorrelated with σ and r; that is in empirical applications, the estimation of equation (23) above is based on the assumption that on average balance of payments are balanced, and thus that the stochastic process governing the difference between payments and receipts in international transactions is without a drift. To examine the optimal stock of reserves for this special case, we evaluate equation (21) at $\mu = 0$ and obtain

$$R_0 = \sqrt{\left[\frac{2C\sigma^2}{\left(2r\sigma^2\right)^{1/2}}\right]} \tag{24}$$

The previous analysis implies that, for the special case of no drift, the optimal level of reserves is *Ro*, equation (25), which can be written as:

$$R_0 = 2^{\frac{1}{2}} C^{\frac{1}{2}} \sigma^{\frac{1}{2}} r^{-\frac{1}{2}} \tag{25}$$

which shows reserves as a function of some basic macroeconomic variables

$$R = f\left(C, \sigma, r\right) \tag{26}$$

or

$$R = f\left(C, \sigma, r.....\right). \tag{27}$$

In estimable form, equation (23) becomes

$$In\ R = \beta_0 + \beta_1 ln\ \sigma + \beta_2 ln\ r + \ldots + u \tag{28}$$

rewritten in order to accommodate other major macroeconomic variables in the encompassed analytical framework.

4.1.2 The OCA and Asymmetric Shock Model

As noted earlier, the OCA theory [Mundel (1961), McKinnon (1963) Kenan (1969), Mongeli (2002), Debrun, Masson and Patillo (2005), Ricci (2008)] identifies the sources of asymmetric shocks to an economy to cover a wide spectrum in the literature. These include exchange rate variability among members, output variation, variation in terms of trade and trade flow, and variation in consumer price index. Also in the literature, asymmetric shocks are traced to fiscal policy distortions resulting from public expenditure, deficit financing and investment. The asymmetric shock model is shown to follow a vector autoregressive process where in the initial stage according to Floyd (2005), a two-variable state of the model and each variable depends on its lagged values, the current and lagged values of the other variable and on a *iid* error term is considered as presented next.

$$y_{1(t)} = v_{10} + v_{12} y_{2(t)} + a_{11} y_{1(t-1)} + a_{12} y_{2(t-2)} + e_{1(t)} \tag{29}$$

$$y_{2(t)} = v_{20} + v_{21}y_{1(t)} + a_{21}y_{1(t-1)} + a_{22}y_{2(t-2)} + e_{2(t)} \quad (30)$$

In matrix notation, this system is written as follows

$$\begin{bmatrix} y_{1(t)} \\ y_{2(t)} \end{bmatrix} = \begin{bmatrix} v_{10} \\ v_{20} \end{bmatrix} + \begin{bmatrix} 0 & v_{12} \\ v_{21} & 0 \end{bmatrix} \begin{bmatrix} y_{1(t)} \\ y_{2(t)} \end{bmatrix} + \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \begin{bmatrix} y_{1(t-1)} \\ y_{2(t-1)} \end{bmatrix} + \begin{bmatrix} e_{1(t)} \\ e_{2(t)} \end{bmatrix} \quad (31)$$

However, with K variables and P lags:

$$y_t = v + A_0 y_t + A_1 y_{t-1} + A_2 y_{t-2} + A_3 y_{t-3} + \ldots + A_p y_{t-p} + e_t \quad (32)$$

Where y_t, v and e_t are kx1 column vectors and $\mathbf{A_0}$, $\mathbf{A_1}$, $\mathbf{A_2}$, . . . $\mathbf{A_p}$ are K x K matrices of coefficients. The vector $\boldsymbol{e_t}$ is a vector of white noise residuals that satisfies $E\left\{Ee_t e_t'\right\}$ = **D**, where **D** is a diagonal matrix. An appropriate scaling of the elements of y would make **D** an identity matrix.

The standard (reduced) form of the above structural VAR system in equations 29 and 30 can be seen:

$$y_{1(t)} = b_{10} + b_{11}y_{1(t-1)} + b_{12}y_{2(t-2)} + u_{1(t)} \quad (33)$$

$$y_{2(t)} = b_{20} + b_{21}y_{1(t-1)} + b_{22}y_{2(t-2)} + u_{2(t)} \quad (34)$$

More compactly,

$$\begin{bmatrix} y_{1(t)} \\ y_{2(t)} \end{bmatrix} = \begin{bmatrix} b_{10} \\ b_{20} \end{bmatrix} + \begin{bmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{bmatrix} \begin{bmatrix} y_{1(t-1)} \\ y_{2(t-1)} \end{bmatrix} + \begin{bmatrix} u_{1(t)} \\ u_{2(t)} \end{bmatrix} \quad (35)$$

Where

$$b_{10} = \frac{v_{10} + v_{12}v_{20}}{1 - v_{12}v_{21}} \quad b_{20} = \frac{v_{20} + v_{21}v_{10}}{1 - v_{12}v_{21}}$$
$$b_{11} = \frac{v_{12}a_{11} + a_{21}}{1 - v_{12}v_{21}} \quad b_{21} = \frac{a_{21} + v_{21}a_{11}}{1 - v_{12}v_{21}}$$
$$b_{12} = \frac{a_{12} + v_{12}a_{22}}{1 - v_{12}v_{21}} \quad b_{22} = \frac{v_{21}a_{21} + a_{22}}{1 - v_{12}v_{21}} \qquad (35a)$$

With

$$u_{1(t)} = \frac{1}{1 - v_{12}v_{21}}\left[e_{1(t)} + v_{12}e_{2(t)}\right] \qquad (35b)$$

And

$$u_{2(t)} = \frac{1}{1 - v_{12}v_{21}}\left[e_{2(t)} + v_{21}e_{1(t)}\right] \qquad (35c)$$

While for the *K* variable case with *p* lags,

$$(I - A_0)y_t = v + A_1y_{t-1} + A_2y_{t-2} + A_3y_{t-3} + \ldots + A_py_{t-p} + e_t \qquad (36)$$

With the assumption that the inverse of $(I - A_0)$ exists, this reduces to

$$y_t = (I - A_0)^{-1}v + (I - A_0)^{-1}A_1y_{t-1} + (I - A_0)^{-1}A_2y_{t-2}$$

$$+(I-A_0)^{-1}A_3y_{t-3}+...+(I-A_0)^{-1}A_py_{t-p}+(I-A_0)^{-1}e_t \quad (37)$$

Letting

$$b=(I-A_0)^{-1}v, \qquad B_3=(I-A_0)^{-1}A_3,$$
$$B_1=(I-A_0)^{-1}A_1, \quad B_p=(I-A_0)^{-1}A_p,$$
$$B_2=(I-A_0)^{-1}A_2, \; u_t=(I-A_0)^{-1}e_t$$

So that

$$y_t=b+B_1y_{t-1}+B_2y_{t-2}+B_3y_{t-3}+...+B_py_{t-p}+u_t \quad (38)$$

The standard form system given by (38) can be manipulated to express the current value of each variable as a function solely of the vector of residuals $\boldsymbol{u_t}$. This is called its moving average representation; $\mathbf{y_t}$ is a moving average of the current and past values of $\boldsymbol{u_t}$.

$$y_t=C_0u_t+C_1u_{t-1}+C_2u_{t-2}+C_3u_{t-3}+...+C_su_{t-s}+y_0 \quad (39)$$

Where y_0 is some initial value of $\boldsymbol{y_t}$

As stated above, $E\left\{Ee_te_t'\right\}$ = D; so that the variance-covariance matrix of the vector of residuals $\boldsymbol{u_t}$ equals

$$\Omega = E\left\{Eu_t u_t'\right\}$$

$$where$$

$$u_t = (I - A_0)^{-1} e_t,$$

$$\Omega = E\left\{Eu_t u_t'\right\}$$

$$= E\left\{\left[(I - A_0)^{-1} e_t\right]\left[(I - A_0)^{-1} e_t\right]'\right\}$$

$$= E\left\{\left[(I - A_0)^{-1}\right] e_t e_t' \left[(I - A_0)^{-1}\right]'\right\}$$

$$= \left[(I - A_0)^{-1}\right] E\left\{e_t e_t'\right\}\left[(I - A_0)^{-1}\right]'$$

$$= \left[(I - A_0)^{-1}\right] D\left[(I - A_0)^{-1}\right]' \qquad (40)$$

However, the problem is that the shocks to the equations contained in the vector $\boldsymbol{u_t}$ are correlated with each other. We therefore cannot determine what the effects on the *K* variables of a shock to an individual structural equation alone would be. This is so as an observed $\boldsymbol{u_t}$ will represent the combined shocks to a number of equations. This can be seen from the fact that from equation (40),

$$u_t = (I - A_0)^{-1} e_t \qquad (41)$$

Therefore, in order to determine the effects of a shock to an individual structural equation of the system, we have to be able to solve the system for A_0 and thereby obtaining $(I - A_0)^{-1}$. This is vital as it will enable us to operate on equation (39) to transform the $\mathbf{U_{t-j}}$'s into $\mathbf{e_{t-j}}$'s and in the process of doing this, the matrices $\mathbf{C_j}$ will also be transformed into a useful representation of the **impulse responses**.

The matrix $\mathbf{A_0}$ can be obtained by statistically estimating the structural model (32). If so, the necessity of running a VAR would have been obviated. However, the reason for VAR analysis is to avoid multi-equation structural models. The approach used to identify A_0 in VAR analysis is to find the matrix that will orthogonalise the errors; that will transform the $\mathbf{u}_{t-j}$'s in into the $\mathbf{e}_{t-j}$'s, which are uncorrelated with each other.

Given any matrix **G** that has an inverse, equation (39) can be rewritten as follows:

$$y_t = C_0 G G^{-1} u_t + C_1 G G^{-1} u_{t-1} + C_2 G G^{-1} u_{t-2}$$

$$+ C_3 G G^{-1} u_{t-3} + ... + C_s G G^{-1} u_{t-s} + y_0 \quad (42)$$

Therefore, the main task here requires finding the **G** for which

$$G = (I - A_0)^{-1} \quad (43)$$

Then

$$y_t = Z_0 e_t + Z_1 e_{t-1} + Z_2 e_{t-2} + Z_3 e_{t-3} + ... + Z_s e_{t-s} + y_0 \quad (44)$$

Where $e_{t-j} = G^{-1} u_{t-j}$ which implies that $u_{t-j} = G e_{t-j}$

The Cholesky Decompositions

Since the matrix of coefficient $\boldsymbol{A_0}$is a K x K matrix, it is always of the form,

$$\begin{bmatrix} 0 & 0 & 0 & \cdots & \cdots & \cdots & \cdots & 0 & 0 \\ a_{21}^0 & a_{21}^0 & a_{21}^0 & \cdots & \cdots & \cdots & \cdots & 0 & 0 \\ a_{31}^0 & a_{31}^0 & a_{31}^0 & \cdots & \cdots & \cdots & \cdots & 0 & 0 \\ a_{41}^0 & a_{41}^0 & a_{41}^0 & \cdots & \cdots & \cdots & \cdots & 0 & 0 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ a_{m1}^0 & a_{m1}^0 & a_{m1}^0 & \cdots & \cdots & \cdots & \cdots & a_{m(m-1)}^0 & 0 \end{bmatrix} \quad (45)$$

Then the structural equation will be of the form

$$\begin{aligned} y_{1t} &= a_{11}^1 y_{1(t-1)} \\ y_{2t} &= a_{21}^0 y_{1t} + a_{21}^1 y_{1(t-1)} + a_{22}^1 y_{2(t-1)} \\ y_{3t} &= a_{31}^0 y_{1t} + a_{32}^0 y_{2t} + a_{31}^1 y_{1(t-1)} + a_{32}^1 y_{2(t-1)} \\ y_{4t} &= a_{41}^0 y_{1t} + a_{42}^0 y_{2t} + a_{43}^0 y_{3t} + a_{42}^1 y_{1(t-1)} + a_{42}^1 y_{2(t-1)} \\ \ldots\ldots &= \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \\ \ldots\ldots &= \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \\ \ldots\ldots &= \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \end{aligned} \quad (46)$$

It is worthy of note from the system that none of the current year values of y_2, y_3, y_4,……,y_m enter into the determination of the current year level of y_1. The current year level of y_1 enters into the determination of the current year level of y_2 and both the current levels of $y1$ and y_2 enter into the determination of the current level of y_3, the current levels of y_1, y_2 and y_3 enter into the determination of the current level of y_4, and so forth so that the system is fundamentally recursive.

4.2 Methodology

The discussion in the theoretical framework section above gives rise to the following models. The first is based on the theory of demand for reserves, which leads to the estimation of the demand and supply determinants of international reserves and the second is the OCA theory and asymmetric shocks model which dovetails into the evaluation of reserves pooling and macroeconomic stability.

4.2.1 Model 1

Stemming from the calibration that leads to equations 27 and 28, the external reserves demand and supply function for international reserves in the ECOWAS region can be specified as follows:

$$RES_t = \varphi_1 + \delta_1 + \alpha_1 RES_{it-1} + \alpha_2 GDPGR_{it} + \alpha_3 EXPT_{it} + \alpha_4 INVT_{it} + \alpha_5 FDI_{it} + \varepsilon_i \quad (47)$$

and

$$RES_t = \varphi_1 + \delta_1 + \beta_1 RES_{it-1} + \beta_2 DEBT_{it} + \beta_3 IMPT_{it} + \beta_4 GOVT_{it} + \beta_5 INF_{it} + \beta_6 EXR_{it} + \varepsilon_i \quad (48)$$

Where, RES_t in the study stands for the total reserves of the individual countries as percentage of GDP. Reserves here are total reserves minus gold comprising special drawing rights, reserves of IMF members held by the IMF, and holdings of foreign exchange under the control of monetary authorities. Gold holdings are excluded. Data are in current U.S. dollars. GDPGR represents the growth rate of GDP of the countries under consideration. It is the annual percentage growth rate of GDP at market prices based on constant local currency. Aggregates are based on constant 2000 U.S. dollars. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes

and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources.

GOVT is general government final consumption expenditure as percentage of GDP. General government final consumption expenditure is also general government consumption which includes all government current expenditures for purchases of goods and services (including compensation of employees). It also includes most expenditure on national defense and security, but excludes government military expenditures that are part of government capital formation.

INV is investment which is measured by gross capital formation as percentage of GDP. Gross capital formation which is also gross domestic investment consists of outlays on additions to the fixed assets of the economy plus net changes in the level of inventories. Fixed assets include land improvements (fences, ditches, drains, and so on); plant, machinery, and equipment purchases; and the construction of roads, railways, and the like, including schools, offices, hospitals, private residential dwellings, and commercial and industrial buildings. Inventories are stocks of goods held by firms to meet temporary or unexpected fluctuations in production or sales, and "work in progress." According to the 1993 SNA, net acquisitions of valuables are also considered capital formation.

EXPT is exports as percentage of GDP. Exports of goods and services represent the value of all goods and other market services provided to the rest of the world. They include the value of merchandise, freight, insurance, transport, travel, royalties, license fees, and other services, such as communication, construction, financial, information, business, personal, and government services. They exclude compensation of employees and investment income (formerly called factor services) and transfer payments. IMPT is imports as percentage of GDP. Imports of goods and services represent the value of all goods and other market services received from the rest of the world. They include the value of merchandise, freight, insurance, transport, travel, royalties, license fees, and other services, such as communication, construction, financial, information, business, personal, and government services. They exclude compensation of employees and investment income (formerly called factor services) and transfer payments.

DEBT is total external debt stock as percentage of GDP. It measured as total debt owed to non-residents repayable in foreign currency, goods, or services. It is the sum of public, publicly guaranteed, and private nonguaranteed long-term debt, short-term debt, and use of IMF credit. EXR is the period average official exchange rate of the respective local currency to the US dollar. It is the exchange rate determined by national authorities or to the rate determined in the legally sanctioned exchange market. It is calculated as an annual average based on monthly averages (local currency units relative to the U.S. dollar). Finally, ε_t is a vector of innovations that may be contemporaneously correlated but are uncorrelated with their own lagged values and uncorrelated with all of the right-hand side variables.

FDI is foreign direct investment as percentage of GDP. It is the net inflows of investment to acquire a lasting management interest (10 percent or more of voting stock) in an enterprise operating in an economy other than that of the investor. It is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital as shown in the balance of payments. This series shows total net, that is, net FDI in the reporting economy from foreign sources less net FDI by the reporting economy to the rest of the world.

INF is inflation rate. Inflation as measured by the consumer price index reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, such as yearly. The Laspeyres formula is generally used.

4.2.2 Model 2

This study also models the behaviour of the macroeconomic variables identified by the OCA theory as the sources of macroeconomic shocks with respect to pooled and unpooled reserves to examine whether a possible reserves pooling arrangement in the ECOWAS region can mitigate the negative impact of the shocks with the aid of the observed dynamic impulse responses from the vector autoregressive framework calibrated in section 4.1 above. The impulse response can provide information on how a variable responds to shocks or innovations in other variables. Also, it enables us trace temporal responses of variables to its own shocks and shocks in other variables as well as provide

detailed information on the relative strength and stability of the pooling arrangement. Thus, following the sources of shocks in the OCA theory and the framework in equation (46), the succeeding behavioural equations are specified:

$$GOVT_{it} = \alpha + \sum_{i=1}^{p} \beta_i RESU_{t-i} + \sum_{i=1}^{p} \varphi_i RESP_{t-i} + \varepsilon_t \quad (49)$$

$$INV_{it} = \alpha + \sum_{i=1}^{p} \beta_i RESU_{t-i} + \sum_{i=1}^{p} \varphi_i RESP_{t-i} + \varepsilon_t \quad (50)$$

$$GDPGR_{it} = \alpha + \sum_{i=1}^{p} \beta_i RESU_{t-i} + \sum_{i=1}^{p} \varphi_i RESP_{t-i} + \varepsilon_t \quad (51)$$

$$TRF_{it} = \alpha + \sum_{i=1}^{p} \beta_i RESU_{t-i} + \sum_{i=1}^{p} \varphi_i RESP_{t-i} + \varepsilon_t \quad (52)$$

$$DEBT_{it} = \alpha + \sum_{i=1}^{p} \beta_i RESU_{t-i} + \sum_{i=1}^{p} \varphi_i RESP_{t-i} + \varepsilon_t \quad (53)$$

$$EXR_{it} = \alpha + \sum_{i=1}^{p} \beta_i RESU_{t-i} + \sum_{i=1}^{p} \varphi_i RESP_{t-i} + \varepsilon_t \quad (54)$$

RESU in the study stands for the total unpooled reserves of the individual countries as percentage of GDP. Reserves are total reserves minus gold comprising special drawing rights, reserves of IMF members held by the IMF, and holdings of foreign exchange under the control of monetary authorities. Gold holdings are excluded. RESP represents pooled reserves of the countries as percentage of their GDP in the region. This is a situation where the countries in the region are committed to a 60% reserves pooling arrangement. Notably, 60% is chosen as it is discovered that this is the prevailing pooling commitment in the WAEMU as it is considered to be pooling already. Thus this study intends to employ this commitment to examine the effect of the pooling on macroeconomic stability for the ECOWAS region. WAEMU's pooling is used as a benchmark to do a counterfactual analysis for ECOWAS on the impact of pooling on macroeconomic stability of ECOWAS.

GDPGR represents the growth rate of GDP of the countries under consideration. It is the annual percentage growth rate of GDP at market prices based on constant local currency. Aggregates are based on constant 2000 US dollars. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources.

GOVT is general government final consumption expenditure as percentage of GDP. General government final consumption expenditure is also general government consumption which includes all government current expenditures for purchases of goods and services (including compensation of employees). It also includes most expenditure on national defense and security, but excludes government military expenditures that are part of government capital formation.

INV is investment which is measured by gross capital formation as percentage of GDP. Gross capital formation which is also gross domestic investment consists of outlays on additions to the fixed assets of the economy plus net changes in the level of inventories. Fixed assets include land improvements (fences, ditches, drains, and so on); plant, machinery, and equipment purchases; and the construction of roads, railways, and the like, including schools, offices, hospitals, private residential dwellings, and commercial and industrial buildings. Inventories are stocks of goods held by firms to meet temporary or unexpected fluctuations in production or sales, and "work in progress." According to the 1993 SNA, net acquisitions of valuables are also considered capital formation.

TRF represents trade flows as percentage of GDP which is a measure of the degree of openness of the countries. It consists of the ratio of total exports and import to GDP in percentage. Here, exports of goods and services represent the value of all goods and other market services provided to the rest of the world. They include the value of merchandise, freight, insurance, transport, travel, royalties, license fees, and other services, such as communication, construction, financial, information, business, personal, and government services. They exclude compensation of employees and investment income (formerly called factor services) and transfer payments. Imports of goods and services represent the value of all goods and other market services received from the rest of the world. They

include the value of merchandise, freight, insurance, transport, travel, royalties, license fees, and other services, such as communication, construction, financial, information, business, personal, and government services. They exclude compensation of employees and investment income (formerly called factor services) and transfer payments.

DEBT is total external debt stock as percentage of GDP. It measured as total debt owed to non-residents repayable in foreign currency, goods, or services. It is the sum of public, publicly guaranteed, and private nonguaranteed long-term debt, short-term debt, and use of IMF credit. EXR is the period average official exchange rate of the respective local currency to the US dollar. It is the exchange rate determined by national authorities or to the rate determined in the legally sanctioned exchange market. It is calculated as an annual average based on monthly averages (local currency units relative to the US dollar). Finally, ε_t is a vector of innovations that may be contemporaneously correlated but are uncorrelated with their own lagged values and uncorrelated with all of the right-hand side variables.

4.3 Estimation Techniques

Panel data analysis will be employed to examine the supply and demand determinants of international reserves holdings for the countries in the first instance. This will provide an empirical elucidation on the determinants of international reserves for the region. Here, both the fixed effects model and the random effects model will be considered. In order to examine the impact of reserves pooling on ECOWAS macroeconomic stability, the impulse response and variance decomposition from the vector autoregression (VAR) framework will be employed. VAR is commonly used for forecasting systems of interrelated time series and for analysing the dynamic impact of random disturbances on the system of variables. The VAR approach obviates the necessity for structural modeling by treating every endogenous variable in the system as a function of the lagged values of all of the endogenous variables in the system as well as other exogenous variables. It measures the percentage of the forecast error of variable that is explained by another. Precisely, it indicates the relative impact that one variable has on another variable. At the same time, it provides information on how a variable of interest responds to shocks or

innovations in other variables. On the other hand, the IRFs allow us to trace temporal responses of variables to its own shocks and shocks in other variables. The results of the VDCs will provide detailed information on the relative strength and stability of the pooling arrangement. From the VDCs and IRFs results, we will capture the relative importance of various shocks and their influences on the macroeconomic stability of member states. The VDCs and IRFs are simulated by orthogonalising the innovations in the VAR equations using the Cholesky decomposition suggested by Sim (1980).

The impulse response is employed to examine the dynamic relationships among variables specifically in this study among macroeconomic variables in relation to a reserves pooling arrangement. The impulse response function traces the time path of a shock in one variable on the remaining variables. By providing the time path of the impact of a shock on the future values of all the variables in the multivariate dynamic system, the impulse response analysis should give better insights into short-term and long-term linkages among the variables employed in each of the six behavioural models employed in this study. On the other hand, the variance decomposition sequences depict a compact overview of the dynamic structures of the VAR Model. This decomposition is also based on a vector moving average model and orthogonal error terms. In contrast to impulse response, the task of variance decomposition is to generate information about the forecast ability. The idea is that even a perfect model involves ambiguity about the realisation of the endogenous variable and its lags because the error terms are associated with uncertainty. According to the interactions between the equations, the uncertainty is transformed to all equations. Thus, the aim of the decomposition is to reduce the uncertainty in one equation to the variance of error terms in all equations.

The choice of this methodology is informed by the fact that when measuring responses to shocks and instability transmission, the VAR methodology is suitable as evident in various studies that have made use of the technique (see, Ogunkola 2005, Bayoumi and Eichengreen, Wami 2005 and Okafor 2011). However, VAR is observed as only a better tool of measuring shocks which makes it more restrictive as Ogunkola (2005) has pointed out the relative dearth of appropriate methodology in studies relating to monetary integration and the OCA criteria.

4.4 Data Type and Sources

The study makes use of time series data from 1981 to 2011 (but uses data from 2001-2011 in the first instance of the analysis) obtained from the IMF International Financial Statistics (IFS) and the World Bank Social Indicators of Development database. Some of the variables of interest for the models to be used in this study include external reserves, GDP, exchange rate, inflation, import of goods and services, export of goods and services, and interest rate.

CHAPTER FIVE

EMPIRICAL ANALYSIS

5.1 Data Diagnostics

5.1.1 Summary Statistics

Table 5.1 shows the summary statistics of the macroeconomic variables employed in this study for the countries in the ECOWAS region. These variables are the unpooled reserves of the countries (RESU), pooled reserves of the countries under an optimal 60% pooling arrangement (RESP), government expenditure (GOVT), investment (INV), growth rate of GDP (GDPGR), trade flow (TRF), debt (debt) and exchange rate (EXR). With the exception of exchange rate (which is in log) and GDPGR, all the variables employed are percentage shares of the GDP of the respective countries in US dollars. From this result, it can be observed that the average percentage of pooled reserves is the highest among the variables.

This is closely followed by the percentage share of debt in GDP of 122.68%. This shows the extent to which debt accumulation is a subject of concern in the region with countries like Liberia, Guinea Bissau and Cote d'voire with the highest individual average shares of 584.53%, 264.90% and 177.8% respectively. The percentage share of trade flows is the next highest after debt. This shows the extent to which the countries in the region are opened in terms of trading activities with other countries of the world. The average shares of investment, government expenditures and unpooled reserves are 18.44%, 13.24% and 10.41% respectively while of EXR and GDPGR are 4.76 and 3.41% respectively. An observation of the median values of the variables reveals that they are not significantly different from their respective mean values except for the share of pooled reserves and debt.

Table 5.1. Summary Statistics of Macroeconomic Variables Employed in the Study

	RESU	RESP	GOVT	INV	GDPGR	TRF	DEBT	EXR	IMP	EXP
Mean	10.40509	116.5880	13.24184	18.43927	3.326305	65.10890	122.6810	4.57509	36.5819	24.9884
Median	9.491249	48.58316	11.99950	17.53587	3.783271	61.95884	79.65388	5.70556	33.0692	24.4797
Maximum	50.58917	924.2271	54.51542	52.88038	106.2798	178.9820	1829.488	8.80357	144.616	91.5139
Minimum	-0.482653	1.888341	2.851294	-2.424358	-51.03086	6.320343	4.543929	-8.19927	0.00000	0.00000
Std. Dev.	8.360771	168.2401	5.922469	9.349251	8.423420	24.50516	190.1991	2.78816	18.5086	13.4685
Skewness	1.025826	2.590387	1.981421	0.982843	2.736513	0.903235	5.519907	-1.64706	1.20561	0.51011
Kurtosis	4.411807	9.896001	10.90381	4.188519	57.36284	4.578524	40.70880	5.94179	8.20299	3.85671
Jarque-Bera	116.0379	1425.909	1384.336	92.11889	57093.34	104.3107	29590.10	377.917	630.298	34.0172
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.00000	0.00000	0.00000
Sum	4671.886	53630.46	5627.781	7726.052	1526.774	28322.37	56433.27	2127.41	16827.6	11494.6
Sum Sq. Dev	31316.31	12991870	14872.07	36536.75	32496.93	260618.2	16604640	3607.07	157238	83263.1
Observations	460	460	425	429	459	435	460	465	460	460

Source: Author's Computation from Estimation Results

In addition, the standard deviations of the variables are also clustered around the mean values suggesting that the variables are properly distributed. The standard deviation as well as the kurtosis and skewness are measures of dispersion. The result suggests that all the variables are positively skewed safe for exchange rate which has a fat-left tail. The mean, skewness, kurtosis and Jarque Bera are traditional tests for the establishment of the normality of the variables. Based on the shown outcomes in the table we reject the null hypothesis of normal distribution of the variables. The implication of this is that normality tests statistics such as the t, z and F may not be significantly consequential for drawing statistical inferences about the probability of the error terms. This finding is further corroborated by the multivariate VAR residual normality tests and presented in the appendices.

5.1.2 Panel Unit Root Test

Since the study largely employed time series data, the stationarity properties of the variables are considered. The test is carried out the results are presented in table 5.2. Here panel unit root is the focus since the scope of the study is a panel of countries. This is done using two different types of panel unit root tests. These are the Levin, Lin and Chu test as well as the Im, Pesaran and Shin test. The tests are carried out to determine the stationarity level of the variables. From the results using the Levin, Lin and Chu, the variables RESU, RESP, GOVT, INV, TRF, DEBT and EXR are integrated of order one. GDPGR is the only variable in the list that is tested to be integrated of order 0. These conclusions are arrived at on the basis of the critical values denoted beneath the table. These levels of stationarity of the variable are further corroborated by the results from the Im, Pesaran and Shin test that the variables, except GDPGR are not integrated at level but integrated at their respective first differences.

Table 5.2. Panel Unit Root Test for the Variables Employed

VARIABLES	Levin, Lin & Chu t*	Im, Pesaran and Shin W-stat	Order of Stationarity	Conclusion
RESU	-8.59180	-10.5852	1st Difference	I(1)
RESP	-10.6370	-10.3981	1st Difference	I(1)
GOVT	-11.0824	-12.1192	1st Difference	I(1)
INV	-6.39935	-10.2697	1st Difference	I(1)
GDPGR	-6.55820	-9.78706	Level	I(0)
TRF	-9.67387	-11.7141	1st Difference	I(1)
DEBT	-7.27960	-8.47671	1st Difference	I(1)
EXR	-6.50336	-8.53900	1st Difference	I(1)

Note: the critical values are -3.64, -2.95 and -2.61 for 1%, 5% and 10% significant levels respectively

Source: Author's Computation from Estimation Results

5.1.3 Cointegration Test

Given the non-stationarity properties of the variables evidenced from the unit root test conducted, the obviation of the possibilities of spuriousness of estimation results is a necessity. This is done through the determination of the possibility of along run relationship existing between and among the chosen variables. The possibility of a long run relation is carried out by the use of cointegration test. In this study, two types of cointegration tests are carried out. The Kao residual cointegration test and the Johansen test for multivariate cointegration are also employed to examine the cointegration status of the six behavioural equations in this part of the study.

i. Panel Cointegration Test

The result from the Kao residual cointegration test is presented in table 5.3.

Table 5.3. Panel Cointegration Test

Kao Residual Cointegration Test Series: RESU RESP GOVT INV GDPGR TRF DEBT EXR				
Null Hypothesis: No cointegration				
Trend assumption: No deterministic trend				
Automatic lag length selection based on SIC with a max lag of 2				
Newey-West automatic bandwidth selection and Bartlett kernel				
			t-Statistic	Prob.
ADF			-1.631272	0.0414
Residual variance			13.43685	
HAC variance			10.52585	

Source: Author's Computation from Estimation Results

The Kao test is carried out using an Automatic lag length selection based on Schwartz information criterion with a maximum lag of two and also on the basis of Newey-West automatic bandwidth selection and Bartlett Kernel. The assumption regarding the trend is that of no deterministic trend. The null hypothesis is that of no cointegration among the variables. From the results reported in table 5.3 on the basis of the Kao residual test, the null hypothesis of no cointegration can be rejected on the basis of the shown probability value at 5% level of significance. Therefore, we can accept the alternate hypothesis and conclude in favour of the presence of cointegration among the chosen variables.

vi. The Johansen Cointegration Test

The Johansen cointegration test results for the behavioural equations are shown in table 5.4 below. The table displays the behavioural equations as well as the number of cointegrating equations found on the basis of the trace test values as well as the max-eigenvalues. From table 5.4, it can be observed that each of the trace and the max-eigenvalue detect the presence of two cointegrating equations for the government equation. This is also the observation for the investment equation where two cointegrating equations are detected for both the trace and max-eigen value. However, in the economic growth equation, both the trace and the max-eigenvalue detect the presence of three cointegrating equations. For the remaining trade flow equation, debt equation as well as the exchange rate equation, two cointegrating equations are detected by both trace and max-eigenvalue. This shows that in all the six behavioural equations, we cannot accept the null hypothesis of no cointegration among the variables but accept the alternate hypothesis and conclude that there exists the presence of a long run relationship among the variables. By implication, if a set of variables are cointegrated in econometrics analysis, the effects of a shock to one variable spread to the others, possibly with time lags, so as to preserve a long-run relationship between the variables.

Table 5.4. Summary of Johansen Cointegration Test Results

Equation	Number of Cointegrating Equation(s) at the 0.05 level	
	Trace Test	**Max-eigenvalue Test**
GOVERNMENT	2	2
INVESTMENT	2	2
GROWTH	3	3
TRADE FLOW	2	2
DEBT	2	2
EXCHANGE RATE	2	2

Source: Author's Computation from Estimation Results

5.2 Fixed Effects and Random Effects Models for Determinants of International Reserves in ECOWAS

In the first instance, an analysis of the supply and demand determinants of international reserves is evaluated for the region. This is a panel data analysis and the fixed effects model and the random effects models are estimated and examined as presented in table 5.5 below.

It is evident from the results, given the value of the R^2 (adjusted), that the independent variables in the model significantly explain changes in external reserves holdings of the ECOWAS countries. This is made obvious given the observation that the R^2 (adjusted) for both the fixed effects model (FEM) and random effects model (REM) are 87.9% and 87.7% respectively. Thus, the observable changes in the reserves of the countries are attributed to the independent variables. The model is overall significant given that the value of the F-statistic is significant at 1%. The Durbin-Watson statistics for both the FEM and the REM suggest the null hypothesis that $\rho = 0$ be accepted where ρ is the autocorrelation coefficient signifying the absence of serial correlation of the disturbance term.

From the result of the fixed and random effect models, it can be observed that the results present sufficient evidence of the impact of the included explanatory variables on the dependent variable. It is observed that in the fixed effect model, it can be seen that the constant of the regression is significant albeit at 10%. This shows the value of the autonomous component of the regression which is the value the dependent variable assumes in the face of total insignificance of all other independent variables. The random effect model result however shows that the constant is not significant. The inclusion of the immediate past period lagged of the dependent variable captures part of the changes in reserves accumulation in the region as the positive coefficient suggest that the stock of reserves in time t-1 adds to reserves in time t. Theory, of course, suggests that the value of a variable in the current period is significantly affected by its lag(s).

Table 5.5. Panel Data Analysis of the International Reserves Supply Model for ECOWAS

Explanatory variables	**Fixed effects model**	**Random effects model**
Constant	-0.6807* (0.6260)	-0.2534 (0.6242)
RESV(-1)	0.8900*** (30.4701)	0.5432* (2.9436)
GDPGR	0.0033* (0.0957)	0.8352 (23.263)
INVMT	0.0173** (0.808)	0.0032* (5.3621)
INVMT (-1)	-0.0848 (1.932)	-0.3100* (12.628)
EXPORT	0.0455*** 3.4317	0.8912*** (0.3846)
FDI	0.0923** (1.8745)	0.0085 (0.9860)
Adj. R Square	0.879	0.877
D-Watson	2.1109	1.8946
S.E. of regression	3.2832	3.8725
F- statistic	42.9653***	
Hausman Chi-square	-	8.253**
No of Countries	15	15

Note: (1) The absolute t-statistics are in parentheses. (2) ***, ** and * denote significance at 1%, 5% and 10% levels respectively.

This is observed both in the fixed effect model and the random effect models. As expected, GDP is positively related to reserves hoarding in the region; meaning that GDP has a significantly positive impact on external reserves accumulation of the country. Even though the fixed effect model is significant at 1%, the random effect model is not. This implies that international reserves accumulation increases with economic size in the ECOWAS region. This result corroborates our apriori expectation about the effect of GDP on reserves hoarding and as found out in the empirical literatures (Gosselin and Parent, 2005) and (Elhiraika and Ndikumana, 2007) where the effect of GDP on external reserves is positive and significant.

In support of the main drivers of external reserves discussed earlier, exports of the countries constitute the major source of supply of the accumulation as evident by the significance of both the FEM and the REM. This confirms our expectation (apriori) regarding the effect of this variable as well as the early statement that most African economies have been accumulating sizable international reserves in the face of today's increasing globalisation and the adverse effect of low reserves holdings during the global economic crises of 2008. Elhiraika and Ndikumana (2007) confirm this and found further (by the sizes of their coefficients) that the real exports effect is even greater than the real GDP effect, underscoring the role of commodity exports (oil and non-oil) in external reserves buildup among African countries. This result buttresses the significance of exports in explaining reserves accumulation than GDP.

The result for FDI and net capital inflows is positive and significant at 10% for the FEM while that of the REM is not significant. As regards the effect and significance of this variable on the international reserves holdings of the West African economies, the result reveals is in line with the anticipation of this study that the size of the external reserves increases with inflow of FDI and capital. Economic theory suggests further that with the inflow of FDI and capital, there will be adequate provision of employment and infrastructure thus leading to general alleviation from poverty, thereby obviating the necessity of de-accumulating the stock of reserves for these purposes. This result also confirms what Soludo (2007) emphasized concerning the positive impact of the variables on reserves accumulation of the country.

The result with respect to the investment coefficient shows that the variable is significant in explaining changes in the international reserves holdings of these countries in the region. As shown, in the current period, the coefficients for both the FEM and the REM are positive and significant. While the FEM is significant at 5%, the REM is significant at 10%. The first period lag of the variable is included in the analysis as a robustness check. It is shown that the coefficients are both negative for the FEM and REM models. While the FEM coefficient is not significant, the REM is significant albeit at 10%. The findings from the investment result suggest that even though investment may be seen as a dis-saving in time t-1, current period (thereby leading to the negative relationship observed) it results to an accretion to overall reserves holdings in the current period. The evidence here corroborates the result of Elhiraika et al (2007) that investment is seen as a boost to efforts towards the accumulation of sizable international reserves. Also the results corroborates the fact that most African economies have been pursuing expansive macroeconomic policy measures to enable them reap the full benefits of increased public investment in the future. The Hausman test result rejects the unbiasedness of the random effect model (estimator) at 5% level of significance which implies that the random effects could be biased, suggesting the need to somewhat rely solely on the fixed effect model.

Turning attention to the demand model, it is also observed from the results, given the value of the R^2 (adjusted), that the independent variables in the model significantly explain changes in external reserves holdings of the ECOWAS countries just as it is in the supply model discussed above. This is made obvious given the observation that the R^2 (adjusted) for both the fixed effects model (FEM) and random effects model (REM) are 86.36% and 85.84% respectively.

Table 5.6. Panel Data Analysis of the International Reserves Demand Model for ECOWAS

Explanatory variables	**Fixed effects model**	**Random effects model**
Constant	0.4258 (0.3416)	-0.3836* (18.394)
RES(-1)	0.8739* (27.302)	0.00983 (0.8362
IMPORT	-0.4325** (2.4732)	-0.3984* (5.3845)
GOVT	-0.0291*** (11.736)	-0.0948** (3.594)
DEBT	-0.8291** (0.4732)	0.3847*** (1.657)
EXCHR	0.9374 (7.843)	0.0083* (23.853)
EXCHR(-1)	0.0662** (0.3147)	0.5637* (0.7453)
INF	0.00583* (1.9900)	0.0463** (0.7463)
Adj. R Square	0.8636	0.8584
D-Watson	1.988	1.838
S.E. of regression	5.6832	5.9463
F- statistic	34.2873***	-
Hausman Chi-square	-	6.574*
No of Countries	15	15

Note: (1) The absolute t-statistics are in parentheses. (2) ***, ** and * denote significance at 1%, 5% and 10% levels respectively.

Thus, the observable changes in the reserves of the countries are attributed to the independent variables. The model is overall significant given that the value of the F-statistic is significant at 1%. The Durbin-Watson statistics, 1.988 and 1.838 for both the FEM and the REM respectively suggest the null hypothesis that $\rho = 0$ be accepted where ρ is the autocorrelation coefficient signifying the absence of serial correlation of the disturbance term.

The result for both the FEM and REM are as shown in the table. As shown earlier in the supply model, the inclusion of the immediate past period lagged of the dependent variable captures part of the changes in reserves accumulation in the region as the positive coefficient suggest that the stock of reserves in time t-1 adds to reserves in time t which is in line with the suggestion of theory that the value of a variable in the current period is significantly affected by its lag(s). This significance is observed in the FEM while the REM is not. The result shows that the signs of the debt coefficients are negative but for both the FEM and REM. This is in line with the apriori expectation of this study that the external debt burden of these ECOWAS countries, in general, depletes the size of reserves holdings through servicing and principal repayment. Overall, this result is in consonance with the results of other works that include this variable (Gosselin and Parent, 2005) and (Elhiraika and Ndikumana, 2007) that there is a negative relationship between external reserves accumulation and external debt accumulation because external reserves, even though accumulated, would be depleted for the purpose of servicing accumulated external debt. The result for imports payment in this study is negative and significant overall for both the FEM and REM. Among African countries, imports payment is one major variable responsible for external reserves de-accumulation as most of the country's international outpayments are drawn from this source (Obaseki, 2007). This fact is confirmed by the negatively significant evidence obtained with regard to the variable as shown in the result in table 5.6. With respect to the government variable, the result shows that both the FEM and REM are negative and significant depicting the negative relationship between government spending and reserves holdings. Just as it is with the import and debt variables, government spending represents a depletion of reserves holding for the countries. The governments and monetary authorities of most African economies often resort to drawing the stock of own reserves to finance domestic spending which include

both recurrent like payment of public servants and capital spending such as the construction of roads and the execution of other developmental projects.

The results for inflation rate and exchange rate exhibit almost the same pattern for both the FEM and REM. They are both positive though with differing degree of significance in accounting for changes in reserves position of the countries. The results for these rates are in consonance with apriori expectations concerning the behaviours of the variables that the monetary authorities increase international reserves holdings with increased volatilities and uncertainties of macroeconomic variables. Also, with respect to exchange rate, the positive coefficients suggest that a rising exchange rate simply implies a depreciation in nominal terms. This leads to a reduction in the price of exports, a rise in the demand for exports and an accretion to reserves holdings. The insignificance of exchange rate in the FEM in the current period in explaining changes in external reserves is in consonance with result of most studies that include this variable as most studies found out that the variables are always insignificant in accounting for the behaviour of external reserves as in Elhiraika and Ndikumana (2007), Choi and Baek (2004), Gosselin and Parent (2005), inter alia. As expected, reserves rise in the face rising inflation thus, corroborating the result of Lin and Wang (2005). As it is with the supply model, the Hausman test result reject the unbiasedness of the random effect model (estimator) at 10% level of significance which implies that the random effects could be biased, suggesting the need to somewhat rely solely on the FEM.

5.3 Vector Autoregressive Analysis

An analysis of the possible extent of macroeconomic stability to be achieved when the countries in the region enter into a reserves pooling arrangement is considered. This is done primarily using the impulse response function and variance decomposition under the vector autoregressive framework.

5.3.1 VAR Stability Condition Check Using the Inverse Roots of AR Characteristic Polynomial

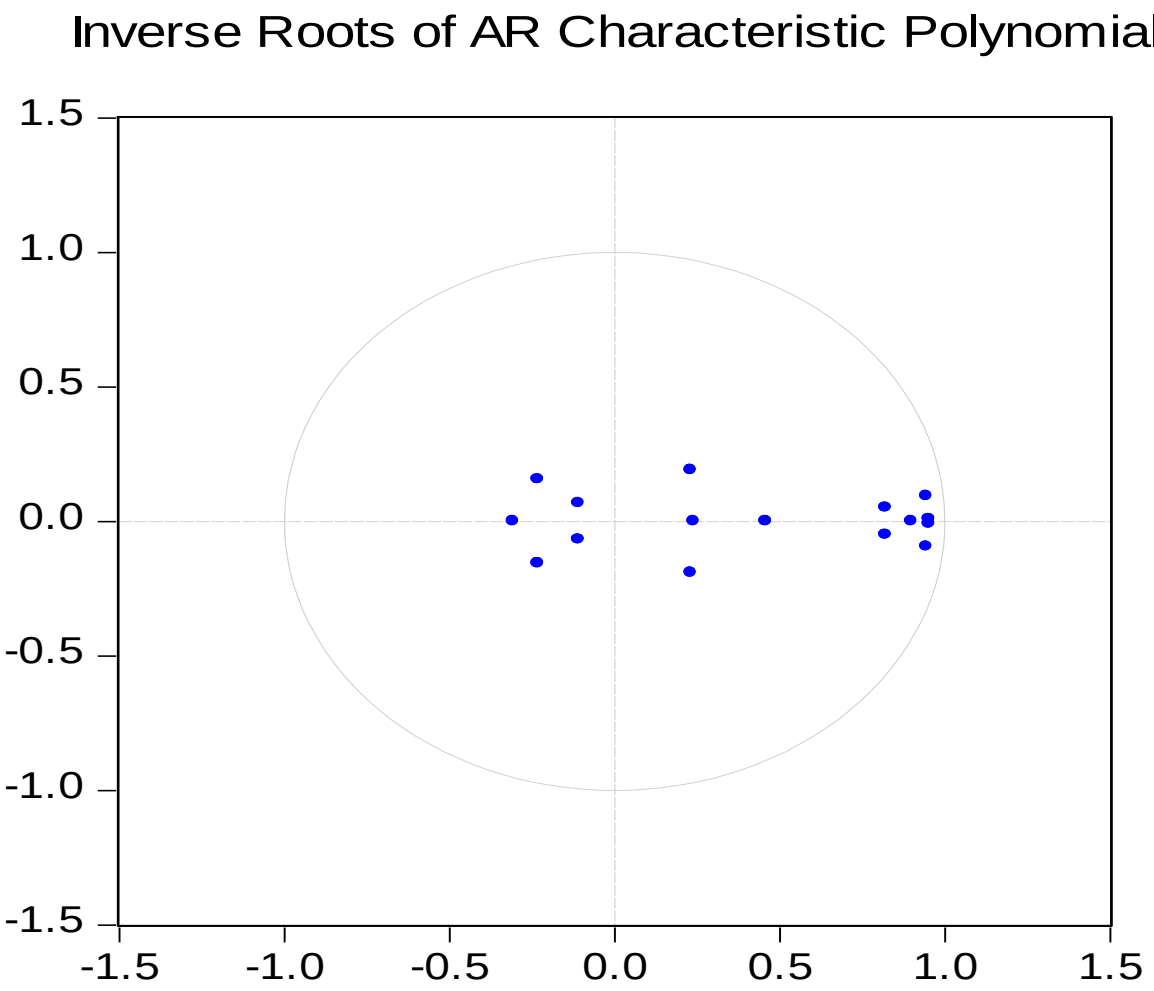
The VAR stability test is conducted to ascertain whether the specification satisfies the stability condition or not. That is the stability is a way developed in order to verify whether the VAR model is overall stationary. The implication is that, if the stability

condition is violated, then the specifications are not stable, and they are not suitable for further analysis which would imply non-stability of the VAR specifications. The stability condition is checked through the use of the inverse roots of AR characteristic polynomial. The decision rule is that for the specifications to be stable, the characteristic roots of the polynomial must fall within the unit circle; if all roots of the characteristic AR polynomial have absolute value less than one. The test is conducted and the result is as shown in figure 5.1. There should be (number of variables)×(number of model lags) roots visible on the graph. In this case, we have 16 roots shown which represents the product of the number of variables and number of optimal lags chosen. The variables employed are (eight of them) unpooled reserves, pooled reserves, investment, government expenditure, external debt, GDP, trade flows and exchange rate while the number of model optimal lags used is gotten to be two. From figure 5.1, it is obvious that all the roots of the polynomial do not exceed the unit circle; that is all the roots lie inside the circle thereby fulfilling the stability condition. Given this result, we can conclude that the VAR specifications are stable.

5.3.2 VAR Residual Tests for Autocorrelations

The VAR residual autocorrelation test is conducted to test the presence (or absence) serial correlation of the error term. The multivariate Portmanteau and the LM tests are employed. The null hypothesis that there is “no residual autocorrelations up to lag h” is tested using both methods and the results presented in table 5.7 and table 5.8. In both cases, the results from the tests show that the null hypothesis is rejected at 1% significance level. This suggests that the serial correlation of the residual terms is not a problem

Figure 5.1. VAR Stability Test



Source: From Estimation Results

Table 5.7. VAR Residual Portmanteau Tests for Autocorrelations

VAR Residual Portmanteau Tests for Autocorrelations

Null Hypothesis: no residual autocorrelations up to lag h

Included observations: 370

Lags	Q-Stat	Prob.	Adj Q-Stat	Prob.	df
3	173.3350	0.0013	174.3891	0.0011	121
4	233.2660	0.0093	234.9750	0.0076	185
5	303.7385	0.0101	306.4129	0.0076	249
6	419.3027	0.0001	423.8820	0.0000	313
7	505.8498	0.0000	512.0981	0.0000	377
8	583.0147	0.0000	590.9682	0.0000	441
9	638.6777	0.0000	648.0190	0.0000	505
10	688.3706	0.0004	699.0922	0.0001	569
11	731.3572	0.0040	743.3959	0.0016	633
12	780.6412	0.0148	794.3320	0.0060	697

*The test is valid only for lags larger than the VAR lag order.

df is degrees of freedom for (approximate) chi-square distribution

Source: Author's Computation

Table 5.8. VAR Residual LM test for Serial Autocorrelation

VAR Residual Serial Correlation LM Tests

Null Hypothesis: no serial correlation at lag order h

Sample: 1981 2011

Included observations: 370

Lags	LM-Stat	Prob
1	124.7121	0.0000
2	107.7039	0.0000
3	67.43474	0.0414

Probs from chi-square with 49 df.

Source: Author's Computation

5.3.3 VAR Lag length Selection Criteria

The selection of the lag length is often guided by some criteria. The most commonly applied are the Akaike information criterion (AIC), the Schwarz information criterion (SIC) and the Hannan-Quinn information criterion (HQ). From the test results shown in table 5.9, the AIC and SIC indicate that the appropriate lag length is 2 while the HQ suggests that the appropriate lag length is 3. Thus, the study adopted the lag length of 2 as suggested by the AIC and SIC.

Table 5.9. VAR Lag Order Selection Criteria

VAR Lag Order Selection Criteria

Endogenous variables: TRF RESP INV DEBT RESU EXR GOVT

Exogenous variables: C

Sample: 1981 2011

Included observations: 279

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-7889.401	NA	9.04e+15	56.60503	56.69613	56.64157
1	-5663.166	4324.801	1.51e+09	40.99761	41.72645	41.28998
2	-5567.981	180.1347	1.08e+09	40.66653*	42.03312*	41.21473
3	-5494.412	135.5364	9.09e+08	40.49041	42.49473	41.29444*
4	-5456.858	67.30070	9.89e+08	40.57246	43.21452	41.63231
5	-5411.548	78.92709	1.02e+09	40.59891	43.87871	41.91459
6	-5330.081	137.8227	8.15e+08	40.36617	44.28371	41.93768
7	-5274.147	91.81938	7.83e+08	40.31647	44.87175	42.14380
8	-5210.423	101.4111*	7.14e+08*	40.21091	45.40394	42.29408

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

Source: Author's Computation

5.3.4 VAR Residual Residual Normality Tests

The VAR normality test is conducted under the null hypothesis that the residuals are multivariate normal in distribution. From table 5.10, it is observed that the skewness, kurtosis and Jaque Berra for all the components of the tests are rejected at 5% significance level. Therefore, the alternate hypothesis is accepted and the conclusion drawn that the residuals are multivariate normal. This shows that the residual terms of the VAR specifications are white noise. The implication here is that the VAR model is well specified and the random terms are purely a result of a random process.

Table 5.10. VAR Residual Normality Tests

VAR Residual Normality Tests				
Orthogonalization: Cholesky (Lutkepohl)				
Null Hypothesis: residuals are multivariate normal				
Included observations: 370				
Component	**Skewness**	**Chi-sq**	**df**	**Prob.**
1	0.321838	6.387432	1	0.0115
2	0.266637	4.384198	1	0.0363
3	-1.113730	76.49103	1	0.0000
4	0.458984	12.99107	1	0.0003
5	-0.870736	46.75450	1	0.0000
6	0.029101	0.052224	1	0.0492
7	0.973509	58.44276	1	0.0000
8	1.877633	217.4063	1	0.0000
Joint		422.9095	8	0.0000
Component	**Kurtosis**	**Chi-sq**	**df**	**Prob.**
1	4.896442	55.44594	1	0.0000
2	12.01118	1251.855	1	0.0000
3	41.16432	22454.61	1	0.0000
4	6.916335	236.4559	1	0.0000
5	14.72964	2121.095	1	0.0000
6	8.144026	407.9404	1	0.0000
7	9.221809	596.7932	1	0.0000
8	12.74907	1465.267	1	0.0000
Joint		28589.46	8	0.0000
Component	**Jarque-Bera**	**df**	**Prob.**	
1	61.83338	2	0.0000	
2	1256.240	2	0.0000	
3	22531.10	2	0.0000	
4	249.4470	2	0.0000	
5	2167.849	2	0.0000	
6	407.9926	2	0.0000	
7	655.2360	2	0.0000	
8	1682.673	2	0.0000	
Joint	29012.37	16	0.0000	

Source: Author's Computation

5.3.5 Impulse Response Analysis

Impulse responses trace out the response of current and future values of each of the variables to a unit increase in the current value of one of the VAR structural errors, assuming that this error returns to zero thereafter. The impulse response function is a practical way of representing the behaviour over time of z in response to shocks to the vector u. The impulse response is performed in order to examine the impact of reserves pooling on macroeconomic stability. This is done by appraising the behaviour of some important macroeconomic variables to shocks arising from unpooled reserves as well as pooled reserves in the region. The selected macroeconomic variables are investment, government expenditure, external debt, trade flows, GDP and exchange rate. The analysis is done over a period of time, in this case, 20 years period. The stability of the macroeconomic variables is examined through the dynamic effect of a Cholesky nonfactorized one standard deviation innovation from both unpooled and pooled reserves. The results are presented in what follows.

Response of Government to Innovation from International Reserves

The impulse response of government expenditure from a shock to unpooled reserves shows an overall significant fluctuation across both the positive and negative domains. As observed in figure 5.2, a one Cholesky standard deviation shock to unpooled reserves leads to an initial significant upswing in government spending from the steady state level of 0.00; it rises and stays approximately 3.7% above the steady state level. Immediately after this sharp rise, there is an improvement as the disequilibrium starts dwindling from the 2nd period and returns to the equilibrium locus in the 7th period. However, this return is short-lived as a deterioration is recorded and this deterioration intensifies steadily below the equilibrium level and extends beyond the end period of the analysis, the 20th period.

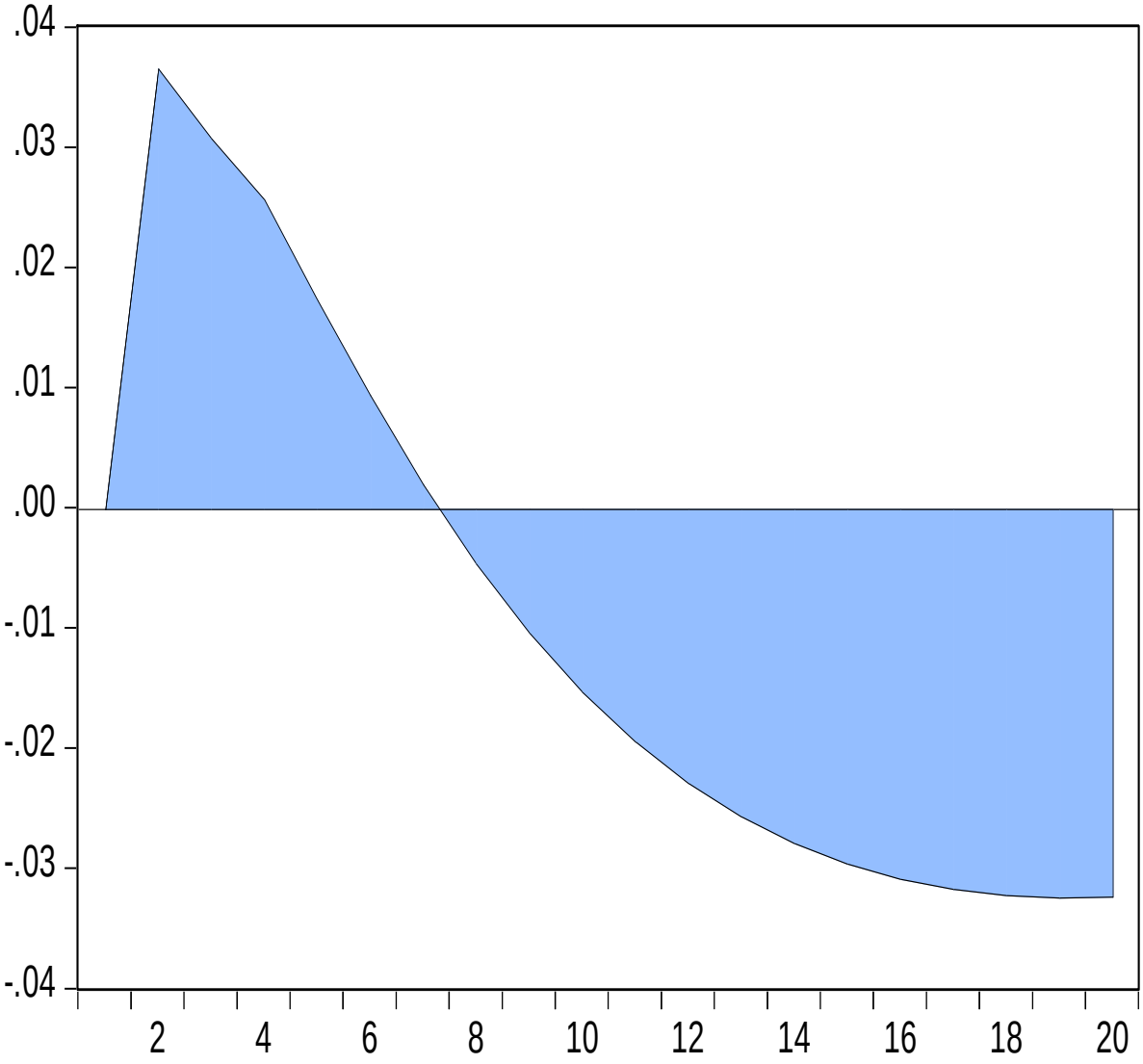


Figure 5.2. Response of Government to Innovation from Unpooled Reserves

Source: Author's Computation

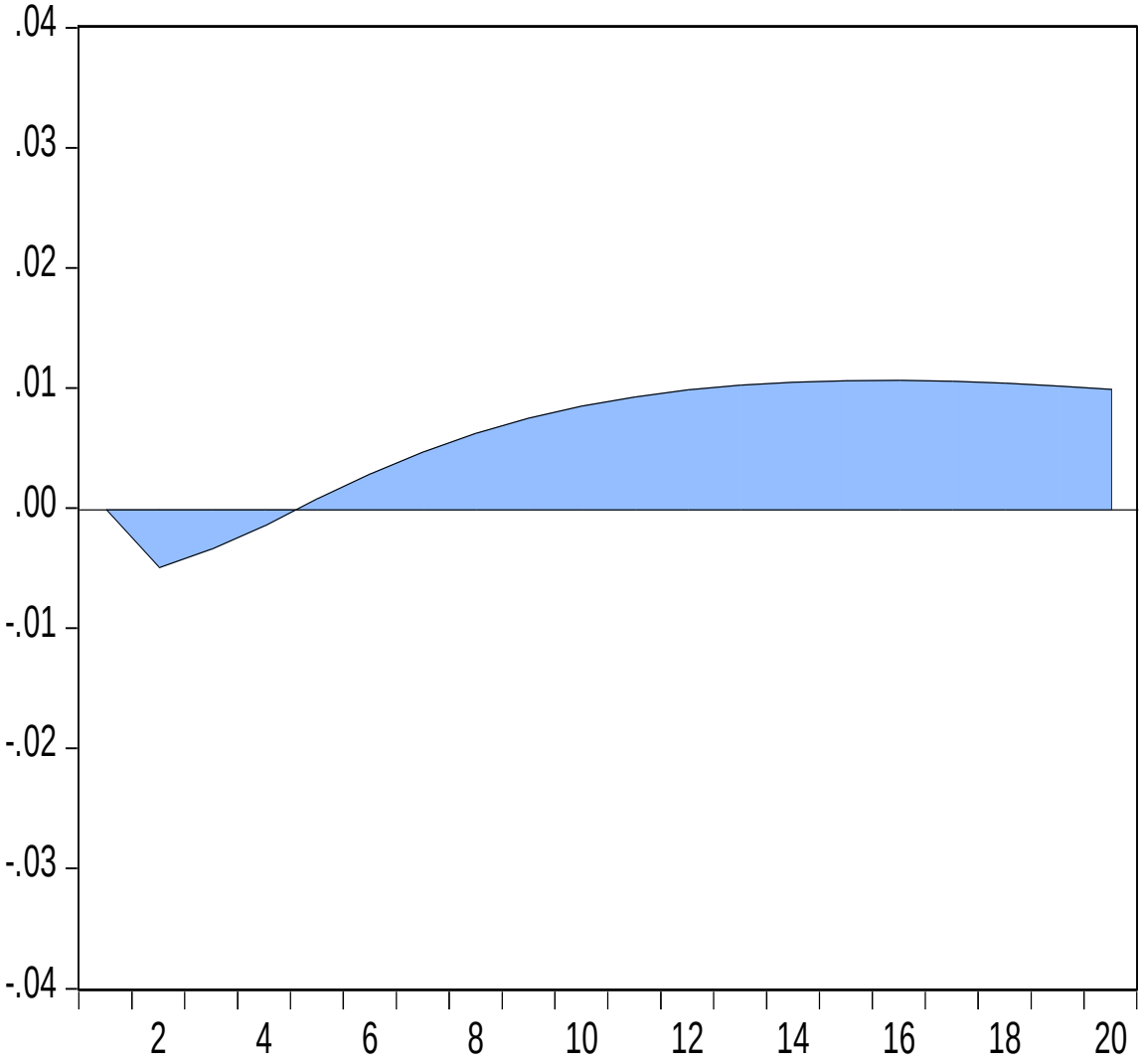


Figure 5.3. Response of Government to Innovation from pooled Reserves

Source: Author's Computation

Therefore, for government spending, a positive response from the equilibrium is observed from period 1 to period 7 and a negative response is observed from the 7th period till the 20th as a result of a Cholesky one standard deviation positive shock to the unpooled reserves of the countries.

On the other hand, one Cholesky standard deviation shock to pooled reserves leads to an initial infinitesimal deterioration in government spending from the steady state level of 0.00 as shown in figure 5.3. This reaches the peak at about 0.5% and the disequilibrium peters out immediately in the 5th period. The impulse response immediately crosses the steady state locus and takes a steady upswing. It rises and peaks approximately 1% above the steady state level between the 14th and 17th periods. Apart from the fact that the disequilibrium and response to shock is minimal here, there is a slight evidence of a return to equilibrium towards the end period.

Response of Investment to Innovation from International Reserves

The impulse response of investment from a shock to unpooled reserves shows a significant upsurge, purely in the positive domain. This is depicted in figure 5.4. A one Cholesky standard deviation shock to unpooled reserves leads to a continuous upswing in investment and reaches its peak in the 11th period. This peak is approximately 15% above the equilibrium locus. Immediately after this sharp rise, there is an improvement as the disequilibrium starts dwindling from the 11nd period.

Notably, this disequilibrium still remains high even at the end of the 20th period at approximately 11%, representing a 26.7% downswing from the peak observed in the 11th period.

Figure 5.5 shows the impulse response of investment to a one Cholesky standard deviation shock to pooled reserves.

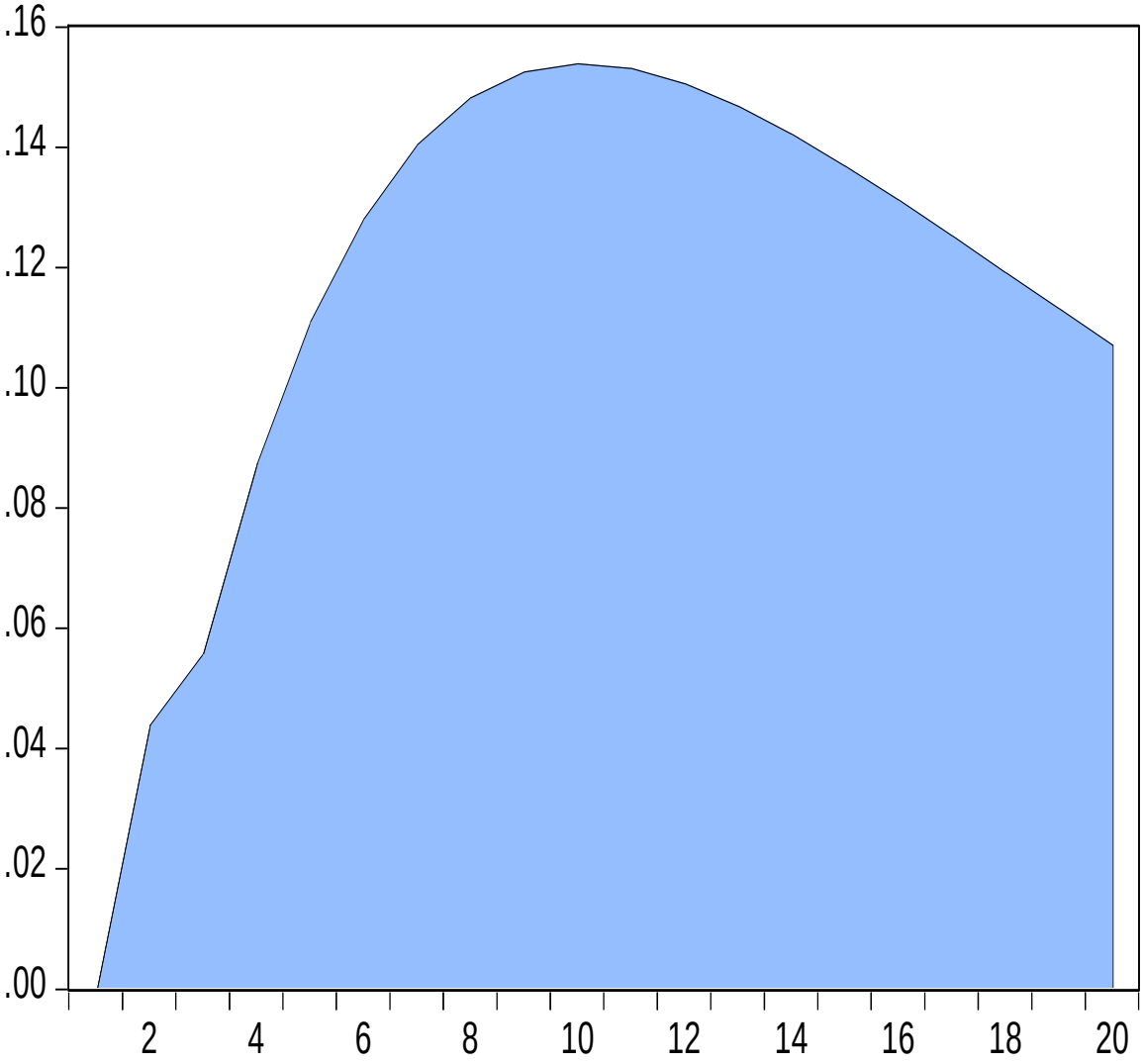


Figure 5.4. Response of Investment to Innovation from Unpooled Reserves

Source: Author's Computation

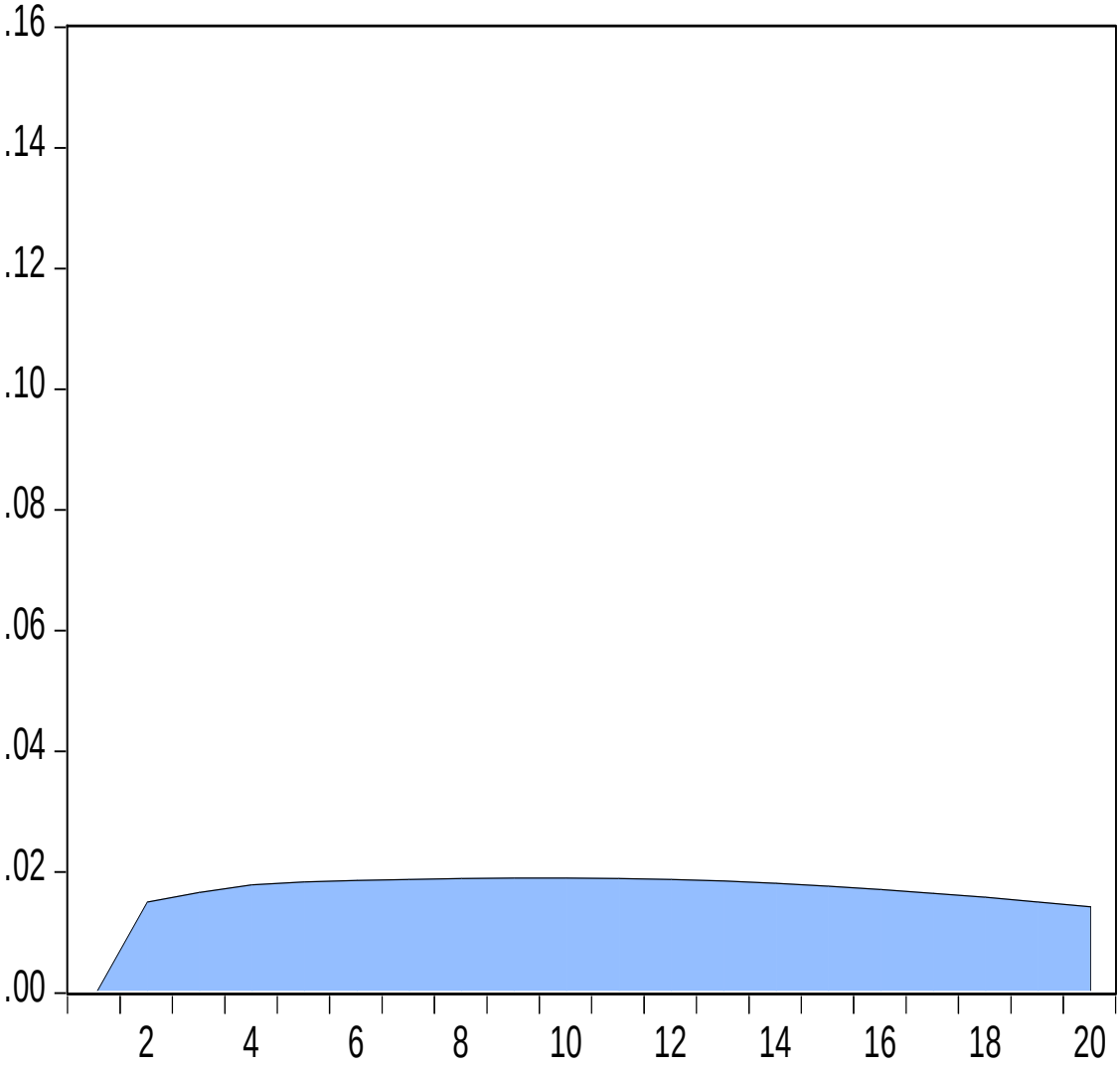


Figure 5.5. Response of Investment to Innovation from pooled Reserves

Source: Author's Computation

From the figure, it can be observed that the shock causes investment to shift from its equilibrium position by an infinitesimal percentage in relation to that of the unpooled reserves. Starting from the initial period, investment jumps approximately to 1.8%. From the 2nd period, the response is apparently constant throughout the forecast period. Overall, the impact is positive and shift from equilibrium is marginal representing about 88% lower than the peak under the unpooled reserves. This shows considerable convergence toward equilibrium in the case of the pooled reserves when compared with the unpooled reserves counterpart in figure 5.4.

Response of Trade Flows to Innovation from International Reserves

Similar to the response of government expenditure, trade flows show an overall significant fluctuation across both the positive and negative domain in response to a shock to unpooled reserves. In figure 5.6, a one Cholesky standard deviation shock to unpooled reserves leads to an initial significant downswing in trade flows from the steady state level of 0.00. The swing below the steady state locus reaches its peak in the 2nd period which is approximately 13% below. Soon after this deterioration, there is an immediate return to equilibrium corresponding to the 4th period.

The return is short-lived as a surfeit is which intensifies steadily above the equilibrium level. It reaches its peak in the 11thperiod corresponding to 12% rise above the equilibrium locus which extends beyond the end period of the analysis, the 20thperiod even though there is a sign of a gradual return to equilibrium, this return however is not within the period captured by this analysis.

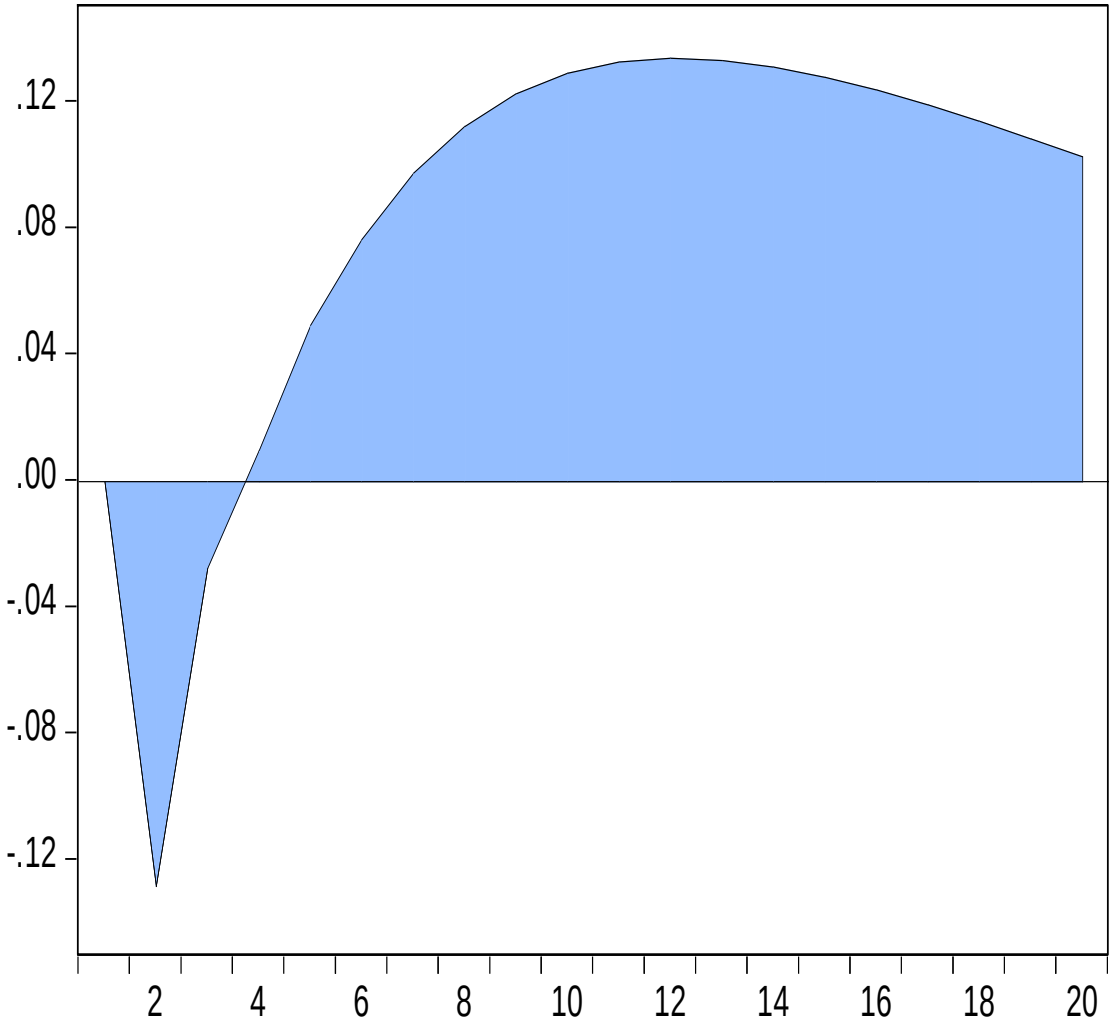


Figure 5.6. Response of Trade Flows to Innovation from Unpooled Reserves

Source: Author's Computation

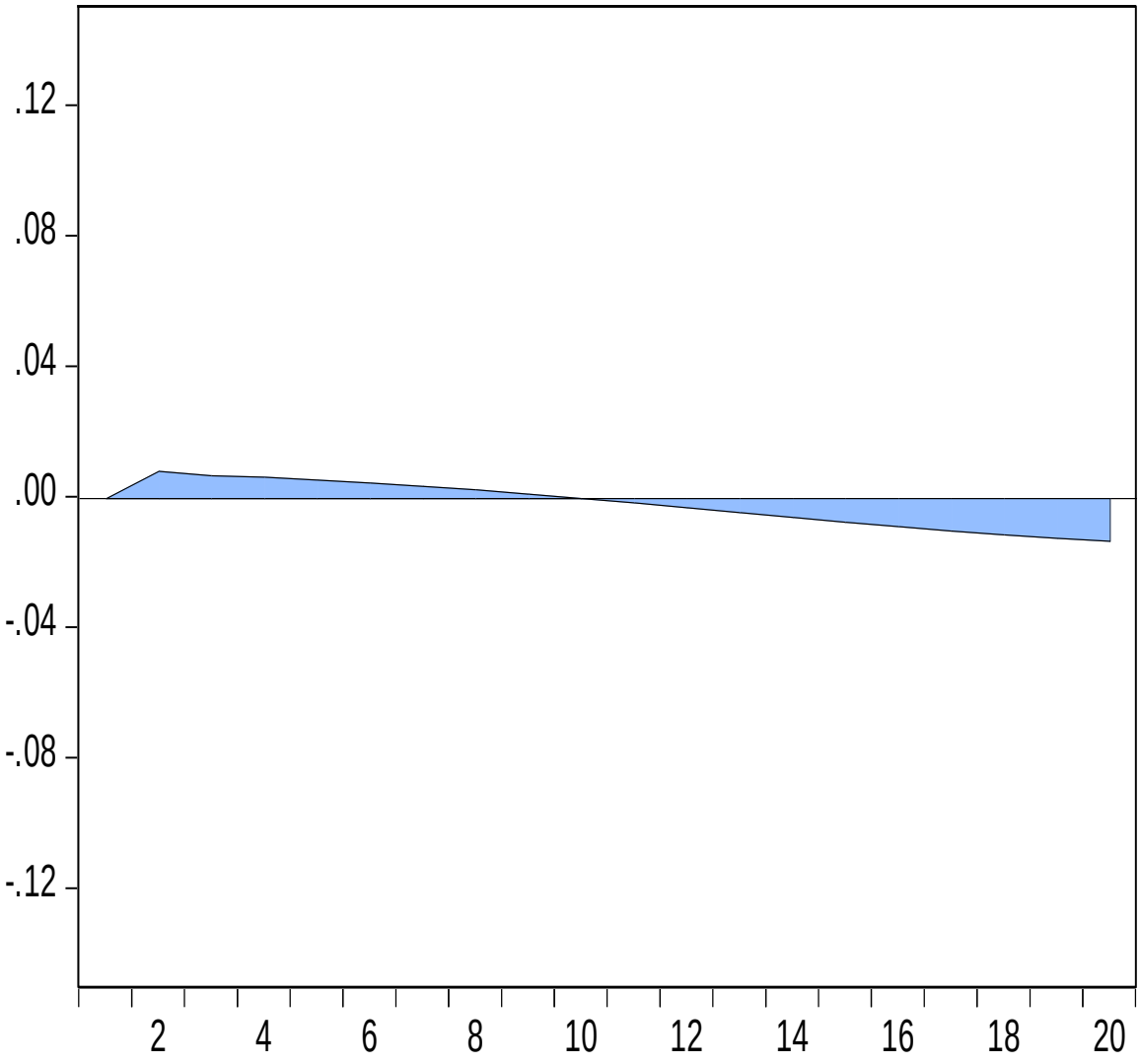


Figure 5.7. Response of Trade Flows to Innovation from pooled Reserves

Source: Author's Computation

Therefore, with regards to the trade flows analysis, a negative response from the equilibrium is observed from period 1 to period 4 and a positive response above the equilibrium is observed from the 7th period till the 20th as a result of a Cholesky one standard deviation positive shock to the unpooled reserves of the countries. Under a reserves pooling arrangement, the response of trade flows to a shock appear negligible. Even though there is fluctuation across both the positive and negative domain, the fluctuation is infinitesimal. From figure 5.7, it is observed that the shock causes trade flow to shift from its equilibrium position by an infinitesimal percentage in relation to its impulse response from unpooled reserves. Starting from the initial period, investment jumps approximately to 1.0%. From the 2nd period, the response peters out gradually with a steady return to equilibrium approximately around the 11th period. Overall, the impact oscillates across the two domains; positive from the 1st to the 11th period then negative from the 11th period to the end of the 20th period and shift from equilibrium is marginal representing about 92% lower than the peak under the unpooled reserves figure above. This shows considerable convergence toward equilibrium in the case of the pooled reserves when compared to the unpooled reserves counterpart in figure 5.6.

Response of Gross Domestic Product to Innovation from International Reserves

GDP shows an overall significant fluctuation entirely the positive domain in response to a shock to unpooled reserves.

In figure 5.8, a one Cholesky standard deviation shock to unpooled reserves exerts about 5% initial significantly positive shock impulse response or innovation in GDP from the steady state level of 0.00. This initial upswing of about 5% is the peak after which the shock started diminishing in the 3rd period equivalent to about 3% and diminishes further towards to about 2.5% in the 4th and this remains almost the same till the end of the period in the 20th year.

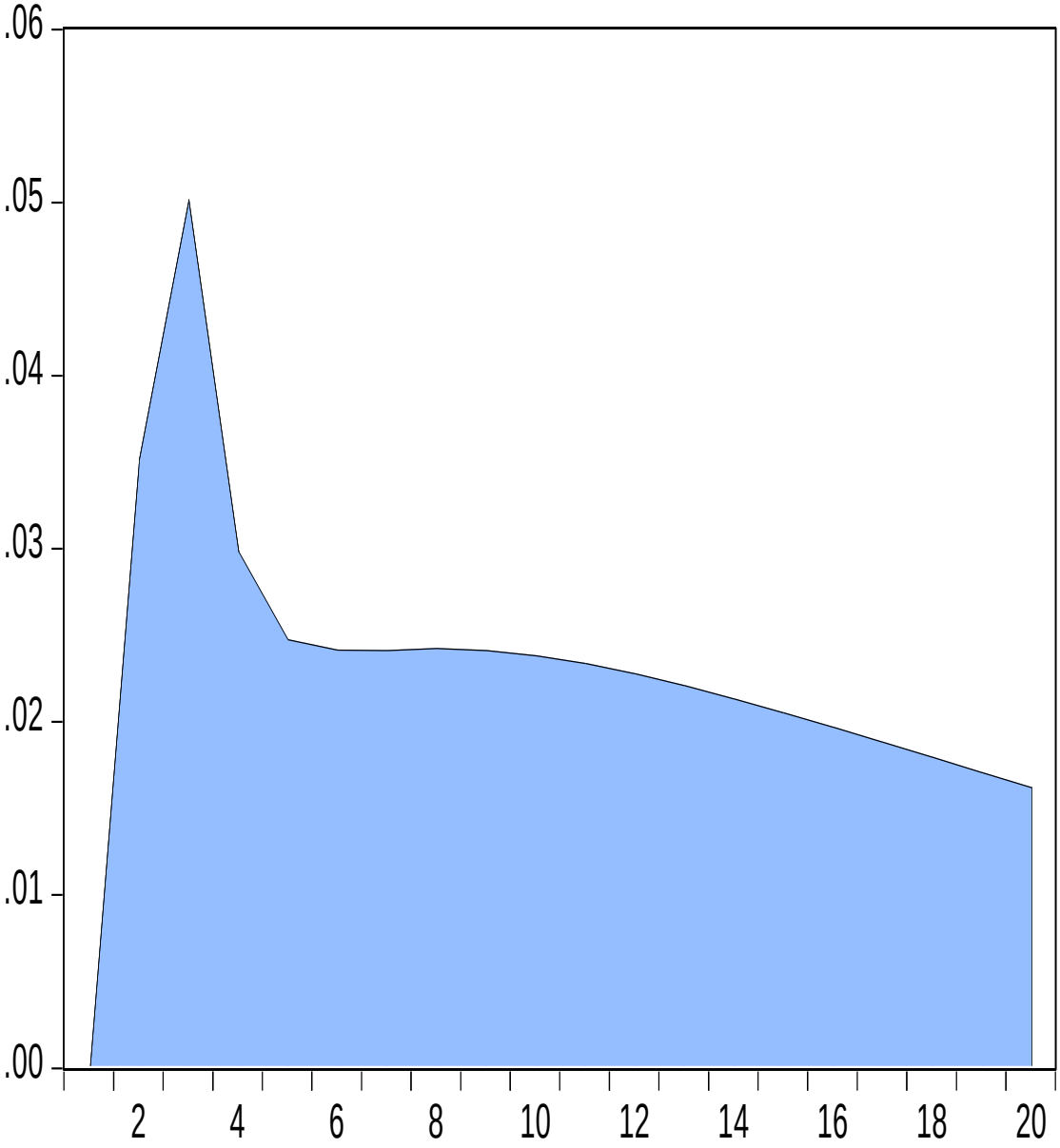


Figure 5.8. Response of GDP to Innovation from Unpooled Reserves

Source: Author's Computation

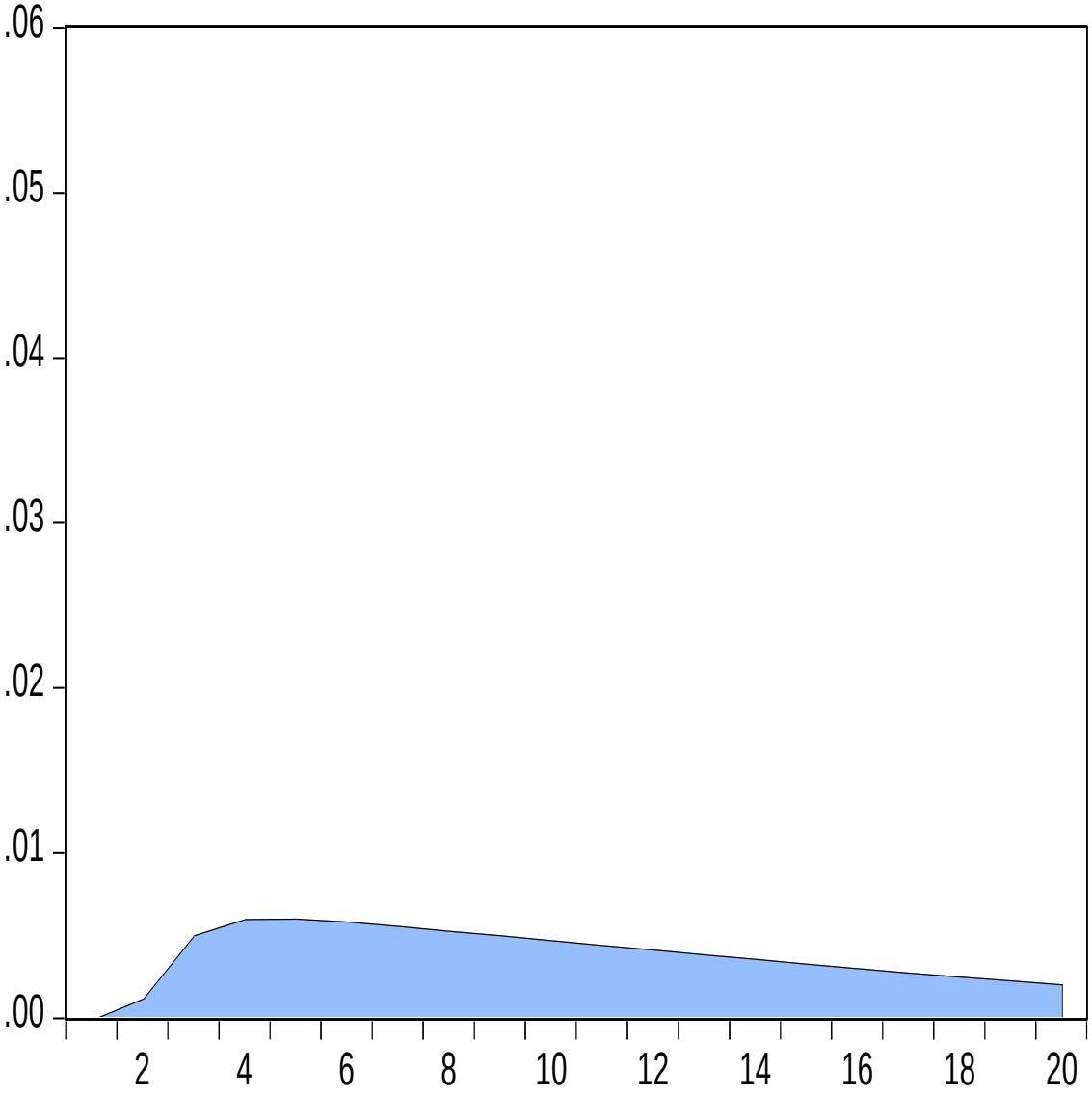


Figure 5.9. Response of GDP to Innovation from pooled Reserves

Source: Author's Computation

With regards to the GDP analysis, an overall positive response from the equilibrium is observed throughout the entire period of the analysis with the peak of the shock in the 3rd period corresponding to 5% as a result of a Cholesky one standard deviation positive shock to the unpooled reserves of the countries.

Figure 5.9 shows the response of economic growth proxied by GDP here to a one Cholesky standard deviation shock in pooled reserves. From the figure, it can be observed that the shock causes investment to shift from its equilibrium position by an infinitesimal percentage in relation to that of the unpooled reserves. The initial shock response or innovation exerted upon GDP as a result of a positive shock to pooled reserves is a positive movement away from steady state. A steady initial rise is observed between period 1 and 3 where the peak is attained in the 3rd period through the 4th to the 6th period corresponding to about 0.05% innovation. From thence, the shock response starts to diminish until the end of the period. Overall, the impact is positive and shift from equilibrium is marginal where the peak here (of 0.05%) is more than 95% lower than the peak of the shock response in unpooled reserves. This shows considerable convergence towards equilibrium in the case of the pooled reserves when compared to the unpooled reserves counterpart in figure 5.8.

Response of External Debt to Innovation from International Reserves

In the case of debt, there is an overall significant fluctuation entirely in the negative domain in response to a shock to unpooled reserves. As shown in figure 5.10, a Cholesky one standard deviation positive shock to unpooled reserves exerts about 6.9% initial significantly negative shock response or innovation in debt from the steady state level of 0.00. This initial downswing below the equilibrium locus of about 6.9% is the peak and this peak is attained in the 2nd period. Soon after this summit, the shock started diminishing gradually and reached its lowest point in the 10th through the 13th period corresponding approximately to 1% and then the deterioration started getting stronger from there until the end of the period. Thus, with regards to the debt analysis, an overall negative response from the equilibrium is observed throughout the entire period of the analysis with the peak of the shock attained in the 2rd period corresponding to about 6.9%

as a result of a Cholesky one standard deviation positive shock to the unpooled reserves of the countries. The response of debt to a one Cholesky standard deviation shock in pooled reserves is represented in figure 5.11. Just as in the case of unpooled reserves, the oscillation here also is purely in the negative domain in response to a shock to pooled reserves.

As shown in figure 5.11, a one Cholesky standard deviation shock to pooled reserves elicited a smooth deterioration in debt, almost u-shaped with the lowest point attained in the 11^{th} period corresponding to about 2.4% below the equilibrium locus. Soon after this lowest point a gradual movement towards equilibrium is observed until the end of the period where the impact is still approximately 1.8% below the equilibrium. Overall, the impact is negative and the shift from equilibrium is lower as compared to the corresponding case of unpooled reserves where the peak here of approximately 2.4% is about 65% lower than the peak of the shock response in unpooled reserves. On the average, this shows considerable convergence towards equilibrium.

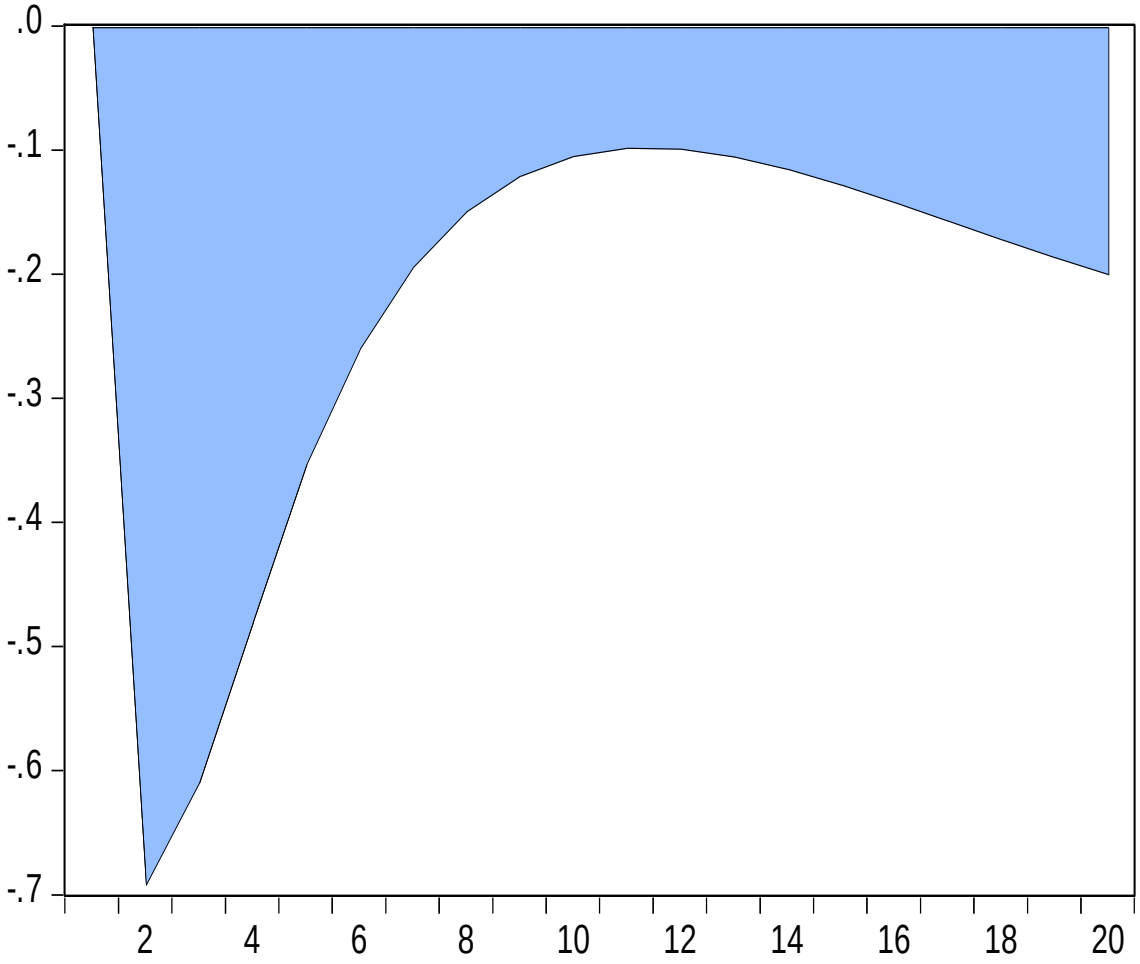


Figure 5.10. Response of External Debt to Innovation from Unpooled Reserves

Source: Author's Computation

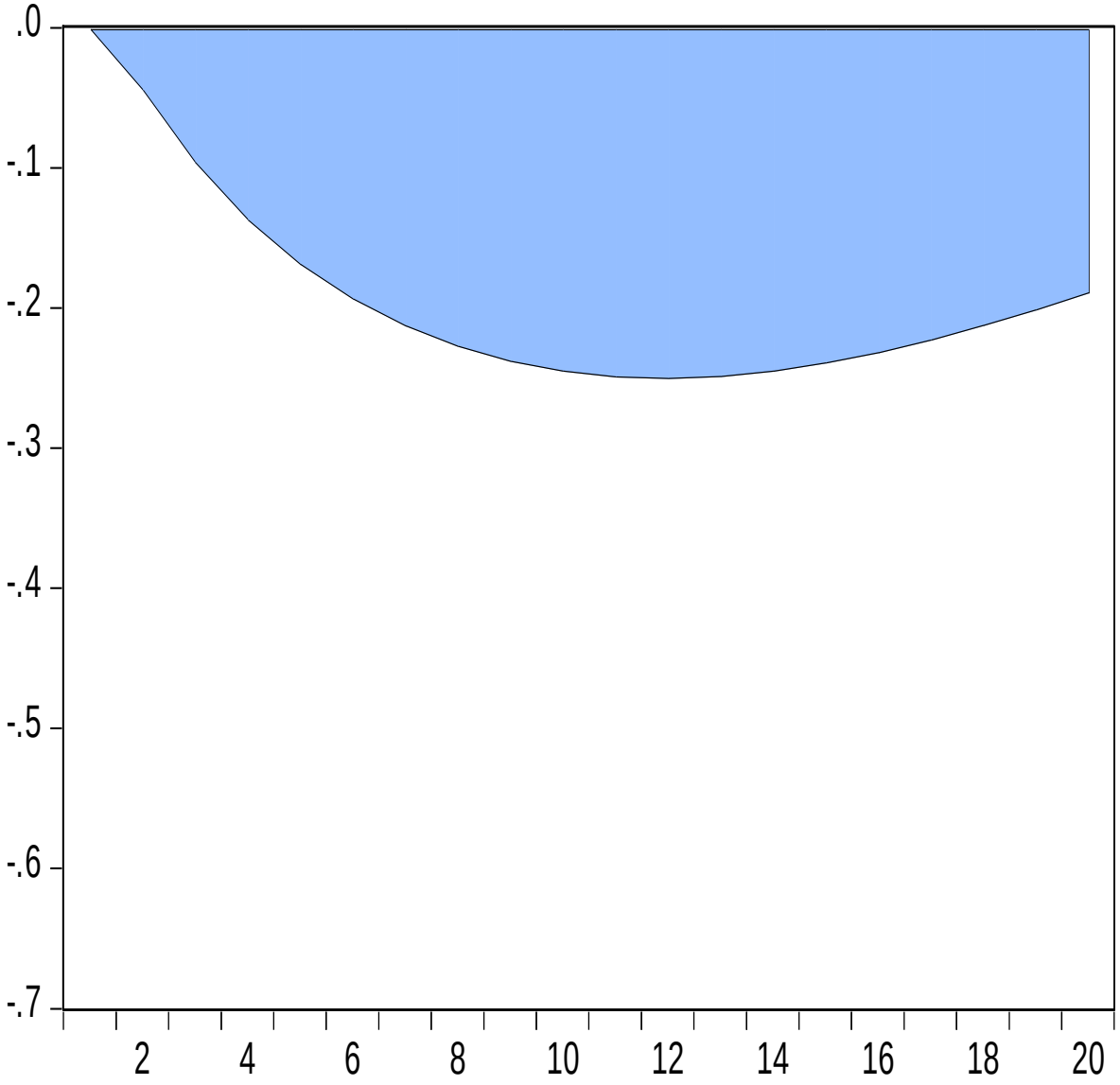


Figure 5.11. Response of External Debt to Innovation from pooled Reserves

Source: Author's Computation

Response of Exchange Rate to Innovation from International Reserves

The case of exchange rate, just like that of debt above, shows that the fluctuation is entirely in the negative domain in response to a shock to unpooled reserves (figure 5.12). A one Cholesky standard deviation shock to unpooled reserves elicits a continuous explosion in terms of impulse response in the exchange rate of the countries. There is an initial jump between the 1st and the 3rd period; thereafter, there is a steady deterioration in exchange rate till the end of the period.

At the peak, which happens to the last period in this analysis, it is observed that a shock to unpooled reserves exerts approximately 1.3% negative shock response or innovation in exchange rate from the steady state level of 0.00.

The case of the response of pooled reserves is even more interesting as it is almost non-existent given its infinitesimal representation. As shown in the figure 5.13, the response of exchange rate to a one Cholesky standard deviation shock in pooled reserves is a paltry deterioration within the period of the forecast. As a diminutive representation of the unpooled reserve case above, the shock impulse response here is a continuous slide away from the equilibrium. At its peak which happens to be the period-end, if the shock in pooled reserves changes by one Cholesky standard deviation, the impulse or innovation in exchange rate will respond by approximately 0.1% which is about 92% lower than the peak of the shock response in exchange rate in the case of unpooled reserves. This shows considerable convergence towards equilibrium in the case of the pooled reserves as compared to the unpooled reserves counterpart in figure 5.12.

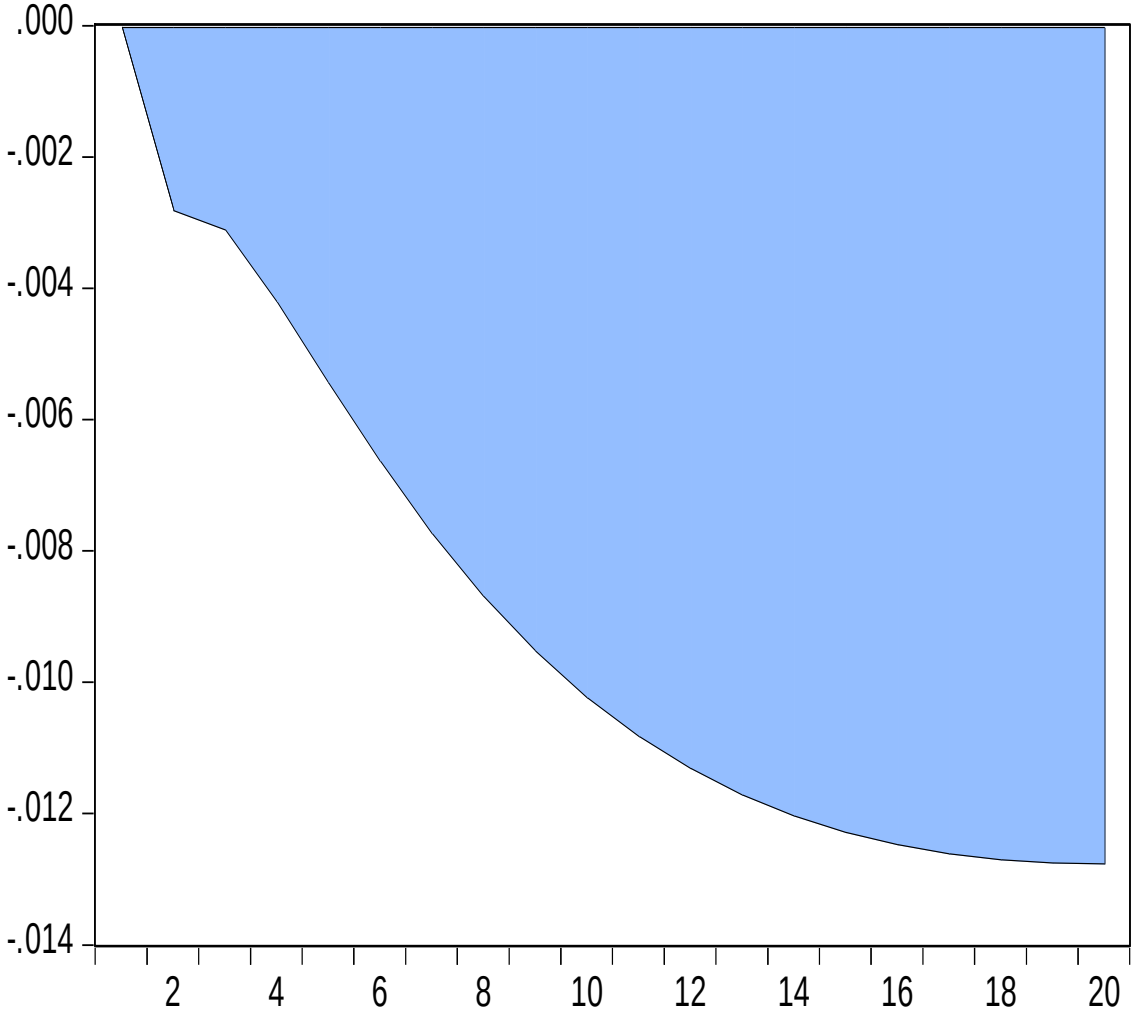


Figure 5.12. Response of Exchange Rate to Innovation from Unpooled Reserves

Source: Author's Computation

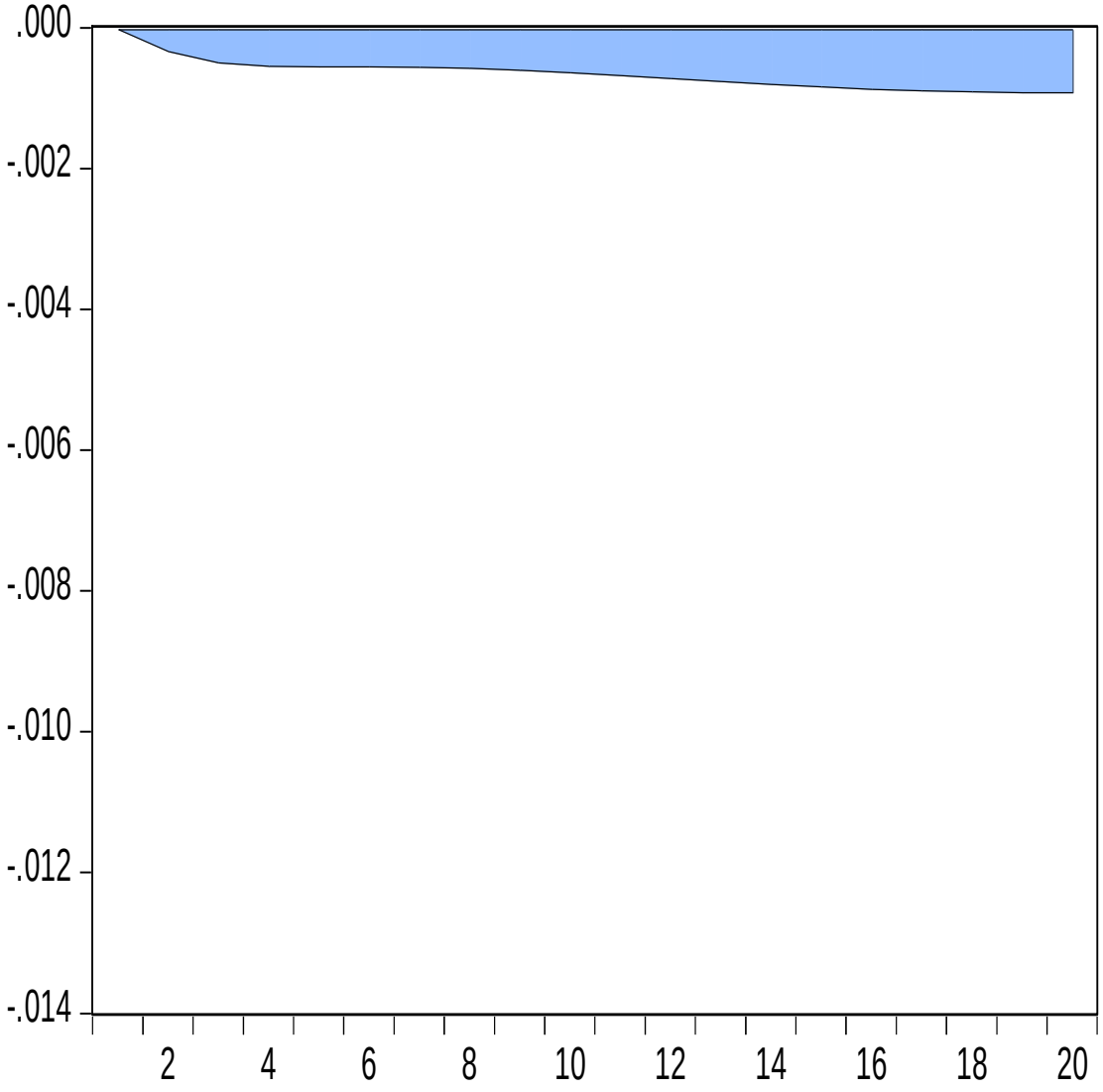


Figure 5.13. Response of Exchange Rate to Innovation from pooled Reserves

Source: Author's Computation

5.3.6 Variance Decomposition

The dynamic response of the macroeconomic stability as given in the impulse response can further be explained by the forecast variance error otherwise known as variance decomposition. While impulse response functions trace the effects of a shock to one endogenous variable on to the other variables in the PVAR, variance decomposition separates the variation in an endogenous variable into the component shocks to the PVAR. In other words, the variance decomposition provides information about the relative importance of each random innovation in affecting the variation of the variables in the PVAR. The summary of the results of the variance decomposition is presented in table 5.11 while the comprehensive decomposition is shown in the appendices. It shows the percentage of the forecast error variance due to each shock in the PVAR model over the 20 years horizon for the ECOWAS region.

From the results obtained, it is observed that the selected variables are explained to a large extent by its own shocks when seen over the entire 20 years period of the forecast. On the basis of their respective averages, it is observed that government expenditure account for about 95.9% of the random shock response or innovation; investment accounted for about 87.37% of the shock response; GDPGR, trade flows, debt and exchange rate account on the average 92.36%, 76.18%, 90.67% and 91.14% respectively of the random shock innovations in each of the behavioural models they represent. It is generally observed that the degree of responses of the selected macroeconomic variables to shocks from reserves (pooled and unpooled) is significantly large. Thus in the light of this result, the extent to which the correction of the distortions and disequilibrium (adjustment back to steady state) in the region can be costly is greatly reduced. For the Cholesky variance decomposition, the ordering of the variables can be very important. Thus, the study re-conducted variance decomposition test to check whether reversing the ordering of the variables can significantly affect the result obtained.

Table 5.11 Variance Decomposition (Summary)

GOVT	INV	GDPGR	TRF	DEBT	EXR
98.92	99.76	96.48	89.48	85.87	99.82
99.18	98.79	94.39	87.53	91.38	99.08
99.30	97.86	94.04	85.70	94.05	98.27
99.29	96.77	93.64	83.97	95.44	97.37
99.17	95.60	93.26	82.34	95.98	96.40
98.93	94.34	92.93	80.78	95.89	95.37
98.58	92.99	92.64	79.31	95.33	94.31
98.11	91.57	92.40	77.92	94.47	93.24
97.56	90.08	92.19	76.61	93.43	92.19
96.94	88.55	92.00	75.39	92.35	91.16
96.27	86.98	91.84	74.25	91.30	90.17
95.57	85.39	91.69	73.20	90.32	89.23
94.85	83.81	91.56	72.23	89.44	88.34
94.14	82.23	91.44	71.34	88.65	87.51
93.44	80.69	91.33	70.53	87.94	86.72
92.76	79.18	91.23	69.79	87.32	85.99
92.11	77.73	91.14	69.12	86.76	85.30
91.49	76.33	91.06	68.52	86.27	84.66
90.92	75.00	90.99	67.99	85.82	84.06
90.38	73.74	90.92	67.51	85.41	83.51

Source: Author's Computation from Estimation Results

As noted in the table, the endogenous variables represented in the behavioural models: Government, investment, GDP growth, trade flows, and exchange rate account with average values 95.9%, 87.37%, 92.36%, 76.18%, 90.67% and 91.14% respectively accounted for (on an average) 89.0% of the forecast random shock response or innovations over the 20 years forecast period. However, when the ordering of these variables is completely reversed, the values are respectively 95.34%, 88.07%, 94.26%, 94.19%, 85.31% and 92.36 averaging 91.91%. as shown in the appendix Difference is considered to be insignificance to influence major conclusions.

5.4 Analysis of Stability Gained from Reserves Pooling

This study is further extended to evaluate, in quantitative terms, the amount of possible stability to be gained from the 60% reserves pooling arrangement by the countries in the community over the 20-years period considered in the study. This is generated from the impulse response estimation. The result is shown in table 5.12. The first column contains the list of the macroeconomic variables representing the behavioural equations estimated in the study. The second and third columns show the estimated instability from unpooled and pooled reserves respectively. They are calculated as the standard deviation of the impulse response tabular values obtained for each of the behavioural equations considered in the study. As shown earlier, the impulse response measures the average perturbation/response of a variable from its equilibrium state as a result of a shock to another. The fourth column estimates the stability achieved by the economic community as a result of a reserve pooling arrangement among the countries. It is defined as the ratio of the difference between the respective unpooled reserves and the pooled reserves to the unpooled reserves while the last column is all about the percentage stability gained from the pooling arrangement.

Table 5.12 Analysis of Stability Gained from Reserves Pooling

BEHAVIOURAL EQUATIONS	Estimated instability from unpooled reserves	Estimated instability from pooled reserves	Stability gained from reserves pooling	Percentage stability gained from reserves pooling	ECOWAS average stability gained from reserves pooling
GOVERNMENT	0.00724	0.00530	0.26779	26.7794	**46.71%**
INVESTMENT	0.01304	0.00590	0.54760	54.7602	
DEBT	0.05653	0.04361	0.22865	22.8647	
TRADE FLOWS	0.02602	0.01122	0.56881	56.8806	
GDP	0.00474	0.00198	0.58249	58.2490	
EXCHANGE RATE	0.00125	0.00049	0.60737	60.7372	

Source: Author's Computation from Estimation Results

From the table, it is observed that the instability to the economy arising from government spending is 0.00724 when the countries are operating individually - under an independent state; however, under reserves pooling arrangement, the instability can be reduced to 0.0053. This represents about 26.78% overall stability gained as a result of reserves pooling relative to the unpooled state of affairs. For investment, it is observed that the instability under an autonomous state is 0.01304 while it is reduced to 0.0059 under a pooling arrangement; representing about 54.76% overall improvement in the region. The external debt record the lowest improvement from a possible reserves pooling arrangement in the region with 22.86% where the estimated instability from unpooled reserves is 0.05653 while that from the pooled reserves to 0.0436. With a reserves pooling arrangement, the stability from trade flows shows a significant improvement compared to that when the countries are operating autonomously. For the trade flow, the estimated instability from unpooled reserves is seen to be 0.026 while that under a pooling arrangement is 0.01122, representing about 56.88% stability gain for the region. The index of economic growth, GDP, is another area where significant stability will be recorded when the region is under a reserves pooling arrangement. Here, the estimated instability for the unpooled scenario is 0.00474 while that for the pooled is 0.00198, representing about 58.25% improvement and stability compared to the autonomous state of affairs. From this table, the largest gain is shown to be coming from exchange rate coordination. Under an unpooled scenario, the estimated instability here is shown to be 0.00125 while that under pooling is 0.00049. This represents about 60.74% improvement. The overall average stability gain for the region is computed to be 46.71% when the countries agree on a 60% reserves pooling. Thus, the study finds strong evidence of macroeconomic stability as a result of international reserves pooling.

5.5 Interpretations

The foregoing analysis considers the response of macroeconomic variables to reserves under a non-pooling scenario as well as under pooling. It is observed from the results presented that when there is a shock emanating from reserves and the total reserves are not adequate enough to insulate the economy, there would be a significant distortion (disequilibrium) to the economy as shown by the response of the macroeconomic variables thus the stability of the economy is undermined as a result of this shock and this creates disequilibrium. However, it is observed from the results presented that when the countries enter into a reserves pooling arrangement and the reserves available to each country is significant, the economy is to a large extent insulated from the negative impact of the shock. It is shown in the results presented that in the cases of pooled reserves analyzed, the distortion in the economy (in terms of the macroeconomic variables examined) is infinitesimal in comparison to the distortion to the economy when the countries are operating in an autonomous state.

From the stability gain analysis carried out, it is observed that the macroeconomic stability in the region is going to improve under a reserves pooling arrangement for all the macroeconomic variables selected for this study. It is shown that the lowest stability gain is recorded by external debt while the highest stability gain is recorded in the area of exchange rate coordination. This corroborates apriori expectations as under a reserves pooling arrangement, a large percentage of reserves is often deployed for the stabilization of the exchange rate. This would be the case under a single currency operation; so that the exchange rate fluctuation does not overshoot or undershoot the level necessary for the attainment of the prime goal of macroeconomic stability. Thus, the crux of this study is the overall estimated macroeconomic stability to be gained if the countries in the region are to operate under a reserves pooling arrangement. This is estimated to be 46.71% which is a significant stability gain to be recorded. Overall, it is observed from the study that reserves are expected to be sources of insulation to the economies so that a positive shock to reserves should not translate to the economy and deteriorate macroeconomic variables. However, due the inadequacy of reserves in these countries, it is observed from the analysis that a positive shock to unpooled reserves drifts the macroeconomic variables away from d steady state. However, under a pooling arrangement, the instabilities are

greatly reduced. This result is significant for the region especially in the face of the increasing campaign for monetary integration and the contemplation for the adoption of a single currency in the region.

The finding from this analysis is consistent with the findings of Ogunkola (2005), Ogunkola and Jerome (2005), Jerome (2005) and Iyoha (2003). These studies find out that monetary integration could be beneficial to the ECOWAS region even though the approaches differ.

5.6 ROBUSTNESS/SENSITIVITY ANALYSIS OF THE OPTIMAL LEVEL OF INTERNATIONAL RESERVES IN THE ECOWAS

5.6.1 Assessing the Size and Benefits of International Reserves Pooling

Following from the club model, coverage is defined as the ratio of reserves holdings to their variability. According to this formulation, coverage will increase if there is an increase in access to reserves or a decrease in reserves variability. Coverage in country *i* is defined as

$$C_i = \frac{PR_i}{Var(PR_i)} \qquad (55)$$

Where PR_i is the average level of reserves during a time period and $VAR\ (PR_i)$ is their variability during the same time period (for each country); and for reserves pool, $PR = \sum PR_i$. This formulation above encompasses two potential sources of gains in reserve pooling. (i) access to increased reserves holdings; (ii) possible reduction in reserves variability in both cases, coverage will increase. Coverage under reserves pooling is higher than that in the independent state if the variability of the pool is lower than that of each country's individual reserves, or if the increased access to reserves outweighs the higher variability of the pool so that the equation becomes:

$$C_i^P = \frac{R_i + \sum_{j \neq i} p.R_j}{Var\left\{ R_i + \sum_{j \neq i} p.R_j \right\}} \qquad (56)$$

where C_i^p is the coverage index for the partial pool for each individual country (i). p is the degree of pooling ($0 < p < 1$), and R_i and R_j are the total reserves of country i and country j (assumed to be the members of the pool). This is to say that if country *i* decides to join the pool, the stock of reserves available for that country to take care of its "problems" (coverage) at any point in time is equal to the stock of its own reserves plus the

summation of the reserves of all other member countries belonging to the pool (depending on the degree of pooling, *p*,). This is deflated by the variability of reserves of all members.

From Equation (19), it is clear that the coverage under reserve pooling will be higher than that in the autonomous state if the variability of the pool is lower than that of each country's reserves separately, or if the increased access to the larger pool of reserves outweighs the higher variability of the pooled reserves. The formulation of the pooled-coverage index assumes that each country has unrestricted access to the pool so that when one country draws down the pool, it reduces coverage for the other member countries. Hence, the pool system is clearly a zero sum game.

The gains and losses from pooling can be quantified by examining the "ideal" level of reserves. That level of reserves that a country would desire to hold to cater for "all" of its needs but cannot on its own due to competing demands for the "scarce" resources - reserves. It is that "highest possible" level of reserves that, given the different contribution of other members of the pool under different pooling arrangement, a country can get for itself. This is equivalent to the hypothetical scenario of "what if each country had wanted to maintain the level of coverage that it actually enjoyed, but did not belong to the pool?" Most of the countries would have had to hold higher reserves to be able to meet these competing needs. But how much higher? This hypothetical level of reserves can be quantitatively obtained by manipulating equation (19) in order to obtain that level of reserves it would have had to hold autonomously in the absence of any pooling arrangement. Thus, the hypothetical reserve is calculated using the resulting equation.

$$HR_i = C_i^p * Var(R_i) \tag{57}$$

Where HR_i is the hypothetical reserve - the level of reserves that each country would have to hold if it does not belong to the pool, but still intends to maintain the coverage actually afforded by the pool. C_i^p is the coverage index of country i under the pooling, and $Var(R_i)$ is the variability of country i own reserves. The gains/losses from reserve pooling may be measured as follows:

$$G/L = HR - AR \tag{58}$$

Where(G/L) is the gain (+) or loss (-) in reserve level, and HR and AR are the hypothetical and actual average reserve respectively.

The average reserve holdings for each country and their variability during the scope of the study will be used. Based on this data, and for each country, we will first compute the coverage index without pooling (0 percent) and then simulate the country's coverage index by imposing additional 10 percent increments in the level of pooling commitment (from 10 percent pooling to 100 percent pooling). The highest overall average for the coverage index with pooling will be found. With this methodology, the level of pooling that will most benefit the ECOWAS economies as a group will be determined. The simulation will identify the degree of pooling (whether partial pooling or complete 100% pooling) that will maximize the overall gains for the countries in the sub-region. Similarly, this same methodology is employed to examine the case of reserves pooling for the WAEMU and non-WAEMU zones separately to examine which zones would enjoys relatively greater gains (or suffer greater loss) from pooling.

5.6.2 Evaluation of Gains/Losses from Reserves Pooling in ECOWAS

This section of the study considers reserves pooling among the ECOWAS countries based on the average reserves of these respective countries in the last decade (2001-2011). The choice of this scope is due to the fact that economic transformations in these countries in the last decade paint a more vivid picture of their present economic realities than periods in the far past. Thus, reserves positions as well their respective variabilities in the recent past are assumed to tell more stories about the economies' present state of affairs[26]. When a group of countries pool reserves together, each member has an unrestricted access to the pool. This is one of the major sources of gains. The average reserves of each member country of ECOWAS and different degrees of pooling for the period 2001 and 2011 are shown in table 5.13.

[26]An alternative analysis using the average reserves of the countries (not reported here) for the entire study sample scope of three decades (1981-2011) did not produce a vivid picture of the actual average reserves position of the countries as compared to the results within one decade. In addition, the 1981-2011 sample periods produced a much lower coverage index of reserves pooled for the region.

With reserves pooling, a country's reserves equals its own total reserves holding plus the sum of partially pooled reserves (depending on the degree of pooling) of all other members belonging to the pool (that is with pooling, $\boldsymbol{R_i = R_i + \Sigma p.R_j}$ *where* $i \neq j$).

In the simplest of cases as shown in table 5.13, international reserves pooling offers the participating countries access to higher reserves to take care of macroeconomic instabilities facing the country at any particular period of time. In the absence of any pooling arrangement, Nigeria has the largest stock of accumulated reserves with an average of US$29.65 billion. This large stockpile is as a result of receipts from the export of crude oil. The next country with the largest stockpile is Cote d'Ivoire with an average of US$2.07 billion. Liberia is the country with the least stockpile with a paltry US$90 million. As the countries in the region enter into a reserves pooling arrangement, each country's access to reserves begins to increase from the 10% simulation to 100%. The scenarios from 10% pooling arrangement to 90% pooling arrangement represent the cases of partially pooled reserves where each country can access all own reserves as well as the sum of the partially pooled reserves of other member countries. Since each member has an unrestricted access to the pool, with a 100% pooling arrangement, the reserves available to any of the members is the reserves of all member countries put together. This is US$39.27 billion in the case of ECOWAS as a whole (table 5.13).

Table 5.13. Average Reserves with Different Degrees of Pooling for ECOWAS Countries (US$ Billions)

Country	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Benin	0.90	4.74	8.57	12.41	16.25	20.08	23.92	27.76	31.60	35.43	39.27
B/Faso	0.73	4.58	8.44	12.29	16.15	20.00	23.85	27.71	31.56	35.42	39.27
C/Verde	0.23	4.13	8.04	11.94	15.85	19.75	23.65	27.56	31.46	35.37	39.27
C/d'Ivoire	2.07	5.79	9.51	13.23	16.95	20.67	24.39	28.11	31.83	35.55	39.27
Gambia	0.13	4.04	7.95	11.87	15.78	19.70	23.61	27.53	31.44	35.36	39.27
Ghana	1.94	5.67	9.41	13.14	16.87	20.60	24.34	28.07	31.80	35.54	39.27
Guinea	0.11	4.02	7.93	11.85	15.77	19.68	23.60	27.52	31.44	35.35	39.27
G/Bissau	0.10	4.02	7.93	11.85	15.77	19.68	23.60	27.52	31.44	35.35	39.27
Liberia	0.09	4.04	7.95	11.87	15.78	19.70	23.61	27.53	31.44	35.35	39.27
Mali	0.97	4.80	8.63	12.46	16.29	20.12	23.95	27.78	31.61	35.44	39.27
Niger	0.41	4.29	8.18	12.07	15.95	19.84	23.73	27.61	31.50	35.38	39.27
Nigeria	29.65	30.61	31.57	32.53	33.50	34.46	35.42	36.38	37.35	38.31	39.27
Senegal	1.35	5.14	8.94	12.73	16.52	20.31	24.10	27.89	31.69	35.48	39.27
S/Leone	0.19	4.10	8.01	11.92	15.82	19.73	23.64	27.55	31.45	35.36	39.27
Togo	0.39	4.27	8.16	12.05	15.94	19.83	23.72	27.60	31.49	35.38	39.27

Source: Author's Computation

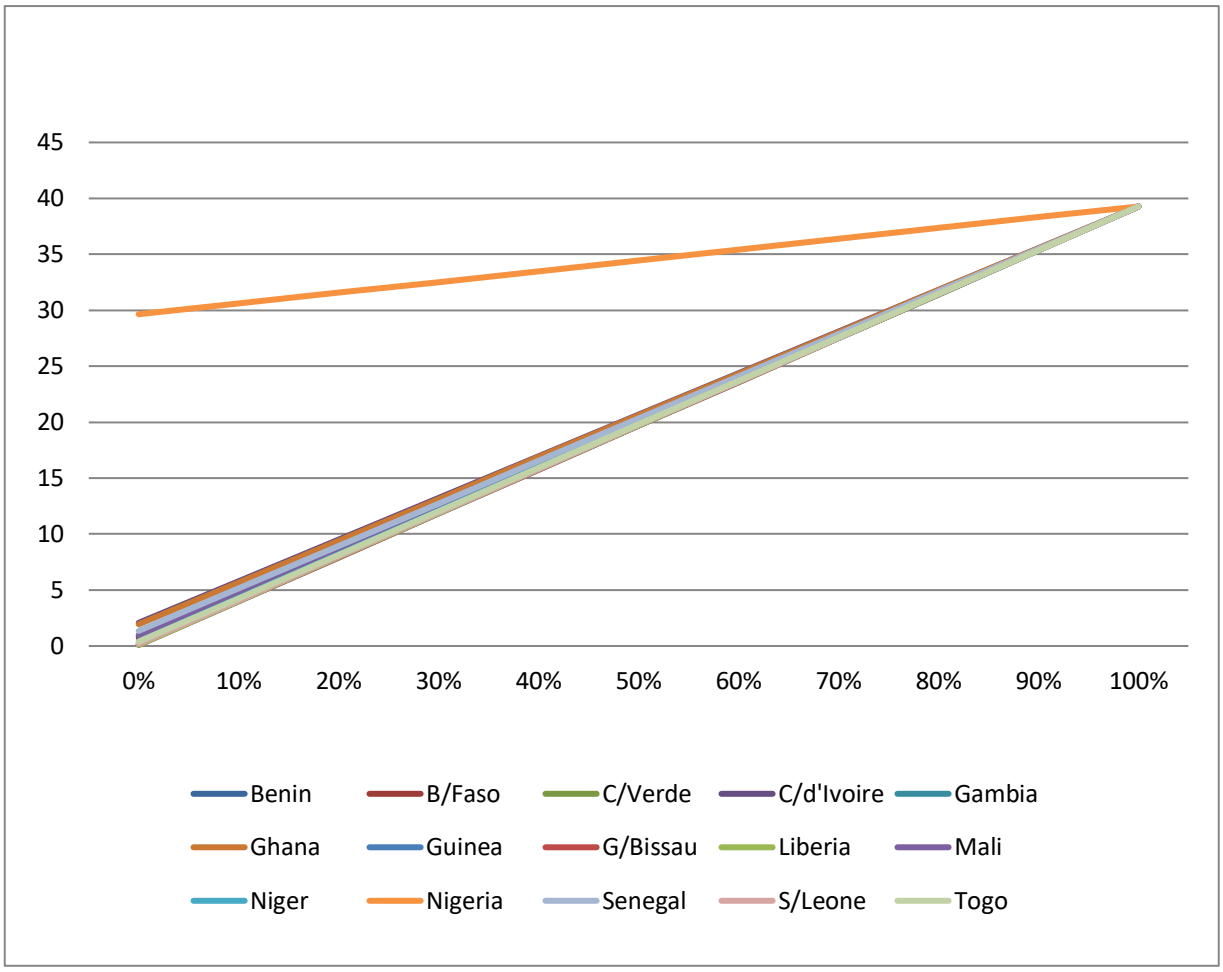


Figure 5.14. Average Reserves with Different Degrees of Pooling for ECOWAS Countries (US$ Billions)

Source: Author's Computation from Estimation Results

The graphical representation of the reserves pooling among the group of countries is shown in figure 5.14. What is so obvious from the figure is the fact that reserves pooling clusters the reserves of participating countries together irrespective of the disparity at the initial stage (0% pooling). The reserves of Nigeria starts at US$29 billion with 0% pooling while those of other members' starts at US$2.09 billion and less. However, there is a convergence in reserves as members enter in a pooling arrangement starting from 10% to 100%.

If we are to go by a parallel quantity of reserves, then it can be concluded that Nigeria would be the greatest earner under an autonomous state due to its large reserves size and would be the greatest looser under a pooling configuration due to the fact it would be forced to share its large reserves with other countries especially under a 100% configuration while Liberia is the greatest looser in autonomous state but highest gainer under a pooling arrangement.

Complications arise in this study due to the fact that the francophone countries are already involved in a sort of pooling arrangement where they keep about 50% of their reserves with the BCEAO for the defense of the CFA Franc. Therefore, in order to account for this fact, this study introduces the idea of reserves variability that helps in capturing the level of stability that the countries are already enjoying or suffering whether they are already part of a pooling arrangement ab initio or not. Countries that are already involved in any form of pooling arrangement are "compensated" by the relative degree of macroeconomic stability already being enjoyed. Thus, the introduction of the risk factor; captured by the reserves variability coefficient, becomes pertinent.

The risk factor in reserves accumulation is an important factor to be put into consideration. This is because it indicates the level of exposure to both internal and external uncertainties. A country with a high risk factor is likely to be a liability to the pool since the country will always resort to the pool for safety. Such risk factor is the variability of each country's reserves, which is measured by the coefficient of variation or standard deviation of each country's reserves. Reserves variability is seen as a measure of a

country's vulnerability to both internal and external shocks. In essence, a smaller variability is desirable. As shown in figure 5.14 above, reserves pooling has a way of reducing reserves variability. The average reserve along with their respective variabilities for each of the member countries is shown in table 5.14.

As shown in table 5.14, foreign reserves of ECOWAS member countries show varying degrees of variability (coefficient of variation) among the countries, some countries appear to be more volatile than others. Liberia is the most volatile country to enter into a reserves pooling arrangement with as it has the highest coefficient of variation of 131.85%. Sierra Leone is next with a coefficient of variation of 62%. The scenarios in these two countries can largely be explained by the significant political instabilities experienced by the countries in the recent past. Benin is the most "benign" country with the least coefficient of variation and is closely followed by Mali. On a general note, the WAEMU countries are shown to exhibit lower coefficients of variation than their non-WAEMU counterparts.

Pooling can be advantageous to countries as it encompasses two sources of gains: the first is through increased access to more reserves and the second is the reduced reserves variability. These two sources of gains are captured in the coverage index. The coverage index was computed starting from the case without any pooling arrangement (0%). The coverage index is simulated for different degrees of pooling starting with a 10% arrangement and imposing additional 10% increments at each scenario. This simulation is done up to 100% which is a situation of complete pooling. Table 5.15 shows coverage with and without pooling for ECOWAS countries. A preliminary indication of gains from pooling for any country can be deduced if at any particular percentage pooling arrangement, its coverage index at that percentage is greater than that in an autonomous state (0%).

Table 5.14 Average Reserves Holding and Reserves Variability of ECOWAS Countries

Country	Actual Average Reserves US$ Million	Standard Deviation (US$ Million)	Coefficient of Variation (Percent)
Benin	899.23	280.82	31.23
B/Faso	728.98	329.66	45.22
C/Verde	229.28	131.85	57.51
C/d'Ivoire	2066.72	809.22	39.15
Gambia	126.00	48.50	38.49
Ghana	1939.57	983.67	50.72
Guinea	108.12	56.12	51.90
G/Bissau	100.12	39.56	39.51
Liberia	86.66	114.26	131.85
Mali	967.46	335.31	34.66
Niger	408.82	233.59	57.14
Nigeria	29646.85	17229.09	58.11
Senegal	1353.20	512.44	37.87
S/Leone	193.28	120.77	62.48
Togo	386.52	208.45	53.93

Source: Author's Computation

Table 5.15 Coverage with and without Pooling for ECOWAS Countries

Country	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Benin	3.20	2.08	2.06	2.15	2.32	2.33	2.34	2.31	2.12	2.08	1.92
B/Faso	2.21	2.02	2.03	2.13	2.31	2.32	2.33	2.31	2.12	2.08	1.92
C/Verde	1.74	1.92	1.98	2.10	2.29	2.31	2.32	2.30	2.12	2.08	1.92
C/d'Ivoire	2.55	2.22	2.15	2.21	2.37	2.37	2.36	2.32	2.13	2.08	1.92
Gambia	2.60	1.95	2.00	2.11	2.30	2.31	2.32	2.30	2.12	2.08	1.92
Ghana	1.97	1.99	2.03	2.13	2.31	2.33	2.33	2.31	2.12	2.08	1.92
Guinea	1.93	2.02	2.02	2.12	2.31	2.32	2.33	2.31	2.12	2.08	1.92
G/Bissau	2.53	1.95	1.99	2.10	2.29	2.31	2.32	2.30	2.12	2.08	1.92
Liberia	0.76	1.89	1.97	2.09	2.28	2.31	2.32	2.30	2.11	2.08	1.92
Mali	2.89	2.11	2.07	2.16	2.33	2.34	2.34	2.31	2.12	2.08	1.92
Niger	1.75	1.93	1.98	2.10	2.29	2.31	2.32	2.30	2.12	2.08	1.92
Nigeria	1.72	1.75	1.82	1.95	2.16	2.20	2.23	2.24	2.08	2.06	1.92
Senegal	2.64	2.12	2.08	2.16	2.34	2.34	2.34	2.31	2.12	2.08	1.92
S/Leone	1.60	1.93	1.99	2.10	2.29	2.31	2.32	2.30	2.12	2.08	1.92
Togo	1.85	1.95	1.99	2.11	2.30	2.31	2.32	2.30	2.12	2.08	1.92
AVERAGE	**2.13**	**1.99**	**2.01**	**2.11**	**2.30**	**2.32**	**2.32**	**2.30**	**2.12**	**2.08**	**1.92**

Source: Author's Computation

The ECOWAS countries stand to benefit differently from the pooling arrangements. There are preliminary indications that Benin will lose from any form of pooling arrangement within the sub-region since none of its coverage indices under the different scenarios of pooling is greater than that in autonomous state (3.20). This point is similarly observed for Cote d'Ivoire, Gambia, Guinea Bissau, Mali and Senegal. For the region as a whole, the coverage indices vary under the different pooling arrangements. The degrees of pooling that maximize overall benefit for the region as a whole are found to be at 50% and 60% since they both have the same highest coverage index of 2.32. This is so as these are the percentage contributions from each member country that produce the highest coverage for the region as a whole.

In order to evaluate the gains proper from international reserves pooling, the hypothetical reserves conception is employed. If a country does not belong to a reserve pool, there is particularly a maximum level of overall satisfaction it wants to derive from its own reserves holding. However given its reserves inadequacy and the dilemma between reserves accumulation and de-accumulation, it cannot attain that highest possible level of satisfaction from own reserves alone. This is the hypothetical reserves conception. As explained earlier under the methodology section, it is that hypothetical scenario of "what if a country wants to maintain the level of coverage that it actually enjoyed (by belonging to a pool) in a independent state?" put differently, what will it cost each country (That is, it is that "highest possible" level of reserves that, given the different contribution of other members of the pool under different pooling arrangement, a country can get for itself. The evaluation procedures for the this level of reserves is as discussed in the methodology section so that the gains/loss from reserves pooling for any country under the different simulation scenarios will be the difference between this hypothetical reserves and the actual average reserves of that country. The comprehensive result from this evaluation for each country under the different pooling arrangements is shown in table 5.16.

Table 5.16. Gains and Losses from Reserves Pooling for ECOWAS

Country	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Benin										
Actual Average reserves (US$ M)	899.23	899.23	899.23	899.23	899.23	899.23	899.23	899.23	899.23	899.23
Coverage Index	2.08	2.06	2.15	2.32	2.33	2.34	2.31	2.12	2.08	1.92
Reserves Variability	280.82	280.82	280.82	280.82	280.82	280.82	280.82	280.82	280.82	280.82
Hypothetical Reserves (US$ M)	584.48	578.24	602.77	652.90	655.20	655.77	648.79	595.60	584.48	540.57
Gains/Losses (US$ Million)	-314.76	-320.99	-296.46	-246.33	-244.03	-243.46	-250.44	-303.63	-314.75	-358.66
B/Faso										
Actual Average reserves (US$ M)	728.98	728.98	728.98	728.98	728.98	728.98	728.98	728.98	728.98	728.98
Coverage Index	2.02	2.03	2.13	2.31	2.32	2.33	2.31	2.12	2.08	1.92
Reserves Variability	329.66	329.66	329.66	329.66	329.66	329.66	329.66	329.66	329.66	329.66
Hypothetical Reserves (US$ M)	665.03	669.02	701.53	762.18	766.28	767.90	760.39	698.52	685.84	634.59
Gains/Losses (US$ Million)	-63.95	-59.96	-27.45	33.20	37.30	38.92	31.42	-30.45	-43.14	-94.39
C/Verde										
Actual Average reserves (US$ M)	229.28	229.28	229.28	229.28	229.28	229.28	229.28	229.28	229.28	229.28
Coverage Index	1.92	1.98	2.10	2.29	2.31	2.32	2.30	2.12	2.08	1.92
Reserves Variability	131.85	131.85	131.85	131.85	131.85	131.85	131.85	131.85	131.85	131.85
Hypothetical Reserves (US$ M)	253.01	261.05	276.42	301.87	304.46	305.77	303.26	278.91	274.10	253.81
Gains/Losses (US$ Million)	23.73	31.78	47.14	72.59	75.18	76.49	73.98	49.63	44.82	24.53
Cote d'Ivoire										
Actual Average reserves (US$ M)	2066.72	2066.72	2066.72	2066.72	2066.72	2066.72	2066.72	2066.72	2066.72	2066.72
Coverage Index	2.22	2.15	2.21	2.37	2.37	2.36	2.32	2.13	2.08	1.92
Reserves Variability	809.22	809.22	809.22	809.22	809.22	809.22	809.22	809.22	809.22	809.22
Hypothetical Reserves (US$ M)	1800.29	1739.47	1787.27	1918.67	1913.91	1907.38	1881.02	1722.51	1686.99	1557.74
Gains/Losses (US$ Million)	-266.43	-327.25	-279.45	-148.05	-152.81	-159.34	-185.70	-344.21	-379.73	-508.99
Gambia										
Actual Average reserves (US$ M)	126.00	126.00	126.00	126.00	126.00	126.00	126.00	126.00	126.00	126.00
Coverage Index	1.95	2.00	2.11	2.30	2.31	2.32	2.30	2.12	2.08	1.92
Reserves Variability	48.50	48.50	48.50	48.50	48.50	48.50	48.50	48.50	48.50	48.50
Hypothetical Reserves (US$ M)	94.73	96.80	102.16	111.38	112.22	112.63	111.65	102.65	100.85	93.36

Gains/Losses (US$ Million)	-31.27	-29.20	-23.84	-14.62	-13.78	-13.37	-14.35	-23.35	-25.15	-32.64
Ghana										
Actual Average reserves (US$ M)	1939.57	1939.57	1939.57	1939.57	1939.57	1939.57	1939.57	1939.57	1939.57	1939.57
Coverage Index	1.99	2.03	2.13	2.31	2.33	2.33	2.31	2.12	2.08	1.92
Reserves Variability	983.67	983.67	983.67	983.67	983.67	983.67	983.67	983.67	983.67	983.67
Hypothetical Reserves (US$ M)	1961.01	1992.79	2093.47	2275.35	2287.64	2292.30	2269.66	2084.75	2046.68	1893.55
Gains/Losses (US$ Million)	21.44	53.21	153.89	335.78	348.07	352.72	330.08	145.17	107.11	-46.03
Guinea										
Actual Average reserves (US$ M)	108.12	108.12	108.12	108.12	108.12	108.12	108.12	108.12	108.12	108.12
Coverage Index	2.02	2.02	2.12	2.31	2.32	2.33	2.31	2.12	2.08	1.92
Reserves Variability	56.12	56.12	56.12	56.12	56.12	56.12	56.12	56.12	56.12	56.12
Hypothetical Reserves (US$ M)	113.19	113.60	119.19	129.56	130.31	130.63	129.38	118.88	116.74	108.03
Gains/Losses (US$ Million)	5.07	5.48	11.06	21.44	22.19	22.51	21.26	10.76	8.62	-0.09
Guinea Bissau										
Actual Average reserves (US$ M)	100.12	100.12	100.12	100.12	100.12	100.12	100.12	100.12	100.12	100.12
Coverage Index	1.95	1.99	2.10	2.29	2.31	2.32	2.30	2.12	2.08	1.92
Reserves Variability	39.56	39.56	39.56	39.56	39.56	39.56	39.56	39.56	39.56	39.56
Hypothetical Reserves (US$ M)	76.95	78.81	83.23	90.78	91.49	91.84	91.05	83.72	82.26	76.15
Gains/Losses (US$ Million)	-23.17	-21.31	-16.88	-9.34	-8.63	-8.28	-9.07	-16.40	-17.86	-23.96
Liberia										
Actual Average reserves (US$ M)	86.66	86.66	86.66	86.66	86.66	86.66	86.66	86.66	86.66	86.66
Coverage Index	1.89	1.97	2.09	2.28	2.31	2.32	2.30	2.11	2.08	1.92
Reserves Variability	114.26	114.26	114.26	114.26	114.26	114.26	114.26	114.26	114.26	114.26
Hypothetical Reserves (US$ M)	216.37	224.94	238.76	261.05	263.48	264.73	262.64	241.62	237.50	219.95
Gains/Losses (US$ Million)	129.71	138.28	152.10	174.39	176.81	178.07	175.98	154.96	150.84	133.29
Mali										
Actual Average reserves (US$ M)	967.46	967.46	967.46	967.46	967.46	967.46	967.46	967.46	967.46	967.46
Coverage Index	2.11	2.07	2.16	2.33	2.34	2.34	2.31	2.12	2.08	1.92
Reserves Variability	335.31	335.31	335.31	335.31	335.31	335.31	335.31	335.31	335.31	335.31
Hypothetical Reserves (US$ M)	707.00	695.38	722.95	781.91	783.92	784.09	775.37	711.54	698.05	645.47
Gains/Losses (US$ Million)	-260.46	-272.08	-244.51	-185.55	-183.54	-183.37	-192.09	-255.92	-269.41	-321.99
Niger										

Actual Average reserves (US$ M)	408.82	408.82	408.82	408.82	408.82	408.82	408.82	408.82	408.82	408.82
Coverage Index	1.93	1.98	2.10	2.29	2.31	2.32	2.30	2.12	2.08	1.92
Reserves Variability	233.59	233.59	233.59	233.59	233.59	233.59	233.59	233.59	233.59	233.59
Hypothetical Reserves (US$ M)	450.13	463.48	490.36	535.27	539.71	541.92	537.39	494.20	485.64	449.66
Gains/Losses (US$ M)	41.31	54.67	81.54	126.45	130.89	133.10	128.58	85.39	76.83	40.84
Nigeria										
Actual Average reserves (US$ M)	29646.85	29646.8	29646.8	29646.8	29646.8	29646.8	29646.8	29646.8	29646.8	29646.85
Coverage Index	1.75	1.82	1.95	2.16	2.20	2.23	2.24	2.08	2.06	1.92
Reserves Variability	17229.09	17229.0	17229.0	17229.0	17229.0	17229.0	17229.0	17229.0	17229.0	17229.09
Hypothetical Reserves (US$ M)	30079.67	31406.5	33663.9	37197.3	37937.7	38505.3	38573.2	35814.4	35514.3	33165.72
Gains/Losses (US$ Million)	432.82	1759.69	4017.05	7550.53	8290.87	8858.50	8926.39	6167.63	5867.45	3518.87
Senegal										
Actual Average reserves (US$ M)	1353.20	1353.20	1353.20	1353.20	1353.20	1353.20	1353.20	1353.20	1353.20	1353.20
Coverage Index	2.12	2.08	2.16	2.34	2.34	2.34	2.31	2.12	2.08	1.92
Reserves Variability	512.44	512.44	512.44	512.44	512.44	512.44	512.44	512.44	512.44	512.44
Hypothetical Reserves (US$ M)	1083.88	1066.61	1107.86	1197.29	1199.70	1199.45	1185.72	1087.83	1066.99	986.44
Gains/Losses (US$ Million)	-269.32	-286.59	-245.35	-155.91	-153.51	-153.76	-167.49	-265.37	-286.21	-366.77
Sierra Leone										
Actual Average reserves (US$ M)	193.28	193.28	193.28	193.28	193.28	193.28	193.28	193.28	193.28	193.28
Coverage Index	1.93	1.99	2.10	2.29	2.31	2.32	2.30	2.12	2.08	1.92
Reserves Variability	120.77	120.77	120.77	120.77	120.77	120.77	120.77	120.77	120.77	120.77
Hypothetical Reserves (US$ M)	233.18	239.81	253.63	276.82	279.09	280.21	277.86	255.52	251.09	232.48
Gains/Losses (US$ Million)	39.90	46.53	60.35	83.54	85.81	86.93	84.58	62.24	57.81	39.20
Togo										
Actual Average reserves (US$ M)	386.52	386.52	386.52	386.52	386.52	386.52	386.52	386.52	386.52	386.52
Coverage Index	1.95	1.99	2.11	2.30	2.31	2.32	2.30	2.12	2.08	1.92
Reserves Variability	208.45	208.45	208.45	208.45	208.45	208.45	208.45	208.45	208.45	208.45
Hypothetical Reserves (US$ M)	405.96	415.67	438.89	478.58	482.25	484.01	479.82	441.16	433.44	401.26
Gains/Losses (US$ Million)	19.44	29.15	52.37	92.06	95.73	97.49	93.30	54.64	46.92	14.74

Source: Author's Computation

Information contained in table 5.16 is summarized in table 5.17 for ease of comprehension and discussion. From the table showing gains and losses from reserve pooling, it can be observed that any form of pooling arrangement will benefit members differently. A negative coefficient (negative gain) in the table is an indication of a loss for that country under that pooling scenario.

Benin will record negative gain for whichever pooling scenario embarked upon by the sub-region. Its loss will be minimized under a 60% pooling arrangement. For Burkina Faso, low percentage pooling arrangement will not be in the country's favour likewise a very high pooling arrangement. Other countries like Cote d' Ivoire, Gambia, Guinea Bissau, Mali and Senegal will record loss under sort of pooling arrangement (from 10% to 100%) for the ECOWAS region as whole. The remaining countries: Cape Verde, Ghana, Guinea, Liberia, Niger, Nigeria, Sierra Leone and Togo will gain positively from any sort of pooling arrangement. In addition, an obvious fact from the analysis is that the WAEMU countries tend to lose more in the prospect of a region-wide reserves pooling arrangement than its non-WAEMU counterparts. This is more or less expected since they have been together as a community and have attained a higher integration status and stability as discussed in the historical background section much earlier in the study; hence, entering into a form of reserves arrangement with "others outside" will be a form of "growth drag" for them .

Table 5.17. Summary of Gains/Losses from Reserves Pooling under different Degrees of Pooling for ECOWAS (US$ Million)

Country	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Benin	-314.76	-320.99	-296.46	-246.33	-244.03	-243.46	-250.44	-303.63	-314.75	-358.66
B/Faso	-63.95	-59.96	-27.45	33.20	37.30	38.92	31.42	-30.45	-43.14	-94.39
C/Verde	23.73	31.78	47.14	72.59	75.18	76.49	73.98	49.63	44.82	24.53
C/d'Ivoire	-266.43	-327.25	-279.45	-148.05	-152.81	-159.34	-185.70	-344.21	-379.73	-508.99
Gambia	-31.27	-29.20	-23.84	-14.62	-13.78	-13.37	-14.35	-23.35	-25.15	-32.64
Ghana	21.44	53.21	153.89	335.78	348.07	352.72	330.08	145.17	107.11	-46.03
Guinea	5.07	5.48	11.06	21.44	22.19	22.51	21.26	10.76	8.62	-0.09
G/Bissau	-23.17	-21.31	-16.88	-9.34	-8.63	-8.28	-9.07	-16.40	-17.86	-23.96
Liberia	129.71	138.28	152.10	174.39	176.81	178.07	175.98	154.96	150.84	133.29
Mali	-260.46	-272.08	-244.51	-185.55	-183.54	-183.37	-192.09	-255.92	-269.41	-321.99
Niger	41.31	54.67	81.54	126.45	130.89	133.10	128.58	85.39	76.83	40.84
Nigeria	432.82	1759.69	4017.05	7550.53	8290.87	8858.50	8926.39	6167.63	5867.45	3518.87
Senegal	-269.32	-286.59	-245.35	-155.91	-153.51	-153.76	-167.49	-265.37	-286.21	-366.77
S/Leone	39.90	46.53	60.35	83.54	85.81	86.93	84.58	62.24	57.81	39.20
Togo	19.44	29.15	52.37	92.06	95.73	97.49	93.30	54.64	46.92	14.74
AVERAGE	**-34.40**	**53.43**	**229.44**	**515.34**	**567.10**	**605.54**	**603.09**	**366.07**	**334.94**	**134.53**

Source: Author's Computation

For the region as a whole, the analysis shows that gains will be recorded if the countries agree to enter into an international reserves pooling arrangement. This is the crux of the finding in this section of the study. The ECOWAS region will gain under any pooling arrangement except for a 10% arrangement where an average loss of US$34.4 million will be recorded. Except for this, varying degrees of gains will be recorded for the different pooling arrangements. An observation of these gains for the region as a whole reveals that there is a particular pooling arrangement that yield the highest possible benefit. This is a 60% pooling arrangement. The region will record a maximal gain of US$605.54 million. It was shown in table 5.15 earlier that using the coverage index, the region is maximally "covered" under any of a 50% pooling arrangement or a 60% arrangement. But here, it is observed that a 60% arrangement yields a higher average gain for the region. Whenever the coverage index under different pooling arrangements are the same, the one with the higher pooling arrangement is expected to yield higher average gain because reserves variability continues to reduce with higher pooling arrangement (see figure 5.14 for reserves clustering with increasing reserves pooling arrangement).

Having identified the degree of pooling that maximises overall gain for the region as whole (60%), a more closer survey of the gains and loss at this percentage is shown in table 5.18. The first column is that of actual average reserves; the second is the hypothetical reserve; the third is the gain and loss while the final column shows the gains and loss as percentage of actual average reserves of each of the countries (bracket indicates negative percentage gain). The analysis of the gains and loss is as already discussed above but of particular interest here is the gain and loss as proportion of actual reserves. This last item is of significance as it measures who gains/losses the most and by how much.

Table 5.18. Optimal Reserves Gains and Loss for ECOWAS (at 60% partial pool)

Country	Actual Average Reserves (US$ M)	Hypothetical Reserves (US$ M)	Gain/Loss (US$ M)	Gain/Loss as % of Actual Reserves
Benin	899.23	655.77	-243.46	(27.07)
B/Faso	728.98	767.90	38.92	5.34
C/Verde	229.28	305.77	76.49	33.36
C/d'Ivoire	2066.72	1907.38	-159.34	(7.71)
Gambia	126.00	112.63	-13.37	(10.61)
Ghana	1939.57	2292.30	352.72	18.19
Guinea	108.12	130.63	22.51	20.82
G/Bissau	100.12	91.84	-8.28	(8.27)
Liberia	86.66	264.73	178.07	205.48
Mali	967.46	784.09	-183.37	(18.95)
Niger	408.82	541.92	133.10	32.56
Nigeria	29646.85	38505.35	8858.50	29.88
Senegal	1353.20	1199.45	-153.76	(11.36)
S/Leone	193.28	280.21	86.93	44.98
Togo	386.52	484.01	97.49	25.22
AVERAGE	**2616.054**	**3221.60**	**605.54**	**22.12**

Source: Author's Computation

A closer examination shows that Liberia is the highest positive gainer in the whole of the reserves pooling scheme recording more than 200% gain. This figure dwarfs the next highest gainer from the pooling arrangement (Sierra Leone with 44.98% gain) by more than 150%. Other countries such as Cape Verde, Guinea, Niger, Nigeria and Togo have moderate gains. Burkina Faso is with the least positive gain. Benin is the country with the highest negative gain followed by Mali, Senegal Guinea Bissau, Gambia and Cote d'Ivoire in that order.

A more striking feature of this analysis is that, countries with the greater gains from this pooling arrangement are either countries with lower levels of own reserves or countries with higher variability of own reserves or countries with a combination of both so that belonging to the pool either increases their access to more foreign reserves (of other members of the pool) or dampens the high variability of their own reserves holdings. As stated earlier, overall, the positive gains tend to be concentrated among the countries outside of the WAEMU community and the larger proportion of the negative gains comes from the WAEMU community. This is largely due to the fact that the countries in the WAEMU cummunity have atttained a significant level of macroeconomic stability even before entering into an overall pooling arrangement with other members of the ECOWAS community.

5.6.3 Evaluation of Reserves Pooling in the WAEMU Community

By way of further analysis of the gains from reserves pooling in the ECOWAS region, independent considerations are given to the two monetary communities within the zone. Table 5.19 below considers an analysis of coverage without and with pooling for the WAEMU countries.

Table 5.19. Coverage without and with Pooling for WAEMU Countries

Country	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Benin	3.20	2.98	2.86	2.79	2.75	2.72	2.70	2.68	2.67	2.66	2.65
B/Faso	2.21	2.45	2.53	2.57	2.60	2.61	2.62	2.63	2.64	2.64	2.65
C/d'Ivoire	2.55	2.60	2.63	2.64	2.65	1.18	2.65	2.65	2.65	2.65	2.65
G/Bissau	2.53	2.68	2.66	2.66	2.65	2.65	2.65	2.65	2.65	2.65	2.65
Mali	2.89	2.81	2.76	2.73	2.71	2.69	2.68	2.67	2.66	2.65	2.65
Niger	1.75	2.27	2.43	2.51	2.55	2.58	2.60	2.62	2.63	2.64	2.65
Senegal	2.64	2.66	2.67	2.66	2.66	2.66	2.66	2.65	2.65	2.65	2.65
Togo	1.85	2.33	2.47	2.53	2.57	2.59	2.61	2.62	2.63	2.64	2.65
WAEMU	**2.45**	**2.60**	**2.63**	**2.64**	**2.64**	**2.64**	**2.65**	**2.65**	**2.65**	**2.65**	**2.65**

Source: Author's Computation

The result shows varying coverage coefficients under different simulations, however, with more convergence as compared to the case of the ECOWAS region results as a whole discussed above. A particular characteristic of the WAEMU coverage indices is that they are higher than those of the overall discussed above. This is largely explained by the greater macroeconomic stability the region enjoys –thereby lower reserves variability. Because of this, the results show that irrespective of the degree of pooling among each other (in the WAEMU community) going by the averages for the community, starting from 30% arrangement, the result will still be a maximum of 2.65 coverage index. Only 10% and 20% pooling that show a less significantly different figure from the maximum while coverage in an autonomous state (0%) is lowest.

For the gains and losses from reserves pooling, only two countries (Benin and Mali) are appearing to have negative gains while the others have positive gains (table 5.20 and 5.21).

Unlike the whole ECOWAS case discussed above where the results show that Guinea Bissau, Cote d'Ivoire, and Senegal have negative gains, they are having positive gains here due to the fact that they do not have to commit too much resources to "cover" for other members of the pool since majority of the members are relatively stable. The result still confirms (nonetheless by a small margin) that a 60% pooling arrangement yield the highest gain for the community as a unit.

Table 5.20. Gains and Losses from Reserves Pooling for WAEMU

	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Benin										
Actual Average reserves (US$ M)	899.23	899.23	899.23	899.23	899.23	899.23	899.23	899.23	899.23	899.23
Coverage Index	2.98	2.86	2.79	2.75	2.72	2.70	2.68	2.67	2.66	2.65
Reserves Variability	280.82	280.82	280.82	280.82	280.82	280.82	280.82	280.82	280.82	280.82
Hypothetical Reserves (US$ M)	836.56	803.60	784.56	772.30	763.78	757.53	752.75	748.97	745.92	743.40
Gains/Losses (US$ Million)	-62.67	-95.63	-114.67	-126.93	-135.45	-141.70	-146.48	-150.26	-153.31	-155.84
B/Faso										
Actual Average reserves (US$ M)	728.98	728.98	728.98	728.98	728.98	728.98	728.98	728.98	728.98	728.98
Coverage Index	2.45	2.53	2.57	2.60	2.61	2.62	2.63	2.64	2.64	2.65
Reserves Variability	329.66	329.66	329.66	329.66	329.66	329.66	329.66	329.66	329.66	329.66
Hypothetical Reserves (US$ M)	807.05	834.46	847.98	855.94	861.17	864.84	867.57	869.67	871.33	872.69
Gains/Losses (US$ Million)	78.07	105.48	119.00	126.97	132.19	135.87	138.59	140.69	142.36	143.71
Cote d'Ivoire										
Actual Average reserves (US$ M)	2066.72	2066.72	2066.72	2066.72	2066.72	2066.72	2066.72	2066.72	2066.72	2066.72
Coverage Index	2.60	2.63	2.64	2.65	2.65	2.65	2.65	2.65	2.65	2.65
Reserves Variability	809.22	809.22	809.22	809.22	809.22	809.22	809.22	809.22	809.22	809.22
Hypothetical Reserves (US$ M)	2107.30	2126.99	2136.82	2141.68	2143.88	2144.61	2144.52	2143.97	2143.15	2142.19
Gains/Losses (US$ Million)	40.58	60.27	70.10	74.95	77.16	77.89	77.80	77.25	76.43	75.47
Guinea Bissau										
Actual Average reserves (US$ M)	100.12	100.12	100.12	100.12	100.12	100.12	100.12	100.12	100.12	100.12
Coverage Index	2.68	2.66	2.66	2.65	2.65	2.65	2.65	2.65	2.65	2.65
Reserves Variability	39.56	39.56	39.56	39.56	39.56	39.56	39.56	39.56	39.56	39.56
Hypothetical Reserves (US$ M)	105.98	105.37	105.12	104.99	104.90	104.84	104.80	104.77	104.74	104.72
Gains/Losses (US$ Million)	5.86	5.26	5.01	4.87	4.79	4.73	4.68	4.65	4.63	4.61
Mali										
Actual Average reserves (US$ M)	967.46	967.46	967.46	967.46	967.46	967.46	967.46	967.46	967.46	967.46
Coverage Index	2.81	2.76	2.73	2.71	2.69	2.68	2.67	2.66	2.65	2.65
Reserves Variability	335.31	335.31	335.31	335.31	335.31	335.31	335.31	335.31	335.31	335.31
Hypothetical Reserves (US$ M)	943.43	926.22	915.02	907.32	901.74	897.53	894.24	891.61	889.45	887.64
Gains/Losses (US$ Million)	-24.03	-41.24	-52.44	-60.14	-65.72	-69.93	-73.22	-75.85	-78.01	-79.82
Niger										
Actual Average reserves (US$ M)	408.82	408.82	408.82	408.82	408.82	408.82	408.82	408.82	408.82	408.82

Coverage Index	2.27	2.43	2.51	2.55	2.58	2.60	2.62	2.63	2.64	2.65
Reserves Variability	233.59	233.59	233.59	233.59	233.59	233.59	233.59	233.59	233.59	233.59
Hypothetical Reserves (US$ M)	530.78	568.08	585.93	596.36	603.19	608.02	611.60	614.37	616.57	618.37
Gains/Losses (US$ Million)	121.97	159.27	177.11	187.54	194.38	199.20	202.79	205.55	207.76	209.55
Senegal										
Actual Average reserves (US$ M)	1353.20	1353.20	1353.20	1353.20	1353.20	1353.20	1353.20	1353.20	1353.20	1353.20
Coverage Index	2.66	2.67	2.66	2.66	2.66	2.66	2.65	2.65	2.65	2.65
Reserves Variability	512.44	512.44	512.44	512.44	512.44	512.44	512.44	512.44	512.44	512.44
Hypothetical Reserves (US$ M)	1365.03	1366.42	1365.40	1363.85	1362.28	1360.84	1359.56	1358.43	1357.43	1356.55
Gains/Losses (US$ Million)	11.82	13.22	12.20	10.65	9.08	7.64	6.35	5.22	4.22	3.34
Togo										
Actual Average reserves (US$ M)	386.52	386.52	386.52	386.52	386.52	386.52	386.52	386.52	386.52	386.52
Coverage Index	2.33	2.47	2.53	2.57	2.59	2.61	2.62	2.63	2.64	2.65
Reserves Variability	208.45	208.45	208.45	208.45	208.45	208.45	208.45	208.45	208.45	208.45
Hypothetical Reserves (US$ M)	486.00	514.43	527.80	535.56	540.62	544.19	546.83	548.87	550.50	551.82
Gains/Losses (US$ Million)	99.48	127.91	141.28	149.04	154.10	157.67	160.31	162.35	163.97	165.30

Source: Author's Computation

Table 5.21. Summary of Gains & Losses from Reserves Pooling under different Degrees of Pooling for WAEMU (US$ Million)

Country	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Benin	-62.67	-95.63	-114.67	-126.93	-135.45	-141.70	-146.48	-150.26	-153.31	-155.83
B/Faso	78.07	105.48	119.00	126.97	132.19	135.87	138.59	140.69	142.36	143.71
C/d'Ivoire	40.58	60.27	70.10	74.95	77.16	77.89	77.80	77.25	76.43	75.47
G/Bissau	5.86	5.26	5.01	4.87	4.79	4.73	4.68	4.65	4.63	4.61
Mali	-24.03	-41.24	-52.44	-60.14	-65.72	-69.93	-73.22	-75.85	-78.01	-79.82
Niger	121.97	159.27	177.11	187.54	194.38	199.20	202.79	205.55	207.76	209.55
Senegal	11.82	13.22	12.20	10.65	9.08	7.64	6.35	5.22	4.22	3.34
Togo	99.48	127.91	141.28	149.04	154.10	157.67	160.31	162.35	163.97	165.29
AVERAGE	**33.88**	**41.82**	**44.70**	**45.87**	**46.32**	**46.42**	**46.35**	**46.20**	**46.01**	**45.79**

Source: Author's Computation

Table 5.22. Optimal Reserves Gains & Losses for WAEMU (at 60% Partial Pool)

Country	Actual Average Reserves (US$ M)	Hypothetical Reserves (US$ M)	Gain/Loss (US$ M)	Gain/Loss as % of Actual Reserves
Benin	899.23	757.53	-141.70	(15.76)
Burkina Faso	728.98	864.84	135.87	18.64
Cote d'Ivoire	2066.72	2144.61	77.89	3.77
Guinea-Bissau	100.12	104.84	4.73	4.72
Mali	967.46	897.53	-69.93	(7.23)
Niger	408.82	608.02	199.20	48.73
Senegal	1353.20	1360.84	7.64	0.56
Togo	386.52	544.19	157.67	40.79
AVERAGE	**863.88**	**910.30**	**46.42**	**11.78**

Source: Author's Computation

An analysis of "by how much gain/loss" here shows that Niger gains most from the pooling amounting to 48% of it actual reserves followed by Togo and Burkina Faso. Minimal positive gains are recorded by Cote d' Ivoire, Guinea Bissau and Senegal while Benin and Mali have negative gains with Benin having the highest negative gain (table 5.22).

5.6.4 Evaluation of Reserves Pooling in the non-WAEMU Community

Table 5.23 shows the coverage indices without and with pooling for the non-WAEMU countries. At the initial level of 0% pooling (without pooling), the coverage for the countries show a wider divergence since each country is operating on its own. But as the countries enter into a reserves pooling arrangement, the coverage indices for the different countries begin to converge up till the case of complete pooling where all the coverage indices are the same for all the countries.

Table 5.23. Coverage without and with Pooling for non-WAEMU Countries

Country	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
C/Verde	1.74	1.77	1.77	1.77	1.86	1.86	1.86	1.86	1.86	1.86	1.86
Gambia	2.60	1.80	1.78	1.78	1.86	1.86	1.86	1.86	1.86	1.86	1.86
Ghana	1.97	1.90	1.85	1.82	1.89	1.89	1.88	1.87	1.87	1.86	1.86
Guinea	1.93	1.86	1.81	1.79	1.87	1.87	1.87	1.87	1.86	1.86	1.86
Liberia	0.76	1.75	1.76	1.76	1.85	1.86	1.86	1.86	1.86	1.86	1.86
Nigeria	1.72	1.73	1.73	1.74	1.83	1.84	1.84	1.85	1.85	1.85	1.86
S/Leone	1.60	1.79	1.78	1.77	1.86	1.86	1.86	1.86	1.86	1.86	1.86
Average	**1.76**	**1.80**	**1.78**	**1.78**	**1.86**	**1.86**	**1.86**	**1.86**	**1.86**	**1.86**	**1.86**

Source: Author's Computation

For the non-WAEMU countries alone, the coverage indices appear to be lower than those obtained for their WAEMU counterparts and even the ECOWAS region as a whole discussed earlier. This is so since the reserves of most of the members here exhibit higher variability as compared to that of the WAEMU community and also as compared to that of ECOWAS, since their apparent vulnerabilities are more concealed by the presence of other countries with lower variabilities. An average coverage of 1.86 appears to be the optimal coverage for the non-WAEMU countries in the event of a reserve pooling arrangement.

The gains and losses for the non-WAEMU as a community under different simulations of pooling are shown in tables 5.24 and 5.25.

From table 5.25, it is observed that more individual countries will record negative gains compared to their cases under the whole ECOWAS (Ghana and Guinea now have negative gains under any pooling arrangement). This is not too far from expectations since the analysis is more or less for a collection of countries with higher vulnerabilities and exposure to shocks. That is, their vulnerabilities are exposed having being separated from the countries in the WAEMU community. On the overall average, reserves pooling will benefit the non-WAEMU countries taken as a unit should there be any reserves pooling arrangement among them. Meanwhile, in the case of the non-WAEMU, the results show that the pooling arrangement that yields the maximum possible gain is 70%. This actually shows that since the coefficient of variation of reserves holding is higher here, more reserves (a higher pooling arrangement) will be required to "cover" all the countries in the community.

Table 5.24. Gains and Losses from Reserves Pooling for non-WAEMU

	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Cape Verde										
Actual Average reserves (US$ M)	229.28	229.28	229.28	229.28	229.28	229.28	229.28	229.28	229.28	229.28
Coverage Index	1.77	1.77	1.77	1.86	1.86	1.86	1.86	1.85	1.85	1.85
Reserves Variability	131.85	131.85	131.85	131.85	131.85	131.85	131.85	131.85	131.85	131.85
Hypothetical Reserves (US$ M)	233.67	233.32	233.19	244.78	245.21	245.41	245.39	243.51	243.50	243.49
Gains/Losses (US$ Million)	4.40	4.05	3.92	15.50	15.93	16.13	16.11	14.23	14.22	14.21
Gambia										
Actual Average reserves (US$ M)	126.00	126.00	126.00	126.00	126.00	126.00	126.00	126.00	126.00	126.00
Coverage Index	1.80	1.78	1.78	1.86	1.86	1.86	1.86	1.85	1.85	1.85
Reserves Variability	48.50	48.50	48.50	48.50	48.50	48.50	48.50	48.50	48.50	48.50
Hypothetical Reserves (US$ M)	87.44	86.49	86.16	90.30	90.37	90.39	90.34	89.62	89.59	89.56
Gains/Losses (US$ Million)	-38.56	-39.51	-39.84	-35.70	-35.63	-35.61	-35.66	-36.39	-36.41	-36.44
Ghana										
Actual Average reserves (US$ M)	1939.57	1939.57	1939.57	1939.57	1939.57	1939.57	1939.57	1939.57	1939.57	1939.57
Coverage Index	1.90	1.85	1.82	1.89	1.89	1.88	1.87	1.85	1.85	1.85
Reserves Variability	983.67	983.67	983.67	983.67	983.67	983.67	983.67	983.67	983.67	983.67
Hypothetical Reserves (US$ M)	1872.79	1817.94	1790.08	1862.22	1854.29	1847.93	1841.87	1823.24	1819.54	1816.53
Gains/Losses (US$ Million)	-66.79	-121.64	-149.49	-77.35	-85.28	-91.65	-97.70	-116.34	-120.04	-123.05
Guinea										
Actual Average reserves (US$ M)	108.12	108.12	108.12	108.12	108.12	108.12	108.12	108.12	108.12	108.12
Coverage Index	1.86	1.81	1.79	1.87	1.87	1.87	1.87	1.85	1.85	1.85
Reserves Variability	56.12	56.12	56.12	56.12	56.12	56.12	56.12	56.12	56.12	56.12
Hypothetical Reserves (US$ M)	104.62	101.56	100.56	105.07	104.95	104.84	104.70	103.79	103.70	103.64
Gains/Losses (US$ Million)	-3.50	-6.56	-7.56	-3.06	-3.17	-3.28	-3.43	-4.33	-4.42	-4.49
Liberia										
Actual Average reserves (US$ M)	86.66	86.66	86.66	86.66	86.66	86.66	86.66	86.66	86.66	86.66
Coverage Index	1.75	1.76	1.76	1.85	1.86	1.86	1.86	1.85	1.85	1.85
Reserves Variability	114.26	114.26	114.26	114.26	114.26	114.26	114.26	114.26	114.26	114.26
Hypothetical Reserves (US$ M)	199.57	200.93	201.36	211.64	212.17	212.45	212.51	210.94	210.97	211.00
Gains/Losses (US$ Million)	112.91	114.27	114.69	124.98	125.51	125.79	125.85	124.28	124.31	124.34
Nigeria										
Actual Average reserves (US$ M)	29646.8	29646.85	29646.8	29646.8	29646.8	29646.8	29646.8	29646.8	29646.8	29646.85

Coverage Index	1.73	1.73	1.74	1.83	1.84	1.84	1.85	1.84	1.84	1.85
Reserves Variability	17229.0	17229.09	17229.0	17229.0	17229.0	17229.0	17229.0	17229.0	17229.0	17229.09
Hypothetical Reserves (US$)	29734.1	29819.64	29903.5	31485.0	31629.7	31743.0	31824.7	31662.3	31740.2	31816.65
Gains/Losses (US$ Million)	87.25	172.79	256.65	1838.15	1982.93	2096.24	2177.86	2015.51	2093.41	2169.81
Sierra Leone										
Actual Average reserves (US$ M)	193.28	193.28	193.28	193.28	193.28	193.28	193.28	193.28	193.28	193.28
Coverage Index	1.79	1.78	1.77	1.86	1.86	1.86	1.86	1.85	1.85	1.85
Reserves Variability	120.77	120.77	120.77	120.77	120.77	120.77	120.77	120.77	120.77	120.77
Hypothetical Reserves (US$ M)	215.58	214.44	214.03	224.51	224.80	224.92	224.85	223.09	223.06	223.02
Gains/Losses (US$ Million)	22.29	21.16	20.75	31.23	31.52	31.64	31.57	29.81	29.77	29.74

Source: Author's Computation

Table 5.25. Summary of Gains/Losses from Reserves Pooling under different Degrees of Pooling for non-WAEMU (US$ Million)

Country	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
C/ Verde	4.40	4.05	3.92	15.50	15.93	16.13	16.11	14.23	14.22	14.21
Gambia	-38.56	-39.51	-39.84	-35.70	-35.63	-35.61	-35.66	-35.70	-35.98	-36.01
Ghana	-66.79	-121.64	-149.49	-77.35	-85.28	-91.65	-97.70	-116.34	-120.04	-123.05
Guinea	-3.50	-6.56	-7.56	-3.06	-3.17	-3.28	-3.43	-4.33	-4.42	-4.49
Liberia	112.91	114.27	114.69	124.98	125.51	125.79	125.85	124.28	124.31	124.34
Nigeria	87.25	172.79	256.65	1838.15	1982.93	2096.24	2177.86	2015.51	2093.41	2169.81
S/Leone	22.29	21.16	20.75	31.23	31.52	31.64	31.57	29.81	29.77	29.74
AVERAGE	**16.86**	**20.65**	**28.44**	**270.54**	**290.26**	**305.61**	**316.37**	**289.64**	**300.18**	**310.65**

Source: Author's Computation

Table 5.26. Optimal Reserves Gains and Losses for non-WAEMU (at 70% Partial Pool)

Country	Actual Average Reserves (US$ M)	Hypothetical Reserves (US$ M)	Gain/Loss (US$ M)	Gain/Loss as % of Actual Reserves
C/Verde	229.28	245.39	16.11	7.03
Gambia	126.00	90.34	-35.66	(28.30)
Ghana	1939.57	1841.87	-97.70	(5.04)
Guinea	108.12	104.70	-3.43	(3.17)
Liberia	86.66	212.51	125.85	145.22
Nigeria	29646.85	31824.71	2177.86	7.35
S/Leone	193.28	224.85	31.57	16.33
AVERAGE	**4618.54**	**4934.91**	**316.37**	**19.92**

Source: Author's Computation

Considering the issue of how much gain for the non-WAEMU countries, it can be observed from table 5.26 that Liberia has the highest positive gain from reserves pooling among these countries. It has an overall gain of 145.22% of own reserves holding. This positive gain is lower than its possible positive gain under an ECOWAS arrangement as a whole which was recorded to be 205.48% of own reserves. This is due to evidence of a higher risk factor in the arrangement here, though inside of ECOWAS, which does not include countries of the WAEMU community. The country with the next highest positive gain (though small when compared to Liberia) is Sierra Leone with 16.33% of actual reserves while Nigeria and Cape Verde record minimal positive gains. However, the remaining three countries (Gambia, Ghana and Guinea) will record negative gains from a possible pooling arrangement with Gambia and Guinea having the highest and lowest negative gains as percentages of their respective actual average international reserves holdings.

The findings from this analysis corroborate those from other studies in other regions of the world. Particularly, they support the findings of William, Polius and Hazel (2001) where they present a comparison of the gains from reserves pooling between the Eastern Caribbean Currency Union (ECCU) and the CFA Franc zone. Also, the findings here agree with the study by Rajan, Siregar and Bird (2003) where they examined the gains to be reaped if the East Asian economies were to pool their reserves together. In a related study for the ASEAN (Association of South-Eastern Nations) plus three (APT) nations, Rajan and Siregar (2004) find that the nations are better-off if they are to commit themselves to a partial reserves pooling scheme than a complete pooling. They find that 50% pooling arrangement to be the optimal.

CHAPTER SIX
SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATION

6.1 Summary and Conclusion

This study examines reserves determinants and the effects of a prospective reserves pooling on macroeconomic stability in the ECOWAS subregion. The study has investigated the motivations, sources, and impact of the reserves accumulation, with a focus on the impact on key macroeconomic variables. In the first instance, an analysis of the supply and demand determinants of international reserves are evaluated for the region through the panel data analysis where the fixed effects model and the random effects models are estimated and examined. From the result of the fixed and random effect models, it was observed that the results present sufficient evidence of the impact of the included explanatory variables on the international reserves accumulation of the countries.

Also, through the robustness analysis, this study evaluated gains from a possible reserves pooling in the ECOWAS region. The study finds that there are gains to be reaped for the region as a whole if the countries therein decide to enter into an international reserves pooling arrangement. By way of summary of the whole idea and benefits of reserves pooling as evaluated in the study, consider the case of Liberia where within the period of the analysis, its actual average reserves is US$86.66 million. Without belonging to the pool, its coverage would be 0.76 given that its reserves variability is 114.26. However, by belonging to the pool, its optimal coverage would become 2.32. Now if it would not be part of the pool, and want to maintain this same level of coverage of 2.32, it means that the country would have to hold reserves amounting to US$264.73 million (hypothetical reserves). Hence, by actually holding only US$86.66 million in reserves, it has "saved" itself the cost of having to accumulate extra reserves amounting to US$178.09 million (which is the difference between 264.73 and 86.66) by belonging to the pool.

The spread of gains from possible reserves pooling for the region is not even. Some countries will gain (more than others) while some others will lose (more than others) in a reserves pooling scheme for the region. However, the countries with the gains constitute a significantly larger proportion of the total countries thereby leading to overall average gain for the entire region. At individual country level, Liberia will be the highest positive gainer followed by Sierra Leone while Benin will be the highest negative gainer followed by Mali.

For the region as a whole, a partial reserves pooling arrangement where members contribute only a percentage of own reserve to the pool is found to be most desirable rather than a complete pooling arrangement. The percentage contribution that maximizes gains from reserves pooling for the ECOWAS region as a whole is found to be 60%. This percentage is also found to be the optimal for the WAEMU community while 70% is found to be the optimal for the non-WAEMU community.

The two monetary communities in the ECOWAS (WAEMU and non-WAEMU) would benefit differently from a collective international reserves pooling arrangement. WAEMU countries would benefit less in a reserves pooling arrangement compared to its non-WAEMU counterparts should the region as a whole decides to enter into a reserves pooling arrangement. This is largely due to the fact that the WAEMU countries have been together for long and have actually attained a higher level of macroeconomic stability and less international reserves variability.

The response of macroeconomic variables to shock or innovations from unpooled and pooled reserves are also considered in the study using the impulse response function and variance decomposition of the VAR framework. The study finds robust evidence of possible macroeconomic stability from reserves pooling as the estimation reveals that a 46.71% stability can be attained in the region's macroeconomy under a reserves pooling arrangement relative to when the countries in the region operate in their individual/autonomous state. This becomes even more significant for the countries of the region when considering the fact that it is a 60% partial pool that the study finds to be optimal for the entire region. This implies that about 40% of resources can be freed up for

other developmental purposes in each of the individual countries apart from having unrestricted access to a larger pool of reserves from the central union.

It should be noted that in any form of monetary integration, countries will not gain equally at the same time. Some will gain at one time or area but will lose in another time or area. It should also be seen like that in the case of a reserves pooling arrangement since reserves pooling is suppose to be a phase of a much wider monetary integration and optimal currency establishment and the very rationale for belonging to a monetary union is for a country to provide benefits to other countries who are part of the union and in need at one time with the understanding that they will do same for the country at some other times when in need as well. There are possibilities that the gains estimated here may not be so obvious under some other circumstances such as lack of trust among members, misappropriation and misuse of the reserves pool as well as the fear of extravagance and profligacy of some members.

6.2 Policy Recommendations

This study is on international reserves pooling and macroeconomic stability in ECOWAS. There is increasing consensus within the region that intra-regional macroeconomic stability is a desirable policy objective. Several options for bringing about such stability, including the adoption of a common currency in the long run and implementation of exchange rate mechanism are being proposed. However, for all these options to be effective in bringing about the desired stability of the regional currency, a necessary impetus in this regard is the pooling of international reserves. One of the key reasons for pooling reserves in the region is to facilitate stability of the regional currency when finally in operation.

Since pooled reserves are held to prevent the exchange rates of member countries from deviating significantly from perceived central rates under the exchange rate mechanism, reserve pooling arrangement must be followed with a framework for exchange rate coordination at the regional level to achieve the above objective. This means that the capacity of the monetary authority in the region to supervise and effectively intervene in the foreign exchange market depends on the quantum of pooled reserves. Besides, a

reserve pooling initiative will only be meaningful if fragmented foreign exchange markets in the region are effectively harmonised to facilitate smooth intervention in the single foreign exchange market that will emerge when the single currency is eventually introduced. Hence, in addition to the framework for pooling reserves, there must be a framework for harmonising fragmented foreign exchange market in the region.

The study finds and recommends partial reserves pooling arrangement for the region which allows for some flexibility in the sense that each country contributes an amount that offers them the highest benefits to the pool. International reserves pooling is a fragment of the subject matter of monetary integration. The countries in the region have been handed some convergence criteria in which reserves adequacy is one of the criteria.

Thus, the ECOWAS countries should intensify macroeconomic reforms in order to meet up with the convergence criteria in order to reap the gains from the macroeconomic stability examined from reserves pooling in this study as well as for the smooth take off of a single currency operation.

6.3 Limitations of the Study

This study has largely focused on the empirical examination of reserves pooling and macroeconomic stability in ECOWAS. However, the institutional bureaucracy and the political economy of pooling have not been captured. Thus, the results and estimated gains from pooling and the impact of pooling on macroeconomic stability may be altered when some of these factors are accounted for.

Only some selected key macroeconomic variables (as identified by the OCA as the sources of macroeconomic shocks) are employed for the estimation of the macroeconomic stability in the region. Thus, possibilities abound that there can be a change in result if more (or different sets of) macroeconomic variables are employed.

A research of this magnitude is challenging and tasking especially in the area of monetary integration and OCAs as well as when dealing with a panel of countries and having a macroeconomic outlook. Thus, study drawbacks associated with imprecision in the sourcing and use of secondary data as well as other unobservable inconsistencies,

inadequacies and inaccuracies in the expressions, presentations and interpretations of facts in the course of the study are also acknowledged as possible snags and shortcomings.

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Appendices

Appendix 1: Variance Decomposition

Period	S.E.	RESU	RESP	GOVT
1	3.416419	0.002209	1.073715	98.92408
2	4.483322	0.064259	0.753941	99.18180
3	5.184239	0.089669	0.613827	99.29650
4	5.700588	0.108542	0.597911	99.29355
5	6.117079	0.117514	0.708091	99.17439
6	6.479011	0.120737	0.944759	98.93450
7	6.810316	0.120357	1.302879	98.57676
8	7.123112	0.118050	1.768328	98.11362
9	7.422802	0.114946	2.322937	97.56212
10	7.711114	0.111818	2.946665	96.94152
11	7.987907	0.109178	3.619491	96.27133
12	8.252242	0.107347	4.322558	95.57010
13	8.502976	0.106500	5.038900	94.85460
14	8.739091	0.106709	5.753842	94.13945
15	8.959835	0.107965	6.455159	93.43688
16	9.164777	0.110204	7.133064	92.75673
17	9.353799	0.113325	7.780065	92.10661
18	9.527062	0.117206	8.390753	91.49204
19	9.684964	0.121713	8.961543	90.91674
20	9.828085	0.126710	9.490402	90.38289

Cholesky Ordering:
RESU RESP GOVT

Period	S.E.	RESU	RESP	INV
1	3.441448	0.222292	0.021413	99.75629
2	4.401919	0.669539	0.545055	98.78541
3	5.098841	1.049923	1.091443	97.85863
4	5.628685	1.522233	1.705664	96.77210
5	6.071036	2.035573	2.364919	95.59951
6	6.464962	2.571502	3.093105	94.33539
7	6.832021	3.105657	3.906413	92.98793
8	7.182977	3.618541	4.815629	91.56583
9	7.522454	4.094717	5.824330	90.08095
10	7.851639	4.523263	6.929591	88.54715
11	8.169958	4.897471	8.122874	86.97966
12	8.476075	5.214375	9.391219	85.39441
13	8.768476	5.474122	10.71856	83.80732
14	9.045786	5.679282	12.08704	82.23368
15	9.306924	5.834165	13.47823	80.68760
16	9.551159	5.944191	14.87416	79.18165
17	9.778108	6.015352	16.25812	77.72653
18	9.987710	6.053778	17.61523	76.33100
19	10.18018	6.065405	18.93275	75.00184
20	10.35596	6.055758	20.20029	73.74396

Cholesky Ordering:
RESU RESP INV

Period	S.E.	RESU	RESP	GDPGR
1	4.136784	0.129039	3.390503	96.48046
2	5.064019	1.844231	3.766920	94.38885
3	5.742970	1.812414	4.147563	94.04002
4	6.230369	1.847893	4.509066	93.64304
5	6.598553	1.988710	4.753746	93.25754
6	6.887145	2.137960	4.935014	92.92703
7	7.119717	2.268366	5.088015	92.64362
8	7.311985	2.369935	5.229124	92.40094
9	7.474366	2.444662	5.365062	92.19028
10	7.613981	2.497775	5.497504	92.00472
11	7.735760	2.534493	5.626082	91.83942
12	7.843170	2.559171	5.749754	91.69108
13	7.938689	2.575175	5.867456	91.55737
14	8.024124	2.585038	5.978337	91.43662
15	8.100827	2.590635	6.081832	91.32753
16	8.169835	2.593335	6.177637	91.22903
17	8.231972	2.594133	6.265676	91.14019
18	8.287918	2.593739	6.346052	91.06021
19	8.338248	2.592652	6.419000	90.98835
20	8.383464	2.591218	6.484855	90.92393

Cholesky Ordering:
RESU RESP GDPGR

Period	S.E.	RESU	RESP	TRF
1	3.468498	0.218589	10.29725	89.48416
2	4.493375	0.146395	12.31906	87.53455
3	5.197585	0.110594	14.18622	85.70319
4	5.729724	0.098503	15.92666	83.97483
5	6.164943	0.097211	17.56446	82.33833
6	6.545176	0.103523	19.11201	80.78447
7	6.892745	0.114850	20.57346	79.31169
8	7.219778	0.129678	21.94964	77.92068
9	7.532367	0.146860	23.24019	76.61294
10	7.833189	0.165530	24.44475	75.38972
11	8.123025	0.185003	25.56350	74.25150
12	8.401695	0.204743	26.59740	73.19786
13	8.668603	0.224324	27.54823	72.22744
14	8.923055	0.243421	28.41852	71.33806
15	9.164438	0.261785	29.21142	70.52679
16	9.392300	0.279237	29.93062	69.79014
17	9.606382	0.295652	30.58020	69.12415
18	9.806619	0.310955	31.16448	68.52457
19	9.993121	0.325105	31.68794	67.98696
20	10.16615	0.338096	32.15513	67.50678

Cholesky Ordering:
RESU RESP TRF

Period	S.E.	RESU	RESP	DEBT
1	4.122319	5.302020	8.832203	85.86578
2	5.030360	3.025707	5.590737	91.38356
3	5.673536	1.996024	3.953021	94.05095
4	6.120923	1.461139	3.102729	95.43613
5	6.461813	1.385614	2.636973	95.97741
6	6.735600	1.746803	2.365994	95.88720
7	6.965121	2.471695	2.197809	95.33050
8	7.163197	3.447546	2.087352	94.46510
9	7.337397	4.551529	2.013634	93.43484
10	7.492413	5.676901	1.968650	92.35445
11	7.631353	6.746328	1.951184	91.30249
12	7.756424	7.713259	1.962933	90.32381
13	7.869290	8.556375	2.006027	89.43760
14	7.971264	9.271941	2.081608	88.64645
15	8.063425	9.866852	2.189197	87.94395
16	8.146684	10.35344	2.326640	87.31992
17	8.221833	10.74603	2.490378	86.76359
18	8.289568	11.05896	2.675883	86.26516
19	8.350517	11.30546	2.878125	85.81642
20	8.405251	11.49726	3.091974	85.41077

Cholesky Ordering:
RESU RESP DEBT

Period	S.E.	RESU	RESP	EXR
1	4.140258	0.127301	0.056324	99.81637
2	5.067806	0.734617	0.182476	99.08291
3	5.740355	1.392231	0.337019	98.27075
4	6.210287	2.221122	0.408664	97.37021
5	6.563338	3.174439	0.426120	96.39944
6	6.837919	4.208911	0.419038	95.37205
7	7.058609	5.284042	0.403792	94.31217
8	7.240867	6.367767	0.388014	93.24422
9	7.394882	7.435996	0.375026	92.18898
10	7.527493	8.471497	0.366282	91.16222
11	7.643373	9.462507	0.362515	90.17498
12	7.745769	10.40149	0.364210	89.23430
13	7.836982	11.28408	0.371774	88.34414
14	7.918675	12.10831	0.385567	87.50612
15	7.992091	12.87389	0.405897	86.72021
16	8.058185	13.58178	0.432992	85.98523
17	8.117719	14.23380	0.466982	85.29922
18	8.171326	14.83234	0.507888	84.65977
19	8.219549	15.38016	0.555618	84.06422
20	8.262865	15.88023	0.609971	83.50980

Cholesky Ordering:
RESU RESP EXR

Appendix 2: Reverse Ordering of Variance Decomposition

Government Spending

Variance Decomposition of GOVT:

Period	S.E.	GOVT	RESP	RESU
1	2.754833	100.0000	0.000000	0.000000
2	3.288216	99.62396	0.236124	0.139921
3	3.719594	99.55018	0.263060	0.186758
4	4.014826	99.56049	0.232938	0.206572
5	4.236776	99.57382	0.221631	0.204549
6	4.405569	99.52467	0.280972	0.194361
7	4.537210	99.38343	0.433101	0.183469
8	4.641740	99.14219	0.681413	0.176394
9	4.726232	98.80582	1.018675	0.175507
10	4.795660	98.38631	1.431885	0.181808
11	4.853602	97.89915	1.905442	0.195409
12	4.902653	97.36103	2.423116	0.215854
13	4.944711	96.78834	2.969312	0.242348
14	4.981176	96.19626	3.529835	0.273905
15	5.013085	95.59822	4.092316	0.309467
16	5.041218	95.00563	4.646390	0.347979
17	5.066161	94.42784	5.183711	0.388445
18	5.088366	93.87220	5.697845	0.429958
19	5.108187	93.34418	6.184096	0.471722
20	5.125906	92.84765	6.639292	0.513060

Cholesky Ordering: GOVT RESP RESU

Investment

Variance Decomposition of INV:

Period	S.E.	INV	RESP	RESU
1	4.251007	100.0000	0.000000	0.000000
2	5.252084	99.13514	0.786879	0.077985
3	5.993790	98.28497	1.551078	0.163953
4	6.520795	97.28321	2.402437	0.314350
5	6.919538	96.18879	3.308345	0.502869
6	7.229828	94.99211	4.293876	0.714015
7	7.478494	93.69919	5.371719	0.929090
8	7.683309	92.31854	6.548166	1.133293
9	7.856625	90.86285	7.821346	1.315802
10	8.007154	89.34737	9.182669	1.469956
11	8.141087	87.78901	10.61825	1.592739
12	8.262811	86.20538	12.11054	1.684086
13	8.375405	84.61403	13.63986	1.746108
14	8.480988	83.03174	15.18590	1.782361
15	8.580973	81.47390	16.72891	1.797191
16	8.676263	79.95416	18.25062	1.795218
17	8.767397	78.48410	19.73496	1.780938
18	8.854657	77.07319	21.16835	1.758458
19	8.938159	75.72872	22.53994	1.731335

20	9.017913	74.45598	23.84151	1.702506

Cholesky Ordering: INV RESP RESU

GDP growth

Variance Decomposition of GDPGR:

Period	S.E.	GDPGR	RESP	RESU
1	7.359799	100.0000	0.000000	0.000000
2	7.755973	96.72184	0.914491	2.363670
3	7.858900	95.87922	1.810839	2.309946
4	7.886851	95.34972	2.355550	2.294734
5	7.903896	94.93945	2.723004	2.337548
6	7.917958	94.61610	2.987081	2.396823
7	7.930336	94.34913	3.200939	2.449934
8	7.941164	94.12495	3.387457	2.487597
9	7.950691	93.93280	3.556701	2.510501
10	7.959156	93.76510	3.712568	2.522329
11	7.966748	93.61677	3.856426	2.526801
12	7.973598	93.48439	3.988749	2.526864
13	7.979802	93.36558	4.109810	2.524610
14	7.985427	93.25864	4.219930	2.521434
15	7.990527	93.16224	4.319545	2.518219
16	7.995146	93.07532	4.409195	2.515482
17	7.999322	92.99701	4.489500	2.513492
18	8.003090	92.92653	4.561124	2.512351
19	8.006482	92.86319	4.624753	2.512052
20	8.009527	92.80640	4.681073	2.512527

Cholesky Ordering: GDPGR RESP RESU

Variance Decomposition of TRF:

Period	S.E.	TRF	RESP	RESU
1	10.87175	100.0000	0.000000	0.000000
2	13.37009	99.63909	0.194837	0.166070
3	15.42544	99.21666	0.513780	0.269556
4	16.94922	98.67190	0.929429	0.398670
5	18.15976	98.05532	1.413755	0.530924
6	19.13532	97.38239	1.950022	0.667588
7	19.93476	96.67099	2.523337	0.805676
8	20.59701	95.93576	3.120902	0.943338
9	21.15040	95.18982	3.731381	1.078802
10	21.61596	94.44450	4.344900	1.210597
11	22.00980	93.70948	4.953005	1.337516
12	22.34446	92.99277	5.548612	1.458616

13	22.62991	92.30086	6.125942	1.573201
14	22.87415	91.63878	6.680425	1.680793
15	23.08368	91.01030	7.208593	1.781112
16	23.26384	90.41800	7.707959	1.874043
17	23.41902	89.86349	8.176901	1.959613
18	23.55289	89.34750	8.614542	2.037962
19	23.66855	88.87005	9.020633	2.109321
20	23.76856	88.43056	9.395448	2.173992

Cholesky Ordering: TRF RESP RESU

External Debt

Variance Decomposition of DEBT:

Period	S.E.	DEBT	RESP	RESU
1	46.21528	100.0000	0.000000	0.000000
2	78.87002	98.63430	1.062453	0.303249
3	103.5684	96.90388	2.430201	0.665920
4	121.0652	95.03962	3.673627	1.286749
5	133.0145	93.10835	4.691702	2.199952
6	141.0715	91.12684	5.496553	3.376606
7	146.5551	89.14028	6.130667	4.729050
8	150.3919	87.21557	6.640090	6.144339
9	153.1808	85.41876	7.064977	7.516260
10	155.2895	83.79694	7.436898	8.766165
11	156.9390	82.37203	7.778838	9.849136
12	158.2641	81.14402	8.106242	10.74973
13	159.3506	80.09827	8.428385	11.47334
14	160.2560	79.21277	8.749764	12.03746
15	161.0217	78.46359	9.071396	12.46501
16	161.6779	77.82819	9.391969	12.77984
17	162.2474	77.28692	9.708807	13.00427
18	162.7476	76.82349	10.01864	13.15787
19	163.1913	76.42470	10.31816	13.25714
20	163.5884	76.08004	10.60441	13.31555

Cholesky Ordering: DEBT RESP RESU

Exchange rate

Variance Decomposition of EXR:

Period	S.E.	EXR	RESP	RESU
1	0.259451	100.0000	0.000000	0.000000
2	0.390048	99.35934	0.496730	0.143930
3	0.486375	98.65687	0.945438	0.397690
4	0.563318	97.90306	1.259799	0.837144
5	0.627637	97.08994	1.475473	1.434585
6	0.683028	96.21725	1.634320	2.148430
7	0.731700	95.30196	1.763894	2.934146

8	0.775070	94.36546	1.880735	3.753803
9	0.814098	93.42767	1.994555	4.577780
10	0.849464	92.50464	2.111040	5.384319
11	0.881677	91.60827	2.233487	6.158240
12	0.911125	90.74671	2.363728	6.889557
13	0.938120	89.92508	2.502659	7.572262
14	0.962919	89.14614	2.650556	8.203302
15	0.985738	88.41095	2.807267	8.781787
16	1.006762	87.71929	2.972344	9.308364
17	1.026151	87.07013	3.145125	9.784746
18	1.044048	86.46184	3.324801	10.21336
19	1.060580	85.89248	3.510462	10.59706
20	1.075861	85.35989	3.701141	10.93897

Cholesky Ordering: EXR RESP RESU

Appendix 3: VAR Estimates

Vector Autoregression Estimates
Date: 07/04/13 Time: 02:09
Sample (adjusted): 1983 2011
Included observations: 381 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	RESU	RESP	GOVT
RESU(-1)	0.841850	-2.283015	0.036658
	(0.05286)	(0.59176)	(0.04263)
	[15.9252]	[-3.85803]	[0.85999]
RESU(-2)	0.028771	1.874955	-0.035013
	(0.05274)	(0.59042)	(0.04253)
	[0.54549]	[3.17565]	[-0.82327]
RESP(-1)	0.002027	1.345220	-0.004819
	(0.00437)	(0.04891)	(0.00352)
	[0.46380]	[27.5016]	[-1.36767]
RESP(-2)	0.005485	-0.357888	0.006302
	(0.00459)	(0.05134)	(0.00370)
	[1.19585]	[-6.97036]	[1.70386]
GOVT(-1)	-0.091888	-0.707886	0.654549
	(0.06129)	(0.68607)	(0.04942)
	[-1.49927]	[-1.03180]	[13.2447]
GOVT(-2)	0.056181	0.218915	0.205154
	(0.05921)	(0.66283)	(0.04775)
	[0.94880]	[0.33027]	[4.29677]
C	1.562761	16.46011	1.612440
	(0.50312)	(5.63205)	(0.40569)

	[3.10612]	[2.92258]	[3.97453]
R-squared	0.816077	0.939845	0.759751
Adj. R-squared	0.813127	0.938880	0.755897
Sum sq. resids	4365.298	547014.6	2838.324
S.E. equation	3.416419	38.24403	2.754833
F-statistic	276.5772	973.8791	197.1196
Log likelihood	-1005.177	-1925.442	-923.1719
Akaike AIC	5.313265	10.14405	4.882792
Schwarz SC	5.385705	10.21649	4.955232
Mean dependent	10.57914	103.5308	13.00886
S.D. dependent	7.903100	154.6934	5.575814

Determinant resid covariance (dof adj.)	123691.8
Determinant resid covariance	116998.7
Log likelihood	-3844.966
Akaike information criterion	20.29379
Schwarz criterion	20.51110

Vector Autoregression Estimates
Date: 07/04/13 Time: 02:29
Sample (adjusted): 1983 2011
Included observations: 379 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	RESU	RESP	INV
RESU(-1)	0.795591	-2.491916	0.043544
	(0.05385)	(0.60815)	(0.06652)
	[14.7747]	[-4.09752]	[0.65465]
RESU(-2)	0.090889	2.101820	0.019571
	(0.05417)	(0.61181)	(0.06692)
	[1.67777]	[3.43540]	[0.29247]
RESP(-1)	0.001001	1.333505	0.011217
	(0.00424)	(0.04783)	(0.00523)
	[0.23625]	[27.8805]	[2.14427]
RESP(-2)	0.007081	-0.347212	-0.009033
	(0.00446)	(0.05041)	(0.00551)
	[1.58633]	[-6.88769]	[-1.63838]
INV(-1)	-0.007525	0.588004	0.715251
	(0.04177)	(0.47179)	(0.05160)
	[-0.18014]	[1.24632]	[13.8610]
INV(-2)	-0.020644	-0.655988	0.144426
	(0.04086)	(0.46151)	(0.05048)
	[-0.50520]	[-1.42141]	[2.86126]
C	1.442962	11.43604	1.657812
	(0.40771)	(4.60460)	(0.50362)
	[3.53918]	[2.48361]	[3.29179]

R-squared	0.823121	0.938152	0.790996
Adj. R-squared	0.820268	0.937155	0.787625
Sum sq. resids	4405.806	561958.8	6722.435
S.E. equation	3.441448	38.86698	4.251007
F-statistic	288.5222	940.4631	234.6448
Log likelihood	-1002.648	-1921.440	-1082.717
Akaike AIC	5.327959	10.17646	5.750486
Schwarz SC	5.400684	10.24919	5.823211
Mean dependent	10.82759	107.4864	18.07861
S.D. dependent	8.117620	155.0403	9.224438

Determinant resid covariance (dof adj.)	309701.6
Determinant resid covariance	292856.3
Log likelihood	-3998.652
Akaike information criterion	21.21189
Schwarz criterion	21.43006

Vector Autoregression Estimates
Date: 07/04/13 Time: 03:49
Sample (adjusted): 1983 2011
Included observations: 417 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	RESU	RESP	GDPGR
RESU(-1)	0.689510	-3.309965	-0.299536
	(0.05036)	(0.55015)	(0.08960)
	[13.6916]	[-6.01648]	[-3.34317]
RESU(-2)	0.159496	2.735041	0.357403
	(0.05078)	(0.55470)	(0.09034)
	[3.14114]	[4.93068]	[3.95633]
RESP(-1)	0.005100	1.296384	0.024230
	(0.00429)	(0.04683)	(0.00763)
	[1.18954]	[27.6810]	[3.17685]
RESP(-2)	-0.000682	-0.316190	-0.019591
	(0.00444)	(0.04846)	(0.00789)
	[-0.15378]	[-6.52414]	[-2.48217]
GDPGR(-1)	0.008813	-0.239662	0.294076
	(0.02706)	(0.29556)	(0.04813)
	[0.32572]	[-0.81087]	[6.10948]
GDPGR(-2)	-0.025243	-0.684460	0.079781
	(0.02658)	(0.29036)	(0.04729)
	[-0.94972]	[-2.35727]	[1.68714]
C	1.579289	16.35527	1.323191
	(0.34619)	(3.78193)	(0.61592)

	[4.56186]	[4.32458]	[2.14832]
R-squared	0.753088	0.933486	0.161374
Adj. R-squared	0.749474	0.932513	0.149101
Sum sq. resids	7016.322	837333.4	22208.32
S.E. equation	4.136784	45.19156	7.359799
F-statistic	208.4180	959.0266	13.14912
Log likelihood	-1180.274	-2177.317	-1420.513
Akaike AIC	5.694358	10.47634	6.846586
Schwarz SC	5.762060	10.54404	6.914288
Mean dependent	10.83581	121.1477	3.709593
S.D. dependent	8.264882	173.9593	7.978605

Determinant resid covariance (dof adj.)	1691826.
Determinant resid covariance	1608048.
Log likelihood	-4754.668
Akaike information criterion	22.90488
Schwarz criterion	23.10799

Vector Autoregression Estimates
Date: 07/04/13 Time: 03:53
Sample (adjusted): 1983 2011
Included observations: 393 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	RESU	RESP	TRF
RESU(-1)	0.814820	-2.263197	-0.160300
	(0.05249)	(0.58223)	(0.16453)
	[15.5231]	[-3.88712]	[-0.97429]
RESU(-2)	0.063287	1.927850	0.112311
	(0.05220)	(0.57898)	(0.16361)
	[1.21244]	[3.32974]	[0.68645]
RESP(-1)	0.000238	1.304175	0.019171
	(0.00436)	(0.04838)	(0.01367)
	[0.05461]	[26.9547]	[1.40217]
RESP(-2)	0.006440	-0.314609	-0.009366
	(0.00454)	(0.05036)	(0.01423)
	[1.41833]	[-6.24672]	[-0.65808]
TRF(-1)	0.026642	0.314623	0.692429
	(0.01657)	(0.18382)	(0.05194)
	[1.60764]	[1.71160]	[13.3302]
TRF(-2)	-0.016136	-0.389432	0.188578
	(0.01635)	(0.18137)	(0.05125)
	[-0.98686]	[-2.14722]	[3.67949]
C	0.447792	14.09196	7.804050
	(0.52171)	(5.78678)	(1.63526)

	[0.85832]	[2.43520]	[4.77237]
R-squared	0.828634	0.937989	0.800700
Adj. R-squared	0.825970	0.937025	0.797602
Sum sq. resids	4643.765	571331.9	45623.28
S.E. equation	3.468498	38.47252	10.87175
F-statistic	311.0809	973.1094	258.4632
Log likelihood	-1042.894	-1988.539	-1491.875
Akaike AIC	5.342972	10.15542	7.627864
Schwarz SC	5.413752	10.22620	7.698645
Mean dependent	10.87620	106.1924	65.19313
S.D. dependent	8.314371	153.3081	24.16555

Determinant resid covariance (dof adj.)	1809236.
Determinant resid covariance	1714271.
Log likelihood	-4493.587
Akaike information criterion	22.97500
Schwarz criterion	23.18734

Vector Autoregression Estimates
Date: 07/04/13 Time: 03:57
Sample (adjusted): 1983 2011
Included observations: 417 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	RESU	RESP	DEBT
RESU(-1)	0.673659	-3.405268	-1.111389
	(0.05106)	(0.55906)	(0.57241)
	[13.1941]	[-6.09111]	[-1.94161]
RESU(-2)	0.159414	3.012443	-0.069982
	(0.05122)	(0.56084)	(0.57423)
	[3.11232]	[5.37133]	[-0.12187]
RESP(-1)	0.006668	1.277353	-0.168504
	(0.00437)	(0.04786)	(0.04901)
	[1.52550]	[26.6873]	[-3.43838]
RESP(-2)	-0.000974	-0.310871	0.176569
	(0.00448)	(0.04903)	(0.05020)
	[-0.21752]	[-6.34070]	[3.51740]
DEBT(-1)	0.000422	0.095695	1.448987
	(0.00367)	(0.04014)	(0.04110)
	[0.11504]	[2.38403]	[35.2562]
DEBT(-2)	-0.002680	-0.066903	-0.533375
	(0.00369)	(0.04041)	(0.04137)
	[-0.72610]	[-1.65571]	[-12.8920]
C	1.831045	9.561227	20.39552
	(0.37053)	(4.05715)	(4.15404)
	[4.94165]	[2.35663]	[4.90980]

R-squared	0.754811	0.933646	0.942651
Adj. R-squared	0.751223	0.932675	0.941811
Sum sq. resids	6967.340	835326.1	875699.4
S.E. equation	4.122319	45.13736	46.21528
F-statistic	210.3636	961.4954	1123.194
Log likelihood	-1178.813	-2176.817	-2186.658
Akaike AIC	5.687353	10.47394	10.52114
Schwarz SC	5.755054	10.54164	10.58884
Mean dependent	10.83581	121.1477	121.8307
S.D. dependent	8.264882	173.9593	191.5872

Determinant resid covariance (dof adj.)	58282124
Determinant resid covariance	55396047
Log likelihood	-5492.651
Akaike information criterion	26.44437
Schwarz criterion	26.64747

Vector Autoregression Estimates
Date: 07/04/13 Time: 04:00
Sample (adjusted): 1983 2011
Included observations: 417 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	RESU	RESP	EXR
RESU(-1)	0.687580	-3.395320	-0.003721
	(0.05037)	(0.55319)	(0.00316)
	[13.6495]	[-6.13774]	[-1.17867]
RESU(-2)	0.159682	2.701788	-0.001784
	(0.05099)	(0.55990)	(0.00320)
	[3.13193]	[4.82548]	[-0.55833]
RESP(-1)	0.005351	1.311214	-0.000511
	(0.00425)	(0.04670)	(0.00027)
	[1.25821]	[28.0757]	[-1.91844]
RESP(-2)	-0.000997	-0.335290	0.000584
	(0.00437)	(0.04804)	(0.00027)
	[-0.22790]	[-6.97875]	[2.12858]
EXR(-1)	0.075344	-14.95729	1.115118
	(0.76001)	(8.34613)	(0.04763)
	[0.09914]	[-1.79212]	[23.4139]
EXR(-2)	-0.039838	14.62926	-0.147977
	(0.73776)	(8.10184)	(0.04623)
	[-0.05400]	[1.80567]	[-3.20074]
C	1.379524	17.79721	0.280983
	(0.50809)	(5.57962)	(0.03184)
	[2.71513]	[3.18968]	[8.82499]
R-squared	0.752673	0.932674	0.990366
Adj. R-squared	0.749053	0.931689	0.990225

Sum sq. resids	7028.113	847561.6	27.59903
S.E. equation	4.140258	45.46673	0.259451
F-statistic	207.9537	946.6287	7024.336
Log likelihood	-1180.624	-2179.849	-25.55618
Akaike AIC	5.696038	10.48848	0.156145
Schwarz SC	5.763739	10.55618	0.223846
Mean dependent	10.83581	121.1477	4.776690
S.D. dependent	8.264882	173.9593	2.624151

Determinant resid covariance (dof adj.)	2200.697
Determinant resid covariance	2091.721
Log likelihood	-3369.229
Akaike information criterion	16.26009
Schwarz criterion	16.46320

Appendix 4: Unit Roots Test

Panel unit root test: Summary
Series: GDPGR
Date: 07/03/13 Time: 01:05
Sample: 1981 2011
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-6.55820	0.0000	15	429
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-9.78706	0.0000	15	429
ADF - Fisher Chi-square	153.915	0.0000	15	429
PP - Fisher Chi-square	267.794	0.0000	15	444

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Panel unit root test: Summary
Series: D(GOVT)
Date: 07/04/13 Time: 17:07
Sample: 1981 2011
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-11.0824	0.0000	15	374
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-12.1192	0.0000	15	374

ADF - Fisher Chi-square	191.731	0.0000	15	374
PP - Fisher Chi-square	327.888	0.0000	15	391

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Panel unit root test: Summary
Series: D(INV)
Date: 07/04/13 Time: 17:10
Sample: 1981 2011
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-6.39935	0.0000	15	374
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-10.2697	0.0000	15	374
ADF - Fisher Chi-square	166.948	0.0000	15	374
PP - Fisher Chi-square	317.868	0.0000	15	389

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Panel unit root test: Summary
Series: D(EXR)
Date: 07/04/13 Time: 17:15
Sample: 1981 2011
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-6.50336	0.0000	15	420
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-8.53900	0.0000	15	420
ADF - Fisher Chi-square	129.701	0.0000	15	420
PP - Fisher Chi-square	194.325	0.0000	15	435

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Panel unit root test: Summary
Series: D(DEBT)
Date: 07/03/13 Time: 01:04
Sample: 1981 2011

Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-7.27960	0.0000	15	415
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-8.47671	0.0000	15	415
ADF - Fisher Chi-square	128.122	0.0000	15	415
PP - Fisher Chi-square	240.414	0.0000	15	430

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Panel unit root test: Summary
Series: D(RESP)
Date: 07/03/13 Time: 01:11
Sample: 1981 2011
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-10.6370	0.0000	15	415
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-10.3981	0.0000	15	415
ADF - Fisher Chi-square	161.489	0.0000	15	415
PP - Fisher Chi-square	209.493	0.0000	15	430

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Panel unit root test: Summary
Series: D(RESU)
Date: 07/03/13 Time: 01:12
Sample: 1981 2011
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-8.59180	0.0000	15	401
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-10.5852	0.0000	15	401
ADF - Fisher Chi-square	165.102	0.0000	15	401

PP - Fisher Chi-square	345.007	0.0000	15	417

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Panel unit root test: Summary
Series: D(TRF)
Date: 07/03/13 Time: 01:13
Sample: 1981 2011
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-9.67387	0.0000	15	387
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-11.7141	0.0000	15	387
ADF - Fisher Chi-square	182.276	0.0000	15	387
PP - Fisher Chi-square	322.134	0.0000	15	403

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Appendix 5: VAR Residual Heteroscedasticity Tests

VAR Residual Heteroscedasticity Tests: Includes Cross Terms

Included observations: 370

Joint test:

Chi-sq	df	Prob.
8870.031	5472	0.0000