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Essays on Economic Effects of the Monetary Union of the West African Monetary Zone

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ESSAYS ON ECONOMIC EFFECTS OF THE MONETARY UNION OF THE WEST AFRICAN MONETARY ZONE (WAMZ)

by

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This dissertation consists of three chapters which as a whole underscore the monetary union of the West African Monetary Zone (WAMZ). WAMZ is a monetary union formed in 2001 by six member countries' Central Banks to ensure monetary integration. These chapters relate to issues of convergence effect, inflation, debt level, remittances, and exchange rate. Chapter One studied the convergence effect of the Monetary Union in the West African Monetary Zone (WAMZ). I relied on secondary data for macroeconomic variables for six countries of the WAMZ (Ghana, Nigeria, Guinea, The Gambia, Sierra Leone, and Liberia) and assessed the growth rate before WAMZ and post WAMZ. The results reveal convergence in some of the countries but not all. The average growth rate of all the six countries except The Gambia increased in the post WAMZ period compared to the pre-WAMZ era. There was no evidence of inflation convergence but some support for exchange rate convergence. Chapter Two investigates the effect of external debt on Inflation in the WAMZ. Specifically, I looked at the three periods namely: Pre WAMZ period (1960 – 2000); During WAMZ period (2001 – 2022); Entire period (1960 – 2022) to examine the increase or decrease in external debt and growth performance and see how they have affected the rise or decline in inflation for the periods. I used normal values and linearized values and then employed non-linearized autoregressive distribution lag (NARDL) technique to

examine whether external public debt has symmetric or asymmetric link with inflation and the results reveal short run asymmetric relationship between inflation and external debt. I employed Cointegration, Granger causality, VAR, Fixed effect and Random effect for the actual values and the linearized values. Chapter Three studied the impact of remittances on the exchange rate of WAMZ. And examined three periods namely Pre-WAMZ, During WAMZ and the Entire period. The study examined the long run and short run impact of migrant remittances on real exchange rate and discovered that remittances, which is a form of capital inflow, leads to appreciation of real exchange rate. The Correlation and Multicollinearity tests reveal no multicollinearity among the variables and the correlation has many negligible and few strong correlations with positive and negative relationships. Further to the increase in remittances in the WAMZ countries in recent decades, the study recommends that the government should create diaspora bond to drive more remittances.

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DEDICATION

My entire dissertation is wholeheartedly dedicated to the Holy Trinity. I dedicate this to God the Father, who is the creator and enabled me to embark on this journey; God the son who is the Savior, who has redeemed me and gives me grace; God the Holy spirit, who sanctifies and helps me.

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CONVERGENCE EFFECTS OF THE MONETARY UNION IN WEST AFRICA MONETARY ZONE

ABSTRACT

It is now reasonably undebatable that monetary and fiscal policies have real effects on monetary union in WAMZ. What seems to prevent the meeting of convergence criteria that was set by the West African Monetary Zone (WAMZ), a counterpart of the European Monetary Union (EMU)has been explored. Consequently, this study examines the convergence effect of the monetary union in the West African Monetary Zone (WAMZ). This research examines the economic convergence criteria and obstacles to achieving them for the six West African economies of Nigeria, The Gambia, Guinea, Sierraleone, Ghana, and Liberia. The study examines the exchange and inflation rates convergence and discovers no evidence of inflation convergence and some support for exchange rate convergence. The study uses panel and time series data for a 63-year period from 1960 -2022. This study is unique because of renewed interest internationally in economies for monetary integration following the success of EMU, need to examine existing policies and suggest better and common economic and financial policies to promote development, uses an updated data and contributes to the literature on monetary integration in West Africa through adding value to the previous studies. The study examined the pre-WAMZ and post WAMZ periods and discovered variations in growth rates. Furthermore, this study uses OLS regression, fixed effect to correct for endogeneity and exogeneity, Granger causality test, Cointegration and Vector Error Correction Model (VECM) for empirical analysis. Our results reveal weak

policy co-ordination in all WAMZ countries, high inflation, high fiscal deficit etc. during the period and these contribute to non-compliance in meeting primary and secondary convergence criteria. WAMZ has not realized some of the objectives of integration into a monetary union because of trade barriers, unstable exchange rate, weak leadership and limitations on intra-regional trade in ECOWAS. Additionally, the results corroborate the assertion that exchange rates do not influence intra-WAMZ exports and should not be an instrument of bilateral stimulation but can be useful for balance of payment adjustment. There is a need for fiscal integration before the introduction of the single currency (ECO) after satisfying the secondary and primary criteria. This paper argues for a need for convergence of core macroeconomic instruments of monetary, fiscal and exchange rate policies to be attained before the achievement of common monetary and economic union for the West African States. This paper recommends formation of currency union, more infrastructure development, fiscal discipline and strengthening of fiscal, monetary and exchange rate policies.

Keywords: *Exchange rate, fiscal policy, monetary policy, fiscal deficit, WAMZ, EMU*

1.0: INTRODUCTION

The objective of this study is to show the Convergence effects of the monetary union in the West African Monetary Zone. This research is posed with some research problems and the research question is:

Based on the “Convergence, Stability, Growth and Solidarity Pact” which was adopted by all the WAMZ countries, they were required to meet all the secondary and primary criteria by December 2002. Given that the West African Monetary Institute (WAMI) role is monitoring macroeconomic development, ensuring a single currency

(ECO) and have a common monetary and fiscal policy by member countries of WAMZ from 2004.

1) The questions this research poses are why have all the primary and secondary criteria not been satisfied? Why has the economic convergence not been fully achieved for the six countries?

Motivation of the Study

The monetary union of the West African Monetary Zone (WAMZ) was largely driven from emulation of the European Economic and Monetary Union (EMU). The enhancement of capital flows emanating from accelerated trade and financial transactions which guarantee improved trade flows with and between component states and the rest of the world. “The main objective of WAMZ is to foster the rapid integration of the six economies with a view to ultimately integrate with the West African Economic and Monetary Union (WAEMU), a group of Francophone ECOWAS members. Thus, the WAMZ is a strategy to realize the broader ECOWAS goal of a region -wide monetary union”. Nwokoye and Kalu (2016). The fundamentals of various sizes of countries, resource endowment and the level of economic development of member countries and their ability to meet the convergence criteria play an important role for all the zones who want to form monetary union. Itsede (2003) argues that unless the fundamentals and convergence of core macroeconomic variables are met, there is no possibility of achieving a common monetary union for the West African countries in the form of WAMZ. However, the motivation for regional cooperation and integration has dominated concerns about dissimilarities of the shocks that accrue to the economies and the adjustment after they respond to the shocks.

Further, understanding monetary issues such as nominal exchange rate determination are entirely under regimes where the government peg the nominal money supply and is of finite importance if government do not specify the monetary policy using monetary aggregate. Two motivations for understanding the nominal price and exchange rate in a multi-country are:

1). The stable demand function for money has resulted in formulating monetary policy based on nominal money supply rule and quantity theory of money with recorded success. However, the volatility of nominal exchange rate remains a complicated model for some government who specify monetary policy in terms of money stock.

2). The development of monetary union in Europe with a single central bank and currency prevents individual countries from accomplishing good monetary policy by controlling money stock. The motivation in line with this is to ascertain if a country can have its monetary policy and give up control of the money supply.

Additionally, the implications of fiscal policy for the determination of nominal exchange rate stems from continuous time open economy version of the overlapping generation model. Aiyagari and Gertler (1985) and Blanchard (1985). The AiYagari-Blanchard model provides a framework for analyzing the effects of fiscal policy in an economy especially in the implied redistribution of wealth across generations and studying the effects of fiscal policies have on real economic variables present in open economy.

Specifically, Frenkel and Razin (1986) examine the effects of tax cuts on the world interest rate, consumption and on current account for two countries using independent economy model. Razin and Helpman (1987) evaluate the dependence of

exchange rate management on the time pattern of fiscal and monetary policies. Daniel (1993) examines the effects of a tax cut in an economy with uncertainty regarding the time of the future tax increase to balance the budget. Kawai and Maccini (1995) study the effects of fiscal deficits on a small open economy that has flexible exchange rates and focuses on the effects of anticipated policy switches to money or tax finance important to close the deficits.

Moreover, variations in the interest rates can easily communicate the influence of monetary policy actions on the larger economy. Studies show that financial policy changes that result in positive real interest rates as occurred in the 1980s would increase financial savings and impact financial market depth. “The usage of exchange rate policy is another price-based method. The exchange rate channel has been proven to be especially effective in an economy with a shallow money market but a deep foreign exchange market” (Adeoye and Saibu, 2014). According to Nnana (2001), monetary policy provides an attempt to govern the economy through managing the quantity of money and access to credit. It is designed to govern the scope, pricing and directing of credit to achieve stated economic objectives, especially exchange rate stability.

Background

After the establishment of Economic Community of West African States (ECOWAS) in May 1975, there was a quest for monetary union in West Africa. The ECOWAS comprises 15 member countries including the six member countries of WAMZ namely Ghana, Guinea, The Gambia, Nigeria, Sierra Leone and Liberia. Prior to the establishment of ECOWAS, there was one monetary zone known as West African

Economic and Monetary Union (WAEMU) which comprises Francophone West African countries and member countries use The CFA franc as their currency. The WAMZ member countries are non-members of WAEMU whose mandate is to promote regional economic integration (Tsangarides & Qureshi, 2008). The WAEMU countries enjoy the same fiscal and monetary policies. The West African Monetary Zone is like the European Monetary Union especially in operational modalities. “The fundamentals of the varying sizes, resource endowment and the level of economic development of the integrating countries as well as member countries meeting the convergence criteria play a great role for all the zones who are attempting to form a monetary union” (Nwokoye and Kalu, 2016).

The West African Monetary Zone was established in December 2000, same time with the West African Monetary Institute (WAMI). WAMI was established to undertake all actions needed to form the West African Central Bank and introduce a common currency, **Eco**, as currency for the monetary zone. The common currency -Eco- is expected to boost inter-regional trade, capital flows, investment and raise growth and employment and increase the performance of the balance of payment. These ambitious targets were expected to have been met by January 2004, but still have not been met even today because of failure to meet the various primary and secondary convergence criteria.

According to WAMI (2002), the primary and secondary criteria are:

Primary Criteria

1). Attain and maintain price stability through achieving single digit inflation rate by 2003 and 5 percent by 2004.

2). Establish a sustainable government fiscal position by reducing the ratio of budget deficit to GDP to 4 percent throughout the period 2003 – 2005.

3). Regulate Central Bank financing of government budget deficit to 10 percent or less throughout the period 2003 – 2005.

4). Manage satisfactory level of gross official foreign exchange reserves of at least 3months of import cover through the period 2003 – 2005.

Secondary Criteria

1). Restriction of new domestic areas and liquidation of current ones.

2). Tax revenue to GDP ratio should be greater than 20 percent.

3). Wage bills to tax revenue ratio should be less than or equal to 35 percent.

4). Public investment to tax revenue should be greater than or equal to 20 percent.

5). Manage real exchange rate stability.

6). The real interest rate should be positive.

Harvey and Cushing (2015) opine that the primary criteria would ensure that the member states economies converge in a way such that there are symmetric shocks while the secondary criteria economies would ensure fiscal convergence. From the period 2001 – 2009, only two countries, Gambia and Nigeria did satisfy all four primary criteria in 2007 and 2008 while The Gambia satisfied all the criteria in 2008 and 2009. However, in recent years none of the member countries have satisfied all the primary and secondary criteria which continues to doubt the possibility of introduction of a common currency, eco, in WAMZ.

Further, monetary and fiscal policies are connected by government sector budget constraint, and this determines how a change in money stock tends to affect the

equilibrium price level. Given the increase in stock of money by open market purchase, the reduction of interest-bearing government debt held by the public, this portends some implications for the future stream of taxes needed to finance the interest cost of government debt. “So, an open market operation potentially has a fiscal side to it and this fact can lead to ambiguity in defining what one means by a change in monetary policy, holding fiscal policy constant”. Walsh (2010).

Studies have shown that monetary variables and equilibrium in international financial markets are crucial determinants of exchange rate dynamics in addition to the importance of fiscal variables and how it determines the time pattern of exchange rates. Annicchiarico (2005) posits that fiscal theory of price level (FTPL) has been extended to open economy models and it shows the implications for a common currency area and exchange rate system. Canzoneri et al (2001a) show the difference between Richardian and non-Richardian regimes using the studies developed by Woodford (1995). In the Richardian regime, the monetary policy provides the nominal anchor, and the exchange rate is determined solely by monetary variables.

Furthermore, monetary and fiscal policy coordination can help monetary and fiscal policies achieve its objective of price stability and stable non-inflationary economic growth. Fiscal policies essentially determine government taxation and spending decisions while monetary policies envelop the decisions involving money supply and interest rate. Given that the objective of fiscal policy is reducing unemployment and increase in output while the monetary policy is maintaining price and exchange rate stability through control of money supply. The overall objective of both fiscal and

monetary policy is to boost the overall welfare of society by keeping inflation low and unemployment low as well.

Research Problem

Exchange rates and interest rates serve as signs for international and domestic asset transactions. Changes in the exchange rate influence import demand through a process that communicates monetary development to the external sector. It has been very challenging to generate a stable exchange rate in WAMZ, whose countries strongly rely on export earnings from their natural resources such as gold, oil etc and imports consumer and industry products. The floating and fixed exchange rate regimes have not given the WAMZ countries the best results.

This could be attributed to the economies being stamped by structural rigidities, bottlenecks and most of our imports and exports are defined by inelasticity on either the demand or supply side or both. (Ndubuisi, Uma and Obidike, 2017). The trend of the exchange rate movement partly depends on the movement of non-oil exports that each country has and generates. The growth recorded in non-oil exports shows that the domestic economy is diversifying, and this has generated enough output for production and for exports. However, for some of the WAMZ countries like Nigeria, they have experienced below threshold level in non-oil exports and exhibiting high volatility, which have resulted in massive importation of important products, rise in demand for foreign exchange and subsequent currency depreciation.

Kohlscheen (2014) asserts that most emerging economies lack long track records with floating exchange rate regimes. The emerging economies allow the value of their currencies to be driven by market forces, which has increased and resulted in

their currencies being at the fore of international policy debate in the global economy. Dornbush (1976) opines that an unexpected monetary contraction results in an immediate appreciation of the currency which creates the conditions for a subsequent depreciation at a rate equivalent to the interest rate differential.

The main focal point of the Central bank is then moved from price stability to debt stability. When the fiscal dominance regime is present, the fiscal authority is no longer interested in the increasing debt since it does not adjust it by cutting down expenditure or by increasing taxes to bring down level of debt stock, but the fiscal authority now expects the Central Bank financing to fund the fiscal deficit. McCallum (1984) and Hakkio and Rush (1991) assert that amassing debt that is not bargained for future expenditure creates room for government default. When the fiscal authority employs deficit financing, which is inflationary, the macroeconomic variables like the monetary aggregates that are under control of the monetary authority, could go out of control resulting in monetary policy being ineffective. Consequently, inflation and exchange rate pressures ensue due to the amount of money in circulation.

Member countries of WAMZ and West African Economic Monetary Union (WAEMU) have convergence criteria such as debt to GDP ratio, limit fiscal deficit, inflation, exchange rate variation and a floor of reserves which were set prior to commencement. The IMF in addition recommended a set of rules known as Performance criteria and Indicative Target (PCIT). The goal is to maintain macroeconomic stability and enhance sustained economic growth in the zone. The domestic and external factors that have impugned the WAMZ countries have been an obstacle to their ability to meet the convergence and performance criteria. For example,

Diallo and Mendy (2018) assert that The Gambia, Ghana, Sierra Leone met only one of the primary convergence criteria, while Guinea, Liberia and Nigeria met three of the criteria and missed one. Inflation was the most missed criterion in 2016 and 2017 except two countries who fulfilled the single deficit inflation. “Challenges of fiscal deficits increased central bank financing and rising inflation have been attributed to government spending outlays and absence of policy coordination” (WAMI, 2016).

2.0: LITERATURE REVIEW

Countries of the West African Monetary Zone (WAMZ)

The countries of the West African Monetary Zone are six namely: The Gambia; Nigeria; Ghana; Sierra Leone; Guinea; and Liberia. In 2000, WAMZ was formed with some Central banks, and they proposed the need for economic integration and improved prosperity, enhancing benefits of trade through improving the welfare of member states. In 2004, the convergence criteria were set for eligibility of countries to join ECOWAS monetary union. According to Nnanna (2002), the primary criteria consist of four pillars namely:

Inflation; overall budget deficit to GDP; Central bank financing of budget deficit; and floor on the foreign exchange reserves: West African Monetary Institute (WAMI) is responsible for monitoring macroeconomic developments in the member states and responsible for the introduction of the single currency (ECO) and the establishment of a common Central Bank. “The proposed single currency is expected to stimulate intra-regional trade, capital flows and investments, increase growth and employment and improve balance of payments performance. In addition, monetary integration they

argued would enhance economic efficiency and strengthen the capacity of the region to compete internationally". Adam, Gyamji and Agyapong (2012).

One of the major objectives of creating WAMZ is to promote trade among member countries. In addition to single currency agenda, programs for the removal of tariff and non-tariff barriers to trade especially through implementation of ECOWAS Trade Liberalization Scheme (ELTS), Implementation of Interstate Road Transit Convention by member states, adoption of common external tariff etc

The Gambia

The Gambian currency of dalasi was pegged to the pound sterling in a fixed exchange rate system between 1965 and 1985. During the Structural Adjustment Programme of 1986 to 1993, the government introduced the inter-bank floating exchange rate system in 1986, which largely caused the depreciation of the currency and then appreciation. The inter-bank foreign exchange system was later introduced, the foreign exchange bureau also, and they both contributed largely to the deepening of the foreign exchange market.

The main objective of monetary policy of the Central Bank of The Gambia is price stability. Also, the Central bank promotes and maintains the stability of the local currency (dalasi), regulates the financial system, and utilizes the resources for economic development efficiently. Although the Central Bank does not have complete independence, it has significant operational independence.

Additionally, the fiscal policy of Gambia is controlled by the Ministry of Finance and Economic Affairs (MFEA) which defines the government macroeconomic policy objectives and framework in line with the pursuit of public and private sector investment

which support high economic growth given the fiscal consolidation. Tarawalie and Ahortor (2012) assert that the MFEA has the exclusive responsibility of budget formulation and implementation and the domestic debt policy of government.

Ghana

The exchange rate system used in Ghana was fixed exchange rate between 1970 and 1985. The Ghanian currency (cedi) was pegged to the British pound and American dollar. In 1986, Ghana adopted the managed floating exchange rate system and the auction market approach for use in the adjustment of the exchange rate and achieve the trade liberalization objective which allows the market forces (demand and supply) determine the cedi-dollar rates.

The monetary policy of Ghana is controlled by the Central bank, and it has the objective of the price stability (low inflation) which supports growth and employment. The Bank of Ghana uses inflation targeting monetary framework for conduct and communication. The goal of inflation targeting is to have inflation below 10 percent and the rate of inflation is measured by the Consumer Price Index (CPI). The Bank of Ghana (BOG) uses some monetary policy instruments such as monetary policy rate, reserve money, required reserve ratio and open market operations.

Similarly, the fiscal policy goals are to allocate and manage financial resources efficiently, improve fiscal resources, reduce debt burden etc. The fiscal policy framework ensures macroeconomic stability for sustained economic growth and development. The Ministry of Finance co-ordinate the fiscal policy and with collaboration of the Economic Management team, Monetary policy committee, Treasury committee, et.c and they

review macroeconomic fundamentals to achieve the government growth and inflation objectives.

Guinea

After Independence in 1958, Guinea adopted the fixed exchange rate system, the government pegged their currency (Guinean Syli) with the Special Drawing Right (SDR). Following the subsequent overvaluation of the Guinea Syli (GS) in the mid-1980s, it exceeded the SDR in the parallel market. Hence, the currency was changed to Guinean franc (GF) and pegged with the US dollar. In the 1990s, the Guinea government adopted the flexible exchange rate and introduced the forex exchange interbank market. The currency was pegged against the US dollar and then liberalized the foreign exchange market.

The monetary policy objective of price stability seeks to support economic growth by implementing a monetary-targeting framework. The Central bank objective focuses on the goal of low inflation and broad money supply growth. The monetary policy instrument used includes monetary policy rate, required reserves and Open market Operations (OMO).

Similarly, the fiscal policy objective is macroeconomic stability, boosting economic growth and reducing fiscal deficit. The features of the fiscal policy seek to ensure increase in revenue mobilization, expenditure management and poverty reduction.

Liberia

Liberia has two currency regimes using both the Liberian dollar and the United States dollar. Just like many other West African countries, they had used fixed

exchange rate system initially and pegged the Liberian dollar to the United States dollar in the 1981 to 1997. In 1998, the exchange rate system changed, and the Liberian dollar freely floated against other foreign currencies. A few years later, the Central Bank adopted the managed float exchange rate regime.

Monetary policy focus in Liberia is price stability. “The Central Bank of Liberia’s monetary policy framework is an exchange rate targeting regime which aims at containing volatility in the exchange rate targeting regime which aims at containing volatility in the exchange rate while building up foreign exchange reserves” Ahortor and Tarawalie (2013). The monetary policy tools include the periodic foreign exchange auction and the treasury bill market which widens the monetary policy space in the highly dollarized and cash based, with a dual currency system of Liberia.

Fiscal policy focus is achieving strong, robust, and sustained economic growth, poverty reduction, efficient service delivery etc.. The main fiscal policy instruments present are taxes, expenditure, deficit financing, grants, contingency funding etc.

Nigeria

Nigeria had used fixed exchange rate system until the Structural Adjustment System (SAP) of 1986. The Nigerian currency (Naira) was pegged to major international currencies including the US dollar, and then returned to fixed exchange rate after SAP. In the mid-1990s, the Central Bank of Nigeria (CBN) introduced a liberalized system of Autonomous Foreign Exchange Market (AFEM) where the Central bank sold foreign exchange to authorized dealers at a market exchange rate. Nigeria later moved to interbank foreign exchange Market and then Wholesale Dutch Auction System (WDAS) in 2006. The managed float exchange is the exchange rate system used now.

The monetary policy is controlled by the central bank of Nigeria (CBN) with the main objectives of ensuring optimal supply of liquidity to achieve price stability and sustained economic growth. The CBN tightens the monetary policy stance by raising the monetary policy rate (MPR) in a bid to control inflation when rise in inflation poses a threat. The CBN uses monetary targeting regime that is anchored on monitoring monetary aggregates, inflation development, managing liquidity and fiscal-monetary co-ordination and clear communication with public. Also, the monetary policy instruments used in Nigeria are Open Market operation, monetary policy rate, liquidity ratio, net open position etc.

Additionally, the core of fiscal policy in Nigeria lies in encouraging investment in specific sectors of the economy, advance public sector revenue, take advantage of public sector funding of infrastructure through public-private partnership and reduced burrowing. The Federal Ministry of Finance is responsible for Fiscal policy management. The main fiscal policy instruments are taxation and government expenditure.

Sierra Leone

Sierra Leone adopted fixed exchange rate until the middle 1980s during the Structural Adjustment Program. The currency (Leone) was pegged against the US dollar. In the wake of the Structural Adjustment program (SAP), the country adopted the floating exchange rate regime. The goal of adopting the floating exchange rate was to increase the competitiveness of their exports and maintain a stable exchange rate with minimal volatility in place.

The monetary policy of Sierra Leone is controlled by the Bank of Sierra Leone (BSL) with the goal of achieving and maintaining price stability. The Bank of Sierra

Leone monetary policy is operated using monetary targeting framework, uses reserve money as the operating target, and broad money as intermediate target. The Bank of Sierra Leone also uses Open market operation (OMO) to conduct monetary policy, deepen interbank market and maintain interest rate at levels that achieve low and stable inflation.

The Fiscal policy has its main goals of achieving sustained economic growth, job creation, and increasing economic and social opportunities to an increasing population. The government has taken steps to achieve these goals especially through establishing cash management committee (CMC), monitoring and intensifying co-ordination between fiscal and monetary policy, continued negotiation of payment arrangement with project contractors and fiscal tightening of expenditure especially non-priority spending.

Currency Area: Optimum Currency Area (OCA) theory is pioneered by Mundel (1961) and Mckinnon (1963), Kenen (1969) and Krugman (1990). The OCA theory is used to make comparisons of cost and benefits of countries that participate in currency union.

The currency union offers benefits such as: lowered transaction costs; price stabilization; improved efficiency of resources allocations; increased product factor and financial market access. The cost of currency union includes loss of sovereignty for maintaining country's monetary and exchange rate policies. Monetary integration involves enacting a single monetary zone that possesses a high degree of monetary stability in the progression of economic integration. The currencies in a monetary zone must be completely convertible at an immutable exchange rate, hence creating a single currency effectively. (Itsede, 2003). Monetary integration can be seen as a continuum of optimum currency area.

The concept of optimum currency area is used to determine the feasibility of monetary union. From definition, monetary union is “an area within which exchange rate bears an immutable relationship to each other. This is usually characterized by common currency, common monetary and fiscal policies, a common pool of foreign exchange reserves, a harmonized credit policy and a common monetary authority or central bank” (Mordi, 2002).

Macroeconomic Convergence: Macroeconomic convergence can be described as a catch up effect where the poorer economies per capita incomes will tend to grow at a faster rate than the richer economies. Dollar and Wolff (1999) posit that the philosophy that underpins the concept of catch-up convergence is associated with diminishing returns to capital. Their rationale is that as capital gets larger, the marginal productivity declines. The catch-up convergence theory opines that as the migration of labour to the richer countries in search of employment opportunities, there is a fall in the productivity of rich countries due to the decline in capital labour ratio. Consequently, there is sluggish growth in richer countries, and they have productivity decline because poorer countries tend to catch up with the richer ones. The convergence machine 2.0 should focus on convergence of opportunities for people and firms across WAMZ and should support the capabilities of people (through skills) and firms (through innovation and technology adoption). Also, the convergence machine 2.0 should provide a level playing field for people and firms through the provision of flexible labour markets and social protection of workers and an enabling business environment. Convergence requires the transfer of resources from one country to another and implementation of certain regulatory rules across the countries. Each country can find its own development model

and drivers, and the two factors important for ensuring long term convergence are quality of institutions and education.

Empirical studies of Meliciani and Peracchi (2004) examine convergence in GDP per capita across European region for the period 1980 – 2000 using median unbiased estimators of the rate of convergence to the steady state growth path and they find the lower mean rate of convergence to be zero for most regions. Busetti et al (2006) investigate inflation convergence in the European Monetary union over the period 1980 – 2006. The study period was divided into before and after the use of the Euro. They apply unit root tests on inflation differential for the first sample (before the use of Euro) and they discover inflation convergence for the period 1980 – 1997. Applying stationarity test for the second sample (after the use of Euro), they find two separate clusters of diverging inflation behavior. Countries namely Austria, Belgium, Germany, France and Finland belong to a lower inflation group while countries namely Portugal, Ireland, Netherland and Greece belong to the higher inflation group.

Further, Dalgaard and Vastrup (2001) examine the existence of sigma (б) convergence in 121 countries over the period 1960 – 1988 and discover the presence of convergence and divergence. The standard deviation of logs of income per capital portrayed convergence while the coefficient of variation showed divergence. Some studies utilize panel data approach for testing the convergence hypothesis (Levine and Lin, 1992; Im, Pesaran & Shin, 2003; Islam, 1995; Bernard and Jones, 1996; and Evans and Karras,1996).

Sani (2004) took a survey of economies of WAMZ highlighting economic features such as population of WAMZ, the Gross Domestic Product (GDP), GDP growth rates,

per capita GDP, Inflation rates, external trade, External Debt, foreign resources, Human and Income poverty levels. The study reveals that balance of payment difficulties is prominent in the WAMZ countries due to periodic adverse shifts in terms of trade, huge public debt, capital flights or low level of inward investment due to unconducive environment. Discoveries from the study using the Human Development Index reveal the presence of high level of poverty, low level of literacy and lack of sufficient good drinking water among other things in the WAMZ countries (Ude, 2022).

Overall, the analysis of socioeconomic performances of the zone reveal that member countries should improve on their current socioeconomic policy reforms and accentuate their political commitments in meeting -up the requirements of convergence criteria to facilitate the integration program.

European Monetary Union: The Heads of State meeting of December 1991 in Maastricht approved the treaty on European union and were resolved to achieve the strengthening and convergence of their economies, hence establishing an economic and monetary union in accordance with the provisions of this Treaty especially having a single and stable currency (European Union, 2015).

At the Cannes European council in June 1995, it was confirmed that in the year 1999, the Economic and Monetary Union leaders at the Madrid European council named **euro** as the European currency. On January 1, 2002, the euro became the legal tender for many European countries. However, European leaders meeting in December 1996 proposed a Stability and Growth Pact which would ensure convergence obligations are met after member states joined the euro area.

Based on the Maastricht criteria that established the European Union (EU), the five conditions to admit countries into the monetary union are as follows:

1) The inflation rate of not higher than 1.5 percentage points and should be above the rate of the three countries with the lowest inflation rate. This ensures price stability.
2) The long-term nominal interest rates should not be higher than two percentage points for the three countries with the lowest inflation rates.
3) There should be no exchange rate realignment for at least two years. And the country should participate in the exchange rate mechanism (ERM II) for at least two years without strong deviations of devaluation.
4) The country should have a debt to GDP ratio that is not more than 60 percent.
5) The country should not be under any excessive deficit procedure and the government budget deficit of not more than 3 percent of each country's GDP. (Nwokoye and Kalu, 2016)

Empirical Literature

There is a plethora of empirical literature on the determinants of economic integration. Barro & Sala -I-Martin (1995) posit that if public infrastructure is included in the production function as an input, the increase in public infrastructure leads to a rise in marginal product of capital, then a rise in capital accumulation and growth. The work of Barro & Sala -I-Martin (1995) neoclassical framework suggests that such supply side policy will accelerate the convergence process especially as the marginal product of private capital tends to increase with the availability of public capital. The question about how regional economic integration brings about growth convergence among members

can be explained by the linkages of regional grouping among trade in goods, services, technology, investment, human resources, and infrastructure.

Nwokoye and Kalu (2016) opine that investment integration facilitates restructuring of an industry across a region on the most efficient basis to exploit the economies of scale and specialization. The efficiency of this results in a generation of income which can act as drivers of trade and growth. Also, trade investment linkages can move in both directions. Free trade agreements can goad investment flows in terms of efficiency seeking regional restructuring, while trade creating joint ventures may impact regional trade flows in a more meaningful way.

Cappelen, Fagerberg & Verspagen (2001) discovered that for European Union (EU), the regional integration and financial support have succeeded in improving the EU's regional policy of providing growth for poorer regions and then contribute to greater equality in productivity and income in Europe. A study on the effect of European integration on long -term growth of EU member states was conducted using panel data techniques and the study reveals a significant positive effect of the length of EU membership on economic growth. This is relatively higher for poorer countries (Crespo - Cuaresma, Dimitz & Ritzberger- Grunwald, 2002).

Onwuka (2004) conducted a comparative analysis on trading system and growth process in ASEAN -5 using panel data effect and endogenous growth model and discovered that although regional and multilateral trading system showed positive effects on growth and FDI, regional trading system recorded small contributions compared with the multilateral trading system. This result was ascribed to the reality that regional openness and regional exchange rate were insufficient to attract more FDI to

enhance growth. The study reveals a negative coefficient for convergence effect for trading system as it was believed to be an expected sign. Studies by Kelegama & Mukherji (2006) portray that trade creating joint ventures are better positioned to take advantage of regional free trade agreements. Cross country investment flows help goad vertical integration and horizontal specialization in a regional grouping and these strengthen trade-investment linkages. This involves the distribution of different stages of production in a particular industry based on region in an integrated manner. Das (2004) suggested focusing on vertical integration and horizontal integration.

Tsangarides & Qureshi (2008) study on Monetary union membership using cluster analysis discover considerable dissimilarities in the economic characteristics of West African countries in terms of economic development, growth, labour mobility, region, culture, transportation, language barriers etc. They posit that there is a significant lack of homogeneity while Nigeria and Ghana appear as independent singletons. Sunde, Chidoko & Zivanomoyo (2009) examined the determinants of intra industry trade between Zimbabwe and Southern African Development Community (SADC) regional trade partners. The study utilized the ordinary least square method on a gravity model equation including intra-industry trade (IIT) index as one of the explanatory variables. The study discovered that per capita income, trade intensity, distance, exchange rate and gross domestic product are the major reason for the explanation of international trade between Zimbabwe and its SADC trading partners. Also, the study reveals that most countries in SADC traded basically same goods, and this was a function of past development these countries experienced during the colonial

era which gave rise to the establishment of similar economic structures and per capita incomes that were the same.

ADB (2011) examines the growth of GDP per labour force in the new EU member states between 1993 – 2002. The EU countries examined tend to converge conditionally towards the average level of GDP per labour force in the EU -15. Growth in the eight Central and Eastern European countries has been supported by higher investment and lower public consumption. Naveh, Torosyan & Jalaee (2012) examined the effect of regional integration on long term economic growth of Iran and Northern countries using time series and cross-sectional data for the period 1995 -2009. The result shows that increased trade exchanges among the studied countries and creation of regional integration exerted long term economic integration effects.

Harvey & Cushing (2015) assert that the variance decomposition of structural vector autoregressive model reveal that ECOWAS zone does not have common sources of shock, this is not surprising because of the presence of diverse economic structures of WAMZ member countries. The correlation of the structural shocks reveal that the countries respond asymmetrically to common supply, while the demand and monetary shocks will respond differently to a common monetary policy. They concluded that it is not advisable for individual countries to go into a monetary union now or in the proximate future unless the economies of these countries converge further.
Debrum et al, (2003) investigate the justification for establishing regional currency unions in West Africa and draw a conclusion that monetary unification will be beneficial for some member states of the ECOWAS despite the prevailing economic, political, and historical differences between two regions in the community. They suggest that the

costs of these countries losing their monetary autonomy are largely overcome by the gains emanating from the partial separation of monetary and fiscal powers. They further state that large countries like Nigeria would no longer be attractive partners because they would now be expected to exert pressure on the common central bank and create excessive inflation in the entire union. Hence, they conclude that the desirability and sustainability of a currency union within ECOWAS largely depends on fiscal discipline displayed by its members and a robust fiscal surveillance procedure followed in the transition phase and after the establishment of the union.

Contributions of the Study

This research measures the level of integration achieved by countries who participate, especially in terms of their response to common shocks. Contrary to the methodology of previous studies, this study involves direct measurement of supply, demand, and monetary shocks to the economies of the different countries and their common response to shocks. Successful convergence will inform policy that will lead to adoption of common currency known as eco.

Several policies such as monetary policy, fiscal policy, exchange rate policy, trade policy etc. are important for macroeconomic management. These policies are organized toward achieving sustainable economic growth, price stability, full employment, and positive balance of payments (Khan et al, 2002). The highest monetary authority of the state -Central Bank – is charged with the job of formulating sound monetary policy stance that drives desired macroeconomic objective and goals. This is achieved by differing policy tools such as open market operation, bank rate policy, minimum reserves requirement and qualitative tools such as moral suasion.

From the fiscal side, the operations are assisted by the government by using revenue and expenditure tools such as taxation, spending, public debt etc.to put into action set down macroeconomic objectives. Fiscal policy exerts impacts on exchange rates through changes in income, price, and interest rates because of expansionary and contractionary fiscal actions (Richard, 2007).

For countries in WAMZ especially Nigeria, they show preference for foreign commodities strengthened by their demands for foreign bills e.g. dollars, pounds etc. and these preferences leads to appreciation of the foreign currency then the depreciation of the local currency. When government spending grows, then inflation can occur if such expenditure is not followed by rapid domestic production activity. With the increase in domestic prices, there is an upturn with the price of local commodities in the international market (Nwosa, 2017). Given the low price of imported merchandise, there exists huge demand for foreign goods which causes more depreciation of the domestic currency to devalue more and then the foreign currency appreciates. Moreover, the massive inflows of foreign exchange earnings associated with rising oil prices provide a good foundation for a stable exchange rate through the effect on foreign reserves. The monetary authorities apply discretionary ability in influencing money stock and interest rate. This makes money costlier or less expensive given the economic conditions and policy positions. Nnana (2001) asserts that monetary policy provides the opportunity to govern the economy through managing the quantity of money and availability of credit. Monetary policy provides governance in the availability, pricing, and direction of credit to achieve the stated economic objectives, especially exchange rate stability.

Furthermore, the depreciation of the currencies of Naira, dalasi, cedi, Leone and other WAMZ member countries currencies have heightened calls for more efforts to address the rapid exchange rate movement over the years. Since exchange rate stability can be achieved through monetary and fiscal policies, the monetary authorities have implemented exchange rate policy stance from fixed to floating exchange rate regimes. Monetary and fiscal policy stance have been influential in the movement of exchange rate in WAMZ member countries using some monetary and fiscal variables that tend to exert influences on exchange rate movement in WAMZ. These variables have appropriate levels that are sustainable in influencing exchange rate movement and cause exchange rate response to shocks in monetary and fiscal policy variables.

3.0: METHODOLOGY

Theoretical Framework

Neoclassical Growth Theory

The Neoclassical growth theory provides the model for the theoretical framework for the study of macroeconomic convergence given its role in capital accumulation. This model, initially constructed by Solow (1956) and Swan (1956) portrays how macroeconomic policy can raise an economy's growth rate by encouraging people to save more. However, the increase in growth predicted by this model does not last and in the long run, the growth rate of the country will revert to technological progress and show diminishing marginal productivity. The neoclassical theory is exogeneous and independent of economic forces (Ude, 2022).

This theory believes that the contributions of macroeconomic policy could lead to long run growth and the rate of technological progress is determined by internal forces

in the economic system. The technological process is driven by the process of innovation which enables business firms to compete in a market economy and incentives needed for innovation depend on policies for competition, intellectual property, and international trade. The neoclassical model is useful in explaining how capital accumulation affects national income, real wages and real interest rate for a given state of technology when it is endogenous. Additionally, the neoclassical model has a stronger ability to predict the convergence in growth rates than other theories of convergence prediction levels. The model asserts that there should be convergence in growth rate for all countries that share in the same technology.

Baumol and Sala-i-Martin (1995) assert that the convergence philosophy of neoclassical growth theory predicts that poorer countries of the convergence club must catch up with richer countries if they have advantage to replicate the existing technological advancement without having to develop their own. Baumol (1986) applies cross-sectional regressions to state that countries and regions are converging or catching up because initial poorer economies were found to have grown faster than richer ones.

Sources of Data

The data used for the study is secondary data for the six WAMZ countries. Data for the variables were obtained from International Monetary Fund (IMF) International Financial Statistics (IFS) CD –ROM, the World Development Indicators (WDI) data base, Organization for Economic Co-operation and Development (OECD) data base and the data base of the West African Monetary Institute (WAMI).

The countries' local currencies are: The Gambia – dalasi; Ghana – cedi ; Guinea – franc; Liberia - Liberian dollar; Nigeria – Naira; and Sierra Leone – leone. The sample period covers a 63-year period from 1960 – 2022. This 63-year period is selected to know and assess how long the different economic effects of the monetary union have had on the WAMZ member countries.

Methodology

Convergence is present when a poor economy increases more rapidly than a rich economy and the poor economy catches up with the level of income per capita production of the rich economy. In literature, it is referred to as the β convergence (Barro and Sala-i-Martin, 1995) and Hall, Wickens and Robertson (1992). Using conditional convergence, we assume that WAMZ countries are identical especially in terms of references, technology, and economic policies. One economic policy that unites all WAMZ countries is the formation of a single currency by 2027. Neoclassical growth model (Solow,1956) predicts that an economy's growth rate is positively correlated with the distance that separates it from its own stationarity.

Hall, Wickens, and Robertson (1992) assert that convergence involves relative long-run behaviour of some time series especially as economic time series are generally non-stationary. We observe that for convergence, difference between the time series do not drift indefinitely far apart. These researchers opine that cointegration of non-stationary time series is important, but not sufficient condition for convergence and thus economic convergence between two series is the approximation to a constant of the difference between the series. Hall et al (1992) assert that X and Y have converged if $\beta = 0$ and Y and Z have convergence if $\beta = 1$ in the model.

$$(\ln X_t - \ln Y_t) = a + b(\ln X_t - \ln Z_t) + \mu_t \quad \text{………………………….(1)}$$

Nevertheless, convergence is assumed to be a gradual and on-going process. Equation 1 is considered as a static model and will subsume structural stability and reject convergence if X and Y are still in the convergence process. Haldane and Hall (1991), Hall and Wickens (1992) propose the use of stochastically varying coefficients that permit dynamic structural change to model unobserved deterministic or stochastic factors that cause parameter changes. These changes allow the data to display the shifts or transitional dynamics in the estimated relationship (Datta, 2003).

Following Hall et al, (1992) Haldene & Hall (1991), Kendall (2000) and Jayaraman, Ward and Xu (2007) by formulating the following model which have time varying parameters.

$$(\ln Y_{ref} - \ln Y_{wamz}) = a(t) + b(t)(\ln Y_{ref} - \ln Y_{NG}) + \mu_t \quad \text{………… (2)}$$

Where Y_{ref}, Y_{WAMZ} and Y_{NG} represent the nominal exchange and inflation rates for the reference country, Nigeria and individual WAMZ countries.

To obtain estimates of a(t) and b(t) in equation (2), we formulate the following state space models:

$$(\ln Y_{ref} - \ln Y_{WAMZ}) = a(t) + b(t)(\ln Y_{ref} - \ln Y_{NG}) + \mu_t \quad \text{………………..(3)}$$

$$a(t) = a(t)_{-1} + V_{1t} \quad \text{………………(4)}$$

$$b(t) = b(t)_{-1} + V_{2t}$$

Equation (3) represents the measurement or observation equation while equations (4) and (5) are the state or transition equations. Also, $\mu_{(t)}$, V_{1t} and V_{2t} have the assumption of normally distributed error terms with zero mean and a constant variance.

We assume that the error terms are serially uncorrelated and independent of each other.

Hall et al (1992) posit that b(t) would move to zero in the limit if the Y_{ref} and Y_{WAMZ} have converged. Alternatively, if Y_{WAMZ} and Y_{NG} have converged, then this parameter would move towards one.

Nevertheless, the convergence of b(t) to zero is considered a necessary but not sufficient condition for the convergence between Y_{ref} and Y_{WAMZ}. We believe that for convergence, a(t) must tend to a constant and b(t) must tend towards zero.

Model

$$(G_{ref} - G_{NG}) = \alpha_0 + \beta_1 INF_{it} + \beta_2 RER_{it} + \beta_3 FD_{it} + \beta_4 DIR_{it} + \beta_5 GDPC_{it} + D_{95} + \delta_i + \gamma_i + \mu_{it}$$

Where :

The dependent variable G_{ref} - G_{NGit} represents the difference in growth rate. The dependent variable is the growth gap with Nigeria growth rate.

GDPC : The per capita GDP

FD: Fiscal Deficit

DIR : Deposit interest rate

RER : real effective exchange rate

INF: Inflation

D_{95} : Dummy variable

δ_i: country fixed effect

α_i: time fixed effect

μ_{it}: error term

Using Time Series for countries

For Ghana

$GR_G - GR_{NGt} = c + \beta_1 GDPC_t + \beta_2 FD_t + \beta_3 DIR_t + \beta_4 RER_t + \beta_5 INF_t + \mu_t$

For Guinea

$GR_G - GR_{NGt} = c + \beta_1 GDCP_t + \beta_2 FD_t + \beta_3 DIR_t + \beta_4 RER_t + \beta_5 INF_t + \mu_t$

For The Gambia

$GR_{TG} - GR_{NGt} = c + \beta_1 GDCP_t + \beta_2 FD_t + \beta_3 INTR_t + \beta_4 RER_t + \beta_5 INF_t + \mu_t$

For Nigeria

$GR_t = c + \beta_1 GDPCP_t + \beta_2 FD_t + \beta_3 INTR_t + \beta_4 RER_t + \beta_5 INF_t + \mu_t$

For Sierra Leone

$GR_S - G_{NGt} = c + \beta_1 GDPCP_t + \beta_2 FD_t + \beta_3 INR_t + \beta_4 RER_t + \beta_5 INF_t + \mu_t$

For Liberia

$GR_L - G_{NGt} = c + \beta_1 GDPCP_t + \beta_2 FD_t + \beta_3 INR_t + \beta_4 RER_t + \beta_5 INF_t + \mu_t$

Motivation for the Model

The Nigerian economy is the largest in the WAMZ monetary union, largest in Sub-Saharan Africa and the entire Africa. Nigerian economy has about 80 percent of the entire WAMZ GDP and a big player in the economy of WAMZ. In the first 14 years of WAMZ (2001 – 2014), Nigeria enjoyed high economic growth. The growth rate of Nigeria between (2007 -2011) shows that Nigeria was among the top five growth countries in the world, growing at an average of 7-8 percent, close to China which was the highest at that time and the Nigerian economic growth was the highest in Sub-Saharan Africa at that time. Hence, Nigeria exerted overwhelming influence, and still exerts influence in WAMZ and the entire Sub-Saharan Africa. Also, the high growth rate of the Nigerian economy between 2001 -2014 was driven by massive growth in the non-

oil sectors especially the service sectors, manufacturing, and financial services. Service sectors such as telecommunications, trade and other service sectors and business friendly policies were growth drivers. There was a boom in the Nigerian economy in these 14-year periods especially in the 7-year period (2007 -2014). The huge crude oil deposits have been the largest source of Government revenue in the last 55 years in Nigeria and it constitutes 80 percent of Government revenue.

Additionally, Nigeria is a rich country and home to a population of over 200 million people and a have many natural resources deposits and enormous potentials of being an economic powerhouse in the future. Even though the Nigerian economy has enjoyed high economic growth since 2001, the economy witnessed a decline in growth in 2015 to 4 percent average growth and has continued to decline since then. The average growth of the Nigerian economy was about 3 percent in 2022.

Furthermore, Nigerian economy far outstrips the economy of other WAMZ countries both in GDP size and GDP growth. Many other countries including WAMZ have enjoyed economic growth and since 2015, many countries have overtaken Nigeria in growth, and they have been growing more than Nigeria. The presence of WAMZ and its economic integration objective have fostered growth in some aspects of their economies.

The growth gap variable helps us capture the difference in growth between each of the countries and Nigeria, which is considered a massive economy. The convergence or catch-up factor will enable us to see how the Nigerian economic growth rate can uplift and bring up other countries growth rate to a much appreciable level to drive overall growth in WAMZ. The growth gap helps us see and access the progress made towards

having a more equal living standard across WAMZ countries and Sub-Saharan Africa which can explain convergence.

The per capita income of Nigeria and Ghana have been the two highest, with about $2,000 average in the last 10 years. However, the huge population disparity between Nigeria and other WAMZ countries have played a role in lowering the income convergence of WAMZ countries especially as Guinea, Liberia and many countries have low per capita income.

While the gaps in the per capital income across WAMZ are not narrowing, it can affect the ability of the economy to catch up or converge. The decline in the dispersions of income across WAMZ countries largely contributes to the convergence. Some years experienced divergence while other years experienced convergence. The patterns of growth experienced in WAMZ countries account for the diverging patterns of convergence and catch up over the past 63 years.

Further, the shifting patterns observed in the relationship between growth and initial income contribute to the growth gap. On the average, the rich country of Nigeria grows faster than the other countries and poor countries. From 2015 -2022, the pattern was reversed and some of the poorer countries have grown faster than Nigeria. The shifting patterns was observed overtime in the average growth rate across WAMZ countries relative to growth in Nigeria. In the years 2015 -2022, Nigeria recorded growth considerably slower at average 2.2 percent. The combination of the shifting pattern observed in the relationship between growth and initial income and the shifting patterns overtime observed in the average growth rate across WAMZ account for the diverging patterns of convergence and catch up which explain the growth gap.

The model will be used to explain convergence, especially how the catch-up effect works on how the poor economies will tend to grow at a faster rate to catch up with richer economies and the relationship between various determinants of growth. All the variables chosen will help us capture the individual effect or contributions of the variable to the catch-up effect required for convergence. When countries with lower levels of GDP per capital catch-up with countries with higher levels of GDP per capita, then convergence has taken place. The convergence model can explain how high- and low-income countries increase their investment in physical and human capital with the aim of increasing the GDP.

Further, one of the strengths of this model is that it emerges directly from the neoclassical economic growth model and suggests that per capita income gaps across economies globally will shrink as the economies converge. Another strength is that the model in the countries used are underdeveloped countries and tend to experience more rapid growth because they can copy or reproduce the production methods, technologies and institutions of developed countries and use them effectively for their countries. Thus, they are considered as second mover advantage. These WAMZ countries have access to the technological know-how of the advanced nations which they tend to use to help them experience rapid rates of growth.

However, the weakness of the model is lack of adequate capital. There is insufficient data on the availability of different types of capital that can enable the WAMZ to secure adequate capital needed to efficiently increase economic productivity needed for catch-up effect on a global scale.

The variables to be used in this model are growth rate, inflation, real exchange rate, deposit interest rate, fiscal deficit, GDP per capita and dummy variable.

Growth gap: The dependent variable of growth gap is the difference in the growth rate of each country vs the growth rate of Nigeria. Nigeria has about 85 percent of the GDP of the entire WAMZ countries. Generally, underdeveloped economies tend to grow more rapidly than wealthier economies and the underdeveloped or smaller economies can catch up to the wealthier economies. In WAMZ, each of the countries is considered small and with differences in growth rate and convergence, we expect them to catch-up with Nigeria, which is the wealthier economy. Also, in WAMZ, the wealthy economy is Nigeria, and it can enhance catch up effect by opening its economy to free trade and ability to absorb new technology to attract capital and participate in global market.

Inflation: Inflation affects many aspects of the economy especially consumer spending, business investment, employment rates, tax policies, et.c. Inflation is measured by Consumer Price Index (CPI) in percentage. Inflation convergence can be realized when the means and variances of the inflation differentials for these WAMZ countries diminish in successive time periods. The convergence for inflation means that inflation rate fluctuates around the equilibrium value and then returns to the mean when in the long run. The inflation in the convergence model will explain how different inflation rates of the WAMZ countries will converge to the equilibrium state and the possible way inflation will prevent shocks that could disrupt this equilibrium from occurring in the long run. Inflation convergence tends to lead to monetary policy convergence.

Real Exchange Rate: The real exchange rate is important in explaining the relationship between the national currency of WAMZ countries and the US dollar, which is the most

widely used foreign currency and a major development partner in the zone. Real exchange rate convergence explains the speed of adjustment of nominal prices specifically in the way that monetary policy does not allow adjustment to happen through the nominal exchange rate channel. This means there is emergence of a single or unified exchange rate system that aligns with and is supported by growth-oriented monetary and fiscal policies. The real exchange rate can also help explain the value of the product of the nominal exchange rate and the ratio of prices between the two countries (the reference country and Nigeria).

Deposit Interest rate: Deposit interest rate convergence promotes financial liberalization reforms and market integration. It is the driver for increased competition in retail banking and the measurement of the extent of integration or convergence across interest rates that are set by banks to provide insights on how fragmented retail markets are despite changes in regulation. In this model, the Deposit interest rate helps access the level of market integration and competition in retail banking regime in WAMZ.

Fiscal Deficit: The fiscal deficit is a core convergence criterion and important in anchoring fiscal policy. The limit on the overall fiscal deficit is 4 to 5 percent in the West African Monetary Zone and the CFA adopts a limit based on the basic budget balance (IMF, 2015). Monetary unions generally set limits on central bank financing of fiscal deficits; the West African Monetary Zone requires that financing of fiscal deficits should not exceed 10 percent of the previous year's tax revenue. A large fiscal deficit can prevent the new monetary authorities from delivering low inflation if the deficits are monetized. Overall, the fiscal deficit in the model helps us access the impact on the fiscal policy on growth convergence.

GDP per capita: The convergence of GDP per capita lies at the heart of the growth convergence. This means that countries with lower levels of GDP per capita will catch up with countries with higher levels of GDP per capita. The increase in investment in physical and human capital with efforts at growing the GDP will enable the catch up of high- and low-income countries. In this model, the variable of the GDP per capital will tell us the catch-up process and help us measure the economic convergence in WAMZ.

Dummy Variable: Dummy variable is a regressor that takes the values of either 1 or 0. The dummy variable can help explain the speed of convergence and growth gap especially in cross-national studies like this. In a model determining convergence, the dummy variable is used to examine conditional convergence and capture changes in the variables over the sample period.

Hypothesis:

Null Hypothesis: $H_0 : \beta = 0$ There is no convergence

Alternative Hypothesis: $H_1: \beta \neq 0$ There is convergence

Dummy variable: $D_t = 0 \quad t < 2000$

$1 \quad t \geq 2000$

Estimation technique: The research uses panel data in the estimation and the OLS regression analysis will be done using STATA and Eviews. The panel data captures the six countries of WAMZ. From the panel data, the analysis would capture the fixed effect and Random effect and correct for endogeneity.

Also, the Eviews will be used to analyze the data for the individual countries of the WAMZ. Further analysis includes the Cointegration, Impulse response, Granger causality and Structural VAR for the supply and demand shocks.

4.0: ANALYSIS AND INTEPRETATION OF RESULTS

Growth of countries in WAMZ

Descriptive statistics of countries' growth rate

	GHANA	GUINEA	LIBERIA	NIGERIA	SIERRALEONE	THEGAMBIA
Mean	3.711	3.440	2.068	3.677	2.740	3.920
Median	4.406	2.503	1.876	4.195	3.349	4.426
Maximum	14.047	10.820	9.535	25.007	26.417	12.393
Minimum	-12.431	-1.122	-30.145	-15.743	-20.598	-8.130
Std Deviation	4.232	1.963	4.749	6.885	6.870	3.514
Skewness	-1.199	1.506	-4.860	0.172	-0.263	-0.624
Kurtosis	5.882	6.752	35.055	5.321	7.440	4.252
Jarque-Bera	36.915	60.781	2945.342	14.452	52.483	8.208
Probability	0.000	0.000	0.000	0.0007	0.000	0.016
Sum	233.823	216.758	130.328	231.694	172.641	247.010
Sum. Sq Dev	1110.619	238.946	1398.599	2939.765	2926.800	765.531
Observation	63	63	63	63	63	63

Source: Researcher's computation from WDI data

The statistics show that the mean growth rate for the 63 -year period hovers around 2 percent for Liberia to 3.9 percent for The Gambia. All the countries had minimum growth rates that were negative, while Sierraleone growth was mostly volatile ranging from a minimum of -20.6percent to a maximum of 26 percent. The least volatile growth was Guinea, from a minimum growth of -1.12percent to a maximum of 10.8 percent during the period. In general, these countries experienced a slow growth rate, and the growth rates were driven by non-oil exports. The level of productivity and economic output of the non-oil sectors have been driving the growth and it has generally not been high. The relative size of the WAMZ countries in the real aggregate demand was another important source of asymmetry. Our data shows that Nigeria accounts for 85 percent of the entire GDP of WAMZ and the dominant economic output of WAMZ and the largest economy in Africa and home to the highest population of about 220 million people.

The pre-WAMZ period is between the year 1960 and 2000 while the post WAMZ period is between the year 2001 and 2022.

Pre-WAMZ average growth rate

Time	1960	1961	1962	1963	1964	1965	1966	1967
Average Growth rate	2.515	2.580	3.801	4.123	3.982	3.914	0.540	-1.426

Time	1968	1969	1970	1971	1972	1973	1974	1975
Average growth rate	2.465	7.540	8.930	4.488	1.016	3.976	5.245	0.079

Time	1976	1977	1978	1979	1980	1981	1982	1983
Average growth rate	2.748	2.643	2.585	1.917	3.311	-1.058	-0.939	-0.438

Time	1984	1985	1986	1987	1988	1989	1990	1991
Average growth rate	3.206	1.493	2.444	3.809	3.091	3.252	4.703	2.598

Time	1992	1993	1994	1995	1996	1997	1998	1999	2000
Average growth rate	-0.329	2.354	0.923	0.568	3.186	2.202	3.015	2.516	4.286

Post WAMZ Average growth

Time	2001	2002	2003	2004	2005	2006	2007	2008	2009
Average growth rate	2.658	8.654	-0.028	5.576	3.795	4.227	6.399	6.475	4.486

Time	2010	2011	2012	2013	2014	2015	2016	2017	2018
Average growth rate	6.346	5.225	7.976	8.368	2.786	-1.327	3.170	5.118	4.390

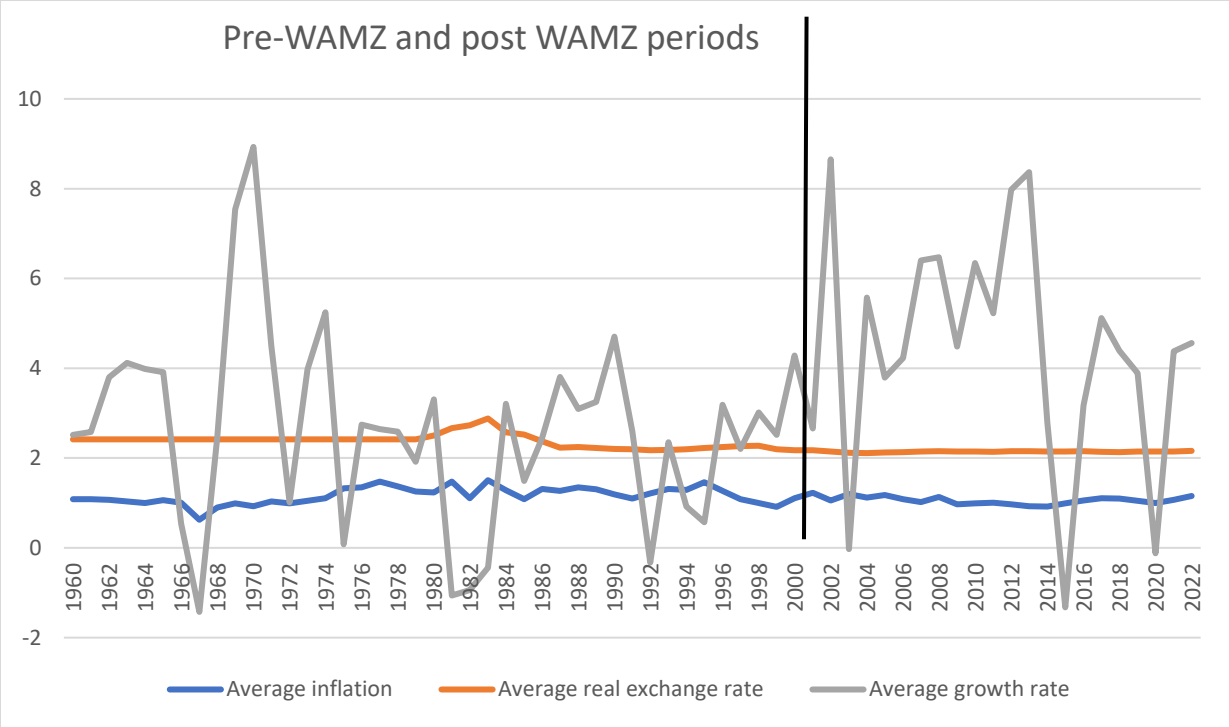
Time	2019	2020	2021	2022
Average growth rate	3.890	-0.120	4.377	4.561

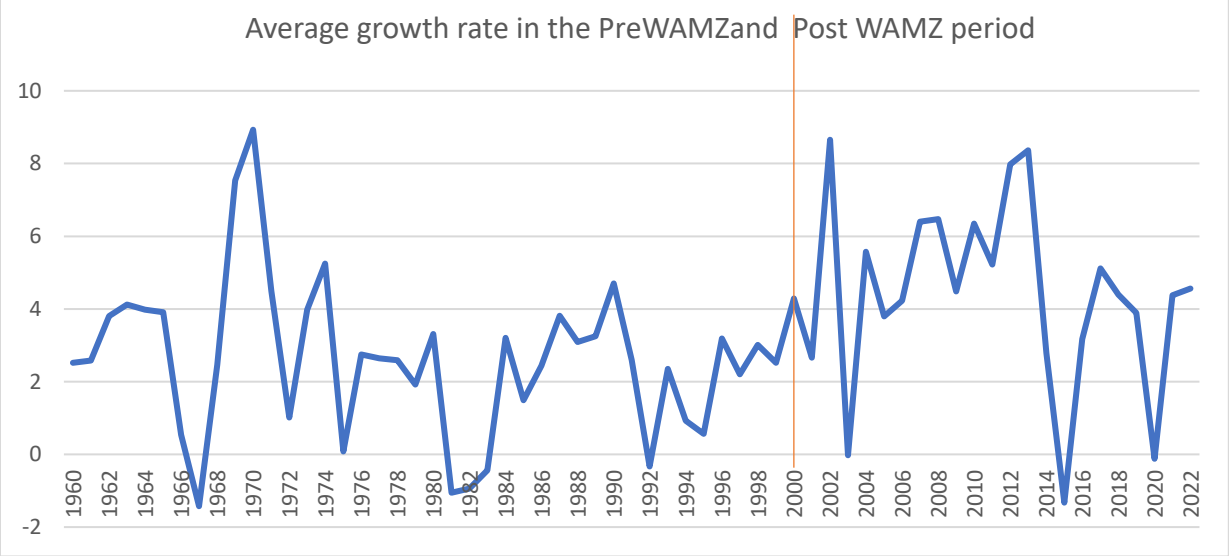
	Pre-WAMZ	Post WAMZ
Average growth	2.631	4.409
SierraLeone	1.331	5.367
Ghana	2.554	5.869
Nigeria	2.937	5.059
Guinea	2.839	4.561
The Gambia	4.376	3.072
Liberia	1.888	2.405

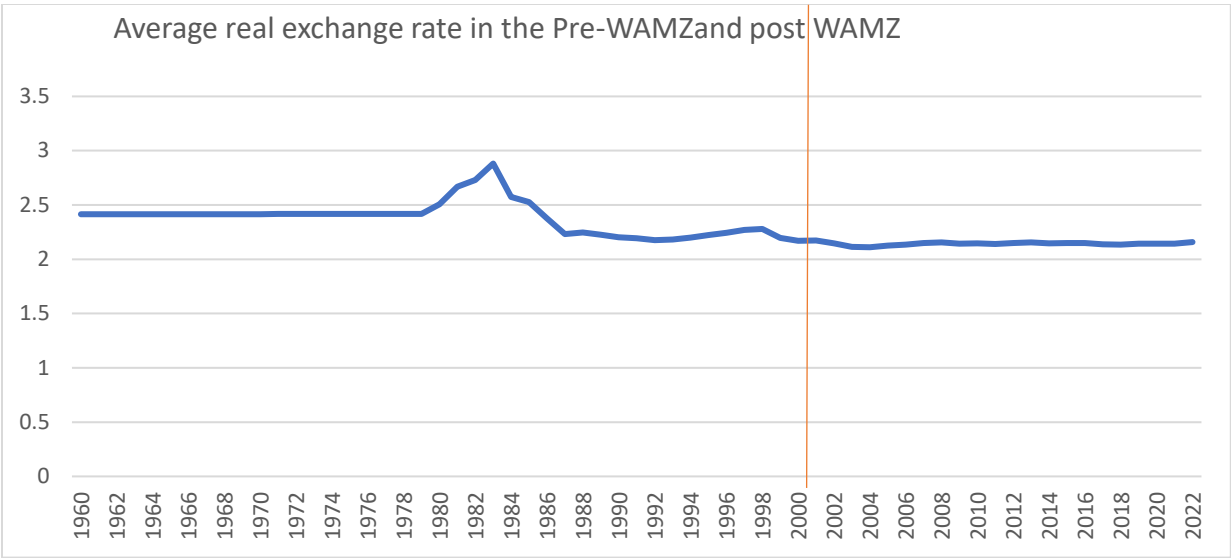
The average growth of the WAMZ countries increased after the formation of WAMZ in 2001. All the six countries, except The Gambia recorded an increase in their

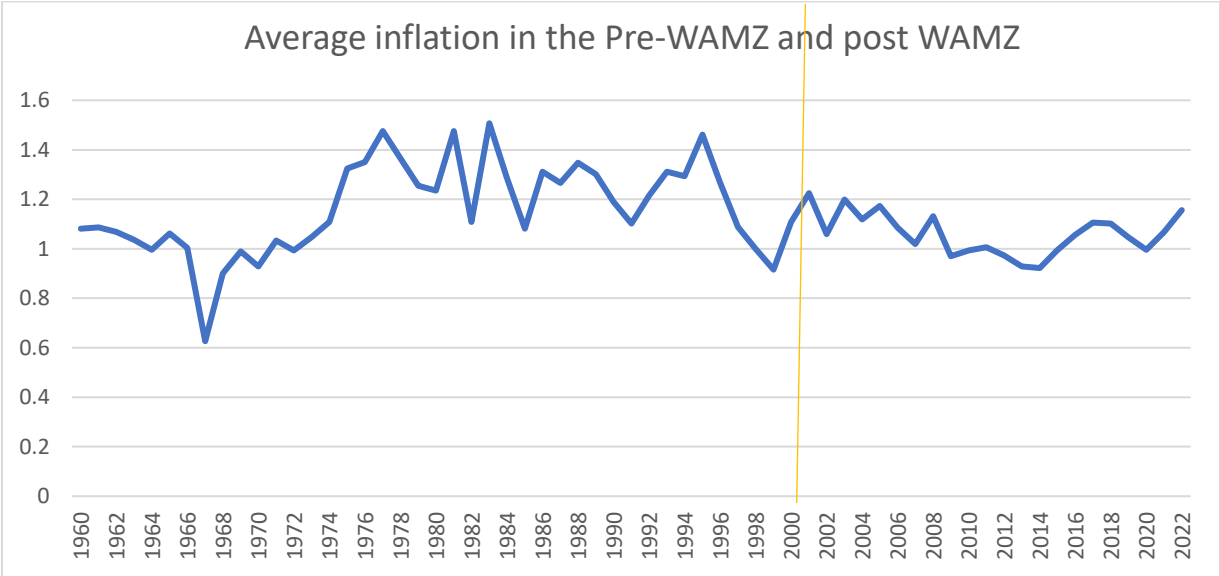
average growth rate after the formation of WAMZ compared to their average growth rate before WAMZ. Even though none of the WAMZ countries is among the top five fastest growing African economies, the post WAMZ average growth rate of 4.4 percent is higher than West Africa average growth rate of 3.6 percent in 2022. West Africa is expected to grow at 3.8 percent in 2023, according to African Development Bank. The overall growth performance of Sub-Saharan Africa is backsliding and lower than the average performance of the largest countries of the continent. Additionally, the West African economic growth decelerated in 2020 and 2021, attributed to the resurgence of shocks emanating from Covid-19 pandemic especially as China is a major trade partner for the region's countries. In the post WAMZ period, the increased growth rate has been driven by increased participation in trade, growth of the non-oil sectors, growth of the service sectors, mobilization of private sector financing for Climate and green growth in West Africa etc. The historical difference in the average growth rate between the pre-WAMZ and post WAMZ period is small.

Albeit the Nigerian economic output is massive compared to other WAMZ member countries, it does not have the highest growth rate. Ghana and Sierra Leone have special experience because they grew above Nigeria post WAMZ while Liberia, The Gambia and Guinea grew below Nigeria in the post WAMZ period. Sierra Leone and Ghana achieved convergence because they grew above Nigeria in the post WAMZ period. Liberia, The Gambia, and Guinea did not achieve convergence because they did not grow above Nigeria.


Pre-WAMZ and post WAMZ periods
10
8
6
4
2
0
-2
1960 1962 1964 1966 1968 1970 1972 1974 1976 1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018 2020 2022
Average inflation
Average real exchange rate
Average growth rate


Average growth rate in the PreWAMZand Post WAMZ period
10
8
6
4
2
0
-2
1960 1962 1964 1966 1968 1970 1972 1974 1976 1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018 2020 2022





In addition to growth, two essential components of the convergence issues are inflation and exchange rate convergence. Given that Inflation and exchange rate have experienced volatility across the zone and the vulnerability of WAMZ countries to external shocks, inflation and exchange rate issues are arguably the most critical issues facing the region as they move towards monetary integration. Inflation has not been single digit, inflation and growth have been cyclical over the 63-year period, pre WAMZ and post WAMZ. The average real exchange rate has been relatively stable in the

period. While the real exchange rate has not recorded sufficient appreciation in value, it has contributed to the unstable inflationary environment. Meanwhile, some of the WAMZ countries experienced a long decline in value of their currencies post WAMZ from 2001.

The Gambian Dalasi recorded steep decline till 2003, the Ghanian Cedi recorded a downward trend until 2015 when it rose slightly before declining again. The Sierra Leonan Leone started with a downward trend at the beginning of the period and then became stable between 2005 and 2008. It later began to rise steadily until 2015 and then hit a steep decline in 2017 which caused a lot of fatalities in the Freetown (capital city) mudslides. The inflation and growth instability have been driven by poor fiscal and monetary policies, rising debt, high prices, less production and export, excessive spending, corruption etc. Several efforts at macroeconomic price stabilization around the desired target inflation have not been achieved.

Further, from the plot of average growth, we can suggest the presence of a strong business cycles asymmetry. This is due to how the average growth vacillated very widely with some of the WAMZ countries recording negative growth in some months and years, and declining growth as well. High growth numbers, declining growth numbers and negative growth numbers were recorded in both the pre-WAMZ and post WAMZ period.

Panel Data Regression Results

Growth gap $= \alpha + \beta Dummy + \varepsilon_{it}$

Where $\beta < 0$ and if $G_{Nigeria} > G_{reference\ country}$

H_0 : no convergence

H_1: increased convergence

$$Grt - Gng : -0.503148 + \beta 0.003867 + \varepsilon_{it} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Dummy variable is the only independent variable in the first regression. It is used to show if there is any categorical effect that may be expected to shift the outcome of the growth gap. It shows the effect of one category of explanatory variable, and it is not statistically significant, which implies that there is no convergence, and we fail to reject the null hypothesis. The effect of any variable on growth gap is larger by 0.003867. The difference in slope value of factors that promote growth gap and factors that do not promote growth gap is higher by 0.003867.

Variable	Coefficient (Standard Error)	P-value
Dependent variable: Growth gap		
Dummy	0.003867 (0.871291)	0.9965
Constant	-0.503148	
R- squared	0.00000	
Prob(F-statistic)	0.996462	

$$Grt - Gng : \alpha + D + \beta_1 X_1 + \beta_2 X_2 + \varepsilon$$

$$Grt - Gng : -0.577245 + -0.038883 + \beta 10.010092 - \beta_2 0.000298 + \varepsilon \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(2)$$

Variable	Coefficient (Standard Error)	P – value
Dependent variable : Growth gap		
Dummy	-0.038883 (0.888095)	0.9651
Inflation	0.010092 (0.034655)	0.7711
Real Effective Exchange rate	-0.000298 (0.002298)	0.8969
Constant	-0.577245	
R-squared	0.000274	
Prob(F-statistic)	0.993536	

The dummy variable is one of the independent variables to explain the growth gap. This shows that one category of the explanatory variable has an effect on the growth gap and it is smaller by 0.038883 while holding other variables constant. Economic theory posits that the rate of economic growth causes a downward pressure on inflation rate. However, from the result, there is a positive relationship between GDP growth and inflation because if the economy grows, then it causes inflation, but the increase in inflation can be controlled through several ways. The rapid rise in inflation leads to lower purchasing power, higher interest rates and then slower economic growth. In this result, the positive relationship between the growth gap and inflation is positive and in consonance with economic theory. This means that if the inflation

increases by one unit, then the growth gap in WAMZ increases by 0.010092 while holding other variables constant. The negative result of the relationship between the real effective exchange rate and the growth gap is in consonance with economic theory. For an economy, an increase in the real effective exchange rate makes the exports more expensive and income cheaper which leads to a loss in trade competitiveness, hence a decline in economic growth. In the result, if the real effective exchange rate increases by one unit, then we see a decrease in growth rate gap by 0.000298 while holding other variables constant. The dummy variable, inflation and real exchange rate are not statistically significant, which implies that there is no convergence among the variables. Hence, we fail to reject the null hypothesis.

$$Grt - Gng = \alpha + D + \beta_1 \text{Fiscal deficit} + \beta_2 \text{GDP per cap} + \beta_3 \text{Deposit Int rate} + \varepsilon_{it}$$

$$Grt - Gng = -1.610168 + 0.210469 + \beta_1 1.21E\text{-}12 + \beta_2 0.002762 + \beta_3 -0.027042 + \varepsilon_{it} \ldots\ldots\ldots\ldots (3)$$

Variable	Coefficient (Standard Error)	P -value
Dependent variable : Growth gap		
Dummy	0.210469 (0.873306)	0.8097
Fiscal deficit	1.21E -12 (3.34E -12)	0.7167
GDP per Capita	0.002762 (0.001128)	0.0149
Deposit Interest rate	-0.027042	0.6947

	(0.068846)	
Constant	-1.610168	
R -squared	0.020579	
Prob (F-statistic)	0.168221	

From our result, only the GDP per capita is statistically significant in explaining the growth gap in WAMZ. The means that a one unit increase in the GDP per capita will make the growth gap increase by 0.002762 units while holding other variables constant. Hence, we reject the null hypothesis and conclude that there is convergence in the GDP per capita.

The positive relationship between the GDP per capita and the GDP growth gap is in consonance with economic theory. The growth in GDP per capita and growth in GDP are considered good measures of economic growth. The GDP per capita tells us the measure of the value of output per person and sustained economic growth is attained when we have increase in average incomes and this is strongly linked to poverty reduction. The variable of fiscal deficit has a coefficient of 1.21E -12 and it is positively related to the growth gap. This means that if the fiscal deficit increases by one unit, then the growth gap will increase by 1.21E -12 units while holding other variables constant. Fiscal deficit tells us how the federal budget is linked and how well the WAMZ countries' economies perform. A faster rate of growth of the economy leads to a raise in tax revenues which lowers spending on social safety net and less poverty. A smaller fiscal or primary deficit with corresponding lower interest rates will lead to growth of GDP and fall in the debt-to-GDP ratio. Also, the dummy variable coefficient of 0.210469 tells us

that the effect on growth gap is larger by 0.210469. The difference in slope value of non-promoter of growth gap and the promoters of growth gap is higher by 0.210469. The deposit interest rate coefficient of -0.027042 tells us that we have a negative relationship between the deposit interest rate and the growth gap. This means that if the deposit interest rate increases by one unit, then we experience a reduction in the growth gap by 0.027042 while holding other variables constant. The deposit interest set by banks is used to guide borrowing costs and the pace of economic growth. The lower rates spur economic growth while a higher deposit rate will restrain spending, investment and stock market valuations and then economic growth.

$$Grt – Gng = \alpha + D + \beta_1 \text{Fiscal deficit} + \beta_2 \text{GDP per cap} + \beta_3 \text{Deposit Int rate} + \beta_4 \text{Inflation} + \beta_5 \text{Real effective exchange rate} + \varepsilon_{it}$$

$$Grt – Gng = -1.863369 + 0.144048 + \beta_1 9.56E\text{-}13 + \beta_2 0.002855 + \beta_3 \text{-}0.029600 + \beta_i 0.009403 + \beta_5 0.000607 + \varepsilon_{it} \text{ ....(4)}$$

Variable	Coefficient(Standard Error)	P-value
Dependent variable : Growth gap		
Dummy	0.144048 (0.890769)	0.8716
Fiscal Deficit	9.56E-13 (3.54E-12)	0.7871
GDP Per capita	0.002855 (0.001154)	0.0139

Deposit interest rate	-0.029600 (0.073189)	0.6862
Inflation	0.009403 (0.038310)	0.8063
Real Effective Exchange rate	0.000607 (0.002442)	0.8040
Constant	-1.863369	
R-squared	0.021464	
Prob (F-statistic)	0.349051	

In this model, we have all the variables put together and we see some changes compared to the previous models. The real exchange rate now showed a positive relationship with the growth gap compared to the negative relationship it showed in the previous model. Among the five independent variables and the dummy, only the GDP per capita is statistically significant. This means that we reject the null hypothesis and conclude that there is convergence in the GDP per capita. If the GDP per capita increases by one unit, then the growth gap will increase by 0.002855 while holding other variables constant. Given the convergence in the GDP per capita, this means that countries with lower level of GDP per capita will catch up to countries with higher levels of GDP per capita. High- and low-income countries' decision to increase investment in physical and human capital with the objective of growing GDP will lead to convergence.

Fixed Effect Regression results

$$Grt - Gng = \alpha + D + \beta_1 Fiscal\ deficit + \beta_2 GDP\ per\ cap + \beta_3 Deposit\ Int\ rate + \beta_4 Inflation + \beta_5 Real\ effective\ exchange\ rate + \varepsilon_{it}$$

$$Grt - Gng = -2.190643 + 0.052409 + \beta_1 7.01E\text{-}12 + \beta_2 0.002904 + \beta_3 -0.047340 + \beta_4 0.024821 + \beta_5 0.000356 + \varepsilon_{it}$$

Variable	Coefficient (Standard Error)	P -value
Dummy	0.052409 (0.900078)	0.9536
Fiscal Deficit	7.01E -12 (1.32E -11)	0.5957
GDP Per Capita	0.002904 (0.001336)	0.0306
Deposit Interest rate	-0.047340 (0.080785)	0.5583
Inflation	0.024821 (0.041968)	0.5547
Real Effective Exchange rate	0.000356 (0.002518)	0.8875
Constant	-2.190643	
R-squared	0.029242	
Prob (F-statistic)	0.521636	

In the fixed effect regression model, the group means are fixed. The fixed effect model is used to make a conditional inference about the average outcome of the variables included. This fixed effect regression model enables us to control all variables that fluctuate over cross sectional unit but are constant overtime.

The fixed effect model addresses endogeneity concerns and control for endogeneity. Fixed effect shows the causal relationship and controls for omitted variables and endogeneity.

$$Cov\ (\varepsilon_{it}, X_{it}) \neq 0$$

$$Cov\ (\varepsilon_{is}, \varepsilon_{it}) \neq 0$$

$$Y_{it} = X^{1}_{it}\beta + \mu_{it} + \alpha_i$$

Y_t is the dependent variable observed for country i at time t. X_{it} is the independent variable observed for i and t. β is the slope coefficient and α_i is an intercept coefficient for country i and μ_{it} is an Idiosyncratic error term.

Fixed effect estimates tend to be unbiased but may be subject to high sample dependence. The fixed effect assumes that individual group and time have different intercept in the regression equation.

H_0 : There is no fixed effect

H_1: There is fixed effect.

From the result, the dummy variable has a coefficient of 0.052409 and the interaction effect is not statistically significant. The effect of the explanatory variable on the growth gap is larger by 0.052409. The difference in the value of the non-promoter of growth and promoter of growth for people is higher by 0.052409. The variable of the fiscal deficit is not statistically significant; hence we fail to reject the null hypothesis and

infer that there is no fixed effect. This means that the effect of the fiscal deficit predictor is assumed to be different across all groups and any change will cause differences in the individual effect. Also, the variable of GDP per capita is statistically significant and we reject the null hypothesis and conclude that there is fixed effect in the GDP per capita. This means that the effect of the variable is assumed to be identical across all groups and any change will make the cause to the individual variable the same.
The variable of deposit interest rate is not statistically significant; hence it does not have a fixed effect and we fail to reject the null hypothesis. The effect of each of the variables of deposit interest rate is assumed to be different across all groups and any change will cause the effect to be different. The variable of inflation is not statistically significant; hence we fail to reject the null hypothesis and conclude that there is no fixed effect present. The variable of real effective exchange rate is not statistically significant; hence we say that the real effective exchange rate does not have fixed effect on the variables. The effect of each real exchange rate variable is assumed to be different across all groups and any change will make the cause for an individual variable to be different.

Unit root test

The presence of unit root causes a spike in output which leads to higher levels of output being higher than the past trend. Unit root measurement tells us how much stationarity a time series model has.

ADF test – Augmented Dickey Fuller test

$$\Delta Y_t = \alpha + \gamma Y_{t-1} + \delta_1 \Delta Y_{t-1} + \ldots\ldots\ldots\ldots + \delta_p \Delta Y_{t-p} + \varepsilon_t$$

$$\Delta Y_t = \alpha + \beta Y_{t-1} - Y_{t-1} + \varepsilon_t$$

H_0 : The residuals have unit root

H_1: There is no unit root in the residuals.

Method	Statistic	Probability
Null: Levin, Lin & Chu	-6.50167	0.00000
Lm, Pesaran and Shin W-stat	-6.49838	0.00000
ADF – Fisher Chi- square	61.5886	0.00000
PP- Fisher Chi -square	122.494	0.00000

The unit root test was only done at levels. We did not do any differencing or ADF further tests because all the variables were statistically significant at the first level. Therefore, we reject the null hypothesis and conclude that the variables have no unit root. The variables are stationary. The stationary variables enable the variables to faithfully reflect the underlying patterns in the data and give correct findings.

Granger Causality

The Granger causality test is important as a statistical hypothesis test because it helps us examine the causal relationship present between variables and how useful it is in forecasting another. The test is done for both short and long run. This test tells us whether the lagged values of a predictor in any of the five models used help in the prediction of an outcome when controlling the lagged values of the outcome itself. The presence of Granger causality for both variables in both directions does not necessarily imply that the series will be co-integrated.

$$Y_t = \alpha + \beta Y_{t-1} + \varepsilon_t$$

The Granger causality test explains causations and the relationship between the two variables showing how the past values of one variable gives predictive information about the future values of another variable, more than the information contained in its own past values. This Granger causality test is important for deciding if a single equation model of Y and X variables has a right- hand side variable and will be necessary for forecasting purposes. The Granger causality test shows how to ascertain the usefulness of one variable to forecast another variable.

$H_0 : \Theta = 0$ No Granger Causality

The coefficient of past values in the regression is equal to zero.

$H_1 : \Theta \neq 0$ There is Granger Causality

The coefficient of past values is not equal to zero.

Null Hypothesis	Observation	P-value
GDP per capita does not Granger cause Grt_Gng Inference: We fail to reject the null hypothesis and conclude that there is no Granger causality	305	0.2258
Fiscal Deficit does not Granger Causes Grt_Gng Inference: We fail to reject the null hypothesis and conclude that there is no Granger Causality	305	0.8989
Dummy does not Granger cause Grt_Gng Inference : We fail to reject the null hypothesis and conclude that there is no Granger Causality	305	0.8236

Deposit Interest rate does not Granger cause Grt_Gng Inference: We fail to reject the null hypothesis and conclude that there is no Granger Causality	302	0.9214
Inflation does not Granger cause Grt_Gng Inference: We fail to reject the null hypothesis and conclude that there is no Granger Causality	305	0.6780
Real Effective Exchange rate does not Granger Cause Grt_Gng Inference: We fail to reject the null hypothesis and conclude that there is no Granger Causality	305	0.9800
Fiscal Deficit does not Granger cause GDP per capita Inference: We fail to reject the null hypothesis and conclude that there is no Granger Causality	305	0.9934
Dummy does not Granger cause GDP per Capita Inference : We fail to reject the null hypothesis and conclude that there is no Granger Causality	305	0.8327
Deposit interest rate does not Granger cause GDP per Capita Inference: We fail to reject the null hypothesis and conclude that there is no Granger Causality	302	0.9201
Inflation does not Granger GDP per capita Inference: We fail to reject the null hypothesis and conclude that there is no Granger Causality	305	0.9530

Real Effective Exchange rate does not Granger cause GDP per Capita Inference: We fail to reject the null hypothesis and conclude that there is no Granger Causality	305	0.6785
Dummy does not Granger cause Fiscal deficit Inference: We fail to reject the null hypothesis and conclude that there is no Granger causality	305	0.9354
Deposit interest rate does not Granger cause Fiscal deficit Inference: We fail to reject the null hypothesis and conclude that there is no Granger causality	302	0.3967
Inflation does not Granger cause Fiscal deficit Inference: We fail to reject the null hypothesis and conclude that there is no Granger causality	305	0.8317
Real Effective Exchange rate does not Granger cause Fiscal Deficit	305	0.9923
Inference: We fail to reject the null hypothesis and conclude that there is no Granger causality		
Deposit Interest rate does not Granger cause Dummy Inference: We fail to reject the null hypothesis and conclude that there is no Granger causality	302	0.6293
Inflation does not Granger Cause Dummy Inference: We fail to reject the null hypothesis and conclude that there is no Granger causality	305	0.4920

Real Effective Exchange rate does not Granger cause Dummy Inference: We fail to reject the null hypothesis and conclude that there is no Granger causality	305	0.8334
Inflation does not Granger cause Deposit interest rate Inference: We fail to reject the null hypothesis and conclude that there is no Granger causality	302	0.1755
Real Effective Exchange rate does not Granger cause Deposit Interest rate Inference: We fail to reject the null hypothesis and conclude that there is no Granger causality	302	0.7496
Real Effective Exchange rate does not Granger cause Inflation Inference: We reject the null hypothesis and conclude that there is Granger causality because it is statistically significant	305	0.0002

Among the joint variables used for the test, all of variable are NOT statistically significant with the exception on the last joint variable of real effective exchange rate and inflation which are statistically significant. Among the non- statistically significant joint variables, we conclude that they do not have Granger causality. While the joint variables of real effective exchange rate and inflation are statistically significant, hence we say that there is Granger causality between real effective exchange rate and inflation. Real effective exchange rate Granger causes inflation. This means that one variable will be useful in forecasting the other. The Real effective exchange rate will be

useful in forecasting inflation and the inflation will also be useful in forecasting real exchange rate.

Cointegration

Cointegration tests are used to test the presence of correlation between two or more non-stationary time series in the long run for a specified period, long run parameters for two or more variables are identified.

$$\Sigma Y_i Y_{it} = \mu_t$$

The presence of cointegration signifies the existence of long run equilibrium relationship between the variables highlighted.

Johanssen cointegration test was performed to ascertain if cointegration exists or not.

H_0: There is no cointegration.

H_1: There is co-integration.

Cointegration involves modelling the variables to I(0) and it is a linear combination of those variables that have lower order of integration.

	Statistic	Prob	Weighted Statistic	Prob
Panel v-Statistic	-1.702987	0.9557	-2.331184	0.9901
Panel rho-Statistic	0.545782	0.7074	0.506053	0.6936
Panel PP-Statistic	-0.491814	0.3114	-1.076325	0.1409

Panel ADF-Statistic	-1.072290	0.1418	-2.602526	0.0046

For the 63-year period of study, the cointegration shows that one of the variables is statistically significant while the remaining three variables are not statistically significant. For the Panel ADF Statistic, being significant means that we reject the null hypothesis and conclude that it has cointegration, while the other three variables do not have cointegration. The variable (Panel ADF-Statistic) shows a long run relationship among variables while the other variables do not have a long run relationship. For the stationary variable, the coefficient estimate of Y_{t-1} is now consistent and then converges to zero. This means that the stationary variable has asymptotic distribution of the F-statistic, and it remains the same. The series does not itself change over time and the statistical properties of a process which generates the time series do not change over time while the other three variables are not the same.

Also, convergence can occur along run equilibrium relationship between or among non-stationary variables. Convergence is similar with cointegration or long-run co-movement between stationary variables or short run co-movements.

Cointegration Pre-WAMZ

Null Hypothesis, H_0 : There is no cointegration

Alternative Hypothesis, H_1: There is cointegration.

	Statistic	Prob	Weighted Statistic	Prob
Panel v-Statistic	-1.218929	0.8886	-1.070520	0.8578
Panel rho-Statistic	1.562101	0.9409	1.548403	0.9392
Panel PP-Statistic	1.546343	0.9390	1.616290	0.9470
Panel ADF Statistic	0.974087	0.8350	1.058752	0.8551

The 41-year period (1960 -2000) prior to the establishment of WAMZ was marked by checkered economic development in WAMZ. From the cointegration result, all the variables were NOT statistically significant, hence we fail to reject the null hypothesis and conclude that there is no cointegration in the pre-WAMZ period. There is no cointegration and the variables are non-stationary. This shows that there is no long-term linear relationship among the time series variables. The variables are non-stationary, and this implies that the statistical properties change over time and the time series has trend or seasonality.

Cointegration Post WAMZ

Null Hypothesis, H_0: There is no cointegration.

Alternative Hypothesis, H_1: There is cointegration.

	Statistic	Prob	Weighted Statistic	Prob
Panel v-Statistic	1.023831	0.1530	0.564477	0.2862
Panel rho-Statistic	0.280266	0.6104	0.458440	0.6767
Panel PP-Statistic	-4.330129	0.0000	-3.393364	0.0003
Panel ADF Statistic	-1.048041	0.1473	-0.873793	0.1911

Following the commencement of WAMZ in 2001, the economy was set to prosper and converge using some sets of criteria (primary and secondary criteria) which were estimated to drive growth and economic development. The cointegration test will enable us to see the relationship (long run or short run) present among the variables. The result shows some differences in the cointegration between the pre-WAMZ and post WAMZ period. While the pre-WAMZ did not have any significant variable in the result, the post-WAMZ period recorded one significant variable. From the result, three of the variables are not statistically significant, hence we fail to reject the null hypothesis and conclude that there is no cointegration present. One of the variables (Panel PP-Statistic) has

statistically significant p-values, thus we reject the null hypothesis and conclude that there is cointegration. It has long run equilibrium relationship among variables.

Cointegration emphasizes whether the long-term linear relationship between two time series variables is stationary even if the linear relationship does not exist or is present in the short term. The variable with cointegration can be stationary or even non-stationary. Finally, this cointegration tests and analysis did uncover casual relations among variables and determine if the stochastic trends in a group of variables are shared by the series or not shared. The cointegration results do not show strong effect on convergence.

Vector Error Correction Model and Estimates (VECM)

$$Y_t = \phi + \phi Y_{t-1} + \varepsilon_t$$

The Vector Error Correction Model (VECM) is useful in analyzing co-integrated variables and relationships; this provides a mechanism to understand the long-run and short -run behavior of the variables in the system. VECM can help identify the presence of long run equilibrium interrelationships among non-stationary variables. It is a cointegrated VAR model.

$$\Delta Y_t = \phi + \alpha\beta^1 Y_{t-1} + \varepsilon_t$$

The cointegrating equation from VECM shows a trend present and the use of restricted trend.

The VECM is an error correction model which is a dynamic model which shows the movement of a variable in any period relates to the previous period's gap from the long -run equilibrium. VECM portrays the short run relationship present among the series.

H0: Π = 0 The variables are stationary and co-integrated

H1: Π = 1 The variables are not stationary and not cointegrated

Rank = 0

Rank =1

Variable	Cointegrating Coefficient
Grt_Gng (-1)	1.00000
GDP per Capita (-1)	-0.001214 (0.00121) [-1.00536]
Fiscal Deficit (-1)	2.92E-12 (4.0E -12) [0.73473]
Dummy (-1)	-1.743170 (1.30495) [-1.33581]
Deposit Interest rate (-1)	0.241080 (0.10240) [2.35432]
Inflation (-1)	-0.133682 (0.05457) [-2.44965]
Real Effective Exchange rate (-1)	0.004628

	(0.00369) [1.25251]

From the result, the deposit interest rate and the inflation are statistically significant while the growth gap, fiscal deficit, Dummy and Real effective exchange rates are not statistically significant. For the deposit interest rate and inflation, they are statistically significant and hence we reject the null hypothesis and conclude that the variables of deposit interest rate and inflation are not stationary and not cointegrated. On the other hand, the variables of growth gap, GDP per capita, fiscal deficit, Dummy and the real exchange rate are not statistically significant, hence we fail to reject the null hypothesis. We can infer that the variables of growth gap, GDP per capital, fiscal deficit, Dummy, and real effective exchange rate are stationary and cointegrated.

The variables of deposit interest rate and inflation have cointegrating trends that are non-stationary and we can use restricted constant specification for the variables because they are not around a constant mean. The restricted constant specification for these variables is useful in modelling multivariate time series. Also, the variables of growth gap, GDP per capita, Fiscal deficit, Dummy and Real effective exchange rate cointegrating trend are stationary and no restriction is used.

Overall, VECM helps us interpret long term and short-term equations and determine the number of co-integrating relationships. VECM has more efficient coefficient estimates. However, when the variables are not stationary then the number of cointegrating equations are reduced.

Countries' Time Series Regression Result

Guinea

Variable	Coefficient (Standard Error)	P -value
Dependent variable: Growth gap		
Dummy	-2.088319 (1.834581)	0.2594
Constant	0.889949	
R -squared	0.020800	
Prob(F-statistic)	0.259443	

Variable	Coefficient	P-value
Dependent variable: Growth gap		
Inflation	-0.293024 (0.252205)	0.2500
Real Effective Exchange rate	-0.133591 (0.196620)	0.4995
Dummy	-1.736681 (1.857712)	0.3537
Constant	35.71016	

R-squared	0.050376	
Prob (F-statistic)	0.380169	

Variable	Coefficient	P-value
Dependent variable: Growth gap		
GDP per capita	0.005279 (0.005695)	0.3578
Fiscal Deficit	2.53E -12 (1.52E -11)	0.8685
Dummy	-1.945847 (1.916462)	0.3142
Deposit Interest rate	0.010000 (0.220963)	0.9641
Constant	-2.662172	
R-squared	0.053295	
Prob (F-statistic)	0.520010	

In the first model, Dummy variable is the only exogeneous variable and the coefficient is -2.088319. This means that the effect on growth gap for Guinea is smaller by 2.088319. The difference in the value of the promoters and non-promoters of this variable for growth gap is smaller by 2.088319. Since the value is not significant, we fail

to reject the null hypothesis and conclude that there is no convergence. For the second regression, the three explanatory variables of inflation, real exchange rate and Dummy are not statistically significant, hence we fail to reject the null hypothesis. We conclude that there is no convergence. For the third regression output, there are four explanatory variables namely GDP per capita, Fiscal deficit, Dummy, and deposit interest rate. They are all not statistically significant hence we fail to reject the null hypothesis. Thus, we can see that there is no convergence among these variables for Guinea.

Liberia

Variable	Coefficient (Standard Error)	P-value
Dependent variable: Growth gap		
Dummy	-0.095000 (2.116509)	0.9643
Constant	-1.563743	
R-squared	0.0000033	
Prob (F-Statistic)	0.964345	

Variable	Coefficient (Standard Error)	P -value
Dependent variable: Growth gap		
Inflation	0.001051 (0.356717)	0.9977

Real Effective Exchange rate	-0.075190 (0.175862)	0.6705
Dummy	-0.159591 (2.297610)	
Constant	15.1806	
R-squared	0.003137	
Prob (F-Statistic)	0.979672	

Variable	Coefficient(Standard Error)	P-value
Dependent variable: Growth gap		
GDP per Capita	0.020616 (0.014351)	0.1563
Fiscal Deficit	-2.68E-09 (4.45E -09)	0.5489
Dummy	-0.145806 (2.148159)	0.9461
Deposit Interest rate	0.759143 (0.552327)	0.1747
Constant	-16.86413	
R-squared	0.054106	

Prob (F-statistic)	0.520825	

The first regression output explains the effect of dummy variable as an exogeneous variable. The dummy variable of -0.095000 is not statistically significant. The effect of an explanatory variable on the growth gap is smaller by 0.095000 . The difference in slope value of non-promoters of growth and the promoters of growth is smaller by 0.09500. Since the Dummy variable is not statistically significant, we conclude that there is no convergence. For the second regression, the independent variables are inflation, real effective exchange rate and the dummy variable. None of the three variables is statistically significant, hence we reject the null hypothesis and conclude that there is no convergence among these variables. If the inflation increases by one unit then the growth gap increased by 0.001051 while holding other variables constant. When the real effective exchange rate increases by one unit, then the growth gap will decrease by 0.075190. For the third regression, the variables are GDP per capita, Fiscal deficit, deposit interest rate and Dummy. The four variables are all not statistically significant, hence we fail to reject the hypothesis and conclude that there is no convergence.

Nigeria

Variable	Coefficient (Standard Error)	P-value
Dependent variable: Growth gap		
Dummy	2.059780	0.2383

	(1.729475)	
Constant	2.631452	
R-squared	0.022725	
Prob (F-statistic)	0.238273	

Variable	Coefficient (Standard Error)	P-value
Dependent variable : Growth gap		
Inflation	-0.070096 (0.060208)	0.2490
Real Effective Exchange rate	-0.017534 (0.008867)	0.0527
Dummy	2.617277 (1.759296)	0.1422
Constant	6.420019	
R-squared	0.092006	
Prob (F-statistic)	0.124857	

Variables	Coefficient (Standard Error)	P-value
Dependent variable: Growth gap		
GDP Per Capita	-0.003746 (0.002212)	0.0957
Fiscal Deficit	-2.05E – 11 (1.43E-11)	0.1573
Dummy	2.125014 (1.756589)	0.2313
Deposit Interest rate	0.214099 (0.229431)	0.3546
Constant	0.771503	
R-squared	0.069369	
Prob(F-statistic)	0.374421	

In the first regression result, the Dummy variable is the only explanatory variable. The coefficient of the Dummy is 2.059780 which means that the effect on growth gap is larger by 2.059780. It is not statistically significant and hence we fail to reject the null hypothesis and conclude that there is no convergence. For the second regression, the variables are the Dummy, inflation, and real effective exchange rate. The inflation is not statistically significant; hence we fail to reject the null hypothesis and conclude that there is no convergence. If inflation increases by one unit, then the growth gap

decreases by 0.070096 while holding other variables constant. The real effective exchange rate is statistically significant; hence we reject the null hypothesis. We conclude that there is convergence in the real effective exchange rate. If the real exchange rate increases by one unit, then the growth gap reduces by 0.017534 while holding other variables constant. Also, for the third regression, the variables are GDP per capita, Fiscal deficit, Dummy, and deposit interest rate. GDP per capita is statistically significant while the other three are not significant. For the GDP per capita, a one-unit increase will result in a reduction in the growth gap by 0.003746 while holding other variables constant. We reject the null hypothesis and conclude that there is convergence in the GDP per capita for Nigeria. The Dummy, fiscal deficit and deposit interest rate are not statistically significant; hence we fail to reject the null hypothesis and conclude that there is no convergence among these variables for Nigeria.

Sierra Leone

Variables	Coefficient (Standard Error)	P -value
Dependent variable: Growth gap		
Dummy	-0.424696 (2.206234)	0.8480
Constant	-0.714904	
R -squared	0.000607	
Prob (F-statistics)	0.847991	

Variable	Coefficient (Standard Error)	P-value
Dependent variable: Growth gap		
Inflation	0.120924 (0.384153)	0.7540
Real Effective Exchange Rate	0.004742 (0.011462)	0.6806
Dummy	-0.301649 (2.254143)	0.8940
Constant	-2.884662	
R -squared	0.004670	
Prob (F-statistic)	0.964024	

Variable	Coefficient (Standard Error)	P-value
Dependent variable: Growth gap		
GDP per Capita	0.034565 (0.020898)	0.1035
Fiscal Deficit	2.17E-09 (1.93E – 09)	0.2637
Dummy	0.556393	0.8049

	(2.242552)	
Deposit Interest rate	-0.108161 (0.128161)	0.4022
Constant	-6.430359	0.1063
R-squared	0.080824	
Prob (F-statistic)	0.290279	

For the first regression, the Dummy variable is the only explanatory variable in the regression. It is not statistically significant; hence we fail to reject the null hypothesis. We can conclude that there is no convergence in the Dummy variable. The effect of the explanatory on growth gap is smaller by 0.424696. For the second regression, the explanatory variables are inflation, real effective exchange rate and Dummy variable and they are not statistically significant. Hence, we fail to reject the null hypothesis and conclude that there is no convergence among the variables of inflation, exchange rate and the Dummy variable. For the third regression, the explanatory variables are GDP per capita, fiscal deficit, Dummy and deposit interest rate are not statistically significant. Hence, we fail to reject the null hypothesis and conclude that there is no convergence among the variables in Sierra Leone.

Ghana

Variable	Coefficient (Standard Error)	P-value
Dependent variable: Growth gap		
Dummy	1.993389 (1.751697)	0.2596
Constant	-0.978728	
R-squared	0.020788	
Prob (F-statistics)	0.259581	

Variable	Coefficient(Standard Error)	P-value
Dependent variable: Growth gap		
Inflation	0.015141 (0.043035)	0.7262
Dummy	1.986941 (1.822345)	0.2800
Real Effective Exchange rate	-0.001590 (0.002337)	0.4990
Constant	-0.839141	
R-squared	0.028431	

Prob (F-statistic)	0.633378	

Variables	Coefficient(Standard Error)	P-value
Dependent Variable: Growth gap		
GDP per capita	0.002008 (0.002418)	0.4097
Fiscal Deficit	-2.62E -11 (1.48E -10)	0.8606
Dummy	1.787955 (1.795472)	0.3235
Deposit interest rate	0.043283 (0.145593)	0.7673
Constant	-3.201114	
R-squared	0.073935	
Prob (F-statistic)	0.338924	

For the first regression, the Dummy variable is the only explanatory variable, and it is not statistically significant. Hence, we fail to reject the null hypothesis and conclude that there is no convergence. The effect of the explanatory variable on growth gap is larger by 1.993389. For the second regression, the independent variables are inflation, Dummy, and real effective exchange rate. The three variables are not statistically

significant. Hence, we conclude that inflation, dummy, and real effective exchange have no convergence. For the third regression, the explanatory variables are GDP per capita, fiscal deficit, Dummy, and deposit interest rate. These variables are not statistically significant; hence we fail to reject the null hypothesis and conclude that there is no convergence among these variables in Ghana.

The Gambia

Variable	Coefficient (Standard Error)	P-value
Dependent variable: Growth gap		
Dummy	1.987738 (1.855975)	0.2884
Constant	-0.924296	
R-squared	0.018457	
Prob (F-statistic)	0.288391	

Variable	Coefficient (Standard Error)	P -value
Dependent variable: Growth gap		
Inflation	0.034980 (0.107939)	0.7470
Dummy	2.293663 (1.844743)	0.2187

Real Effective Exchange rate	0.031501 (0.014972)	0.0397
Constant	-6.914495	
R-squared	0.090455	
Prob (F-statistic)	0.130472	

Variable	Coefficient (Standard Error)	P -value
GDP per capita	-0.002108 (0.008884)	0.8133
Fiscal Deficit	-2.45E -10 (3.22E -09)	0.9397
Dummy	2.327299 (1.982419)	0.2452
Deposit Interest rate	-0.253800 (0.359882)	0.4835
Constant	2.620222	
R-squared	0.038534	
Prob (F-statistic)	0.677496	

In the first regression result, the only explanatory variable is the Dummy variable. The Dummy variable is not statistically significant; hence we fail to reject the null hypothesis. We conclude that there is no convergence for this variable in The Gambia.

The effect of the explanatory on the growth gap is larger by 1.987738. In the second regression, the explanatory variables inflation, dummy variable, and real effective exchange rate. The dummy variable and the inflation are not statistically significant; hence we fail to reject the null hypothesis and conclude that inflation and dummy variable have no convergence. On the other hand, the real effective exchange rate is statistically significant at the 5% level. Therefore, we reject the null hypothesis and conclude that there is convergence in the real effective exchange rate in The Gambia. In the third regression, the explanatory variables are GDP per capita, Fiscal deficit, Dummy, and Deposit interest rate. They are all not statistically significant, thus we fail to reject the null hypothesis. We conclude that the variables of GDP per capita, fiscal deficit, Dummy and deposit interest rate have no convergence in The Gambia.

Furthermore, with increased convergence with the WAMZ, the growth gap would become narrower and the historical difference in growth pre-WAMZ and post WAMZ will be small. From the average growth Pre-WAMZ and Post WAMZ, Sierra Leone and Ghana moved above Nigeria in the post WAMZ period. Thus, SierraLeone and Ghana achieved convergence because they grew above Nigeria. How was it achieved? First, there was more conscious efforts of each of the countries- Sierraleone and Ghana- by their fiscal and monetary authorities towards adopting sustainable policies and efforts at synchronization of such policies with regional target (monetary policy target for inflation and output) set for each of the endeavors. Second, Sierraleone and Ghana have shown narrow divergence compared to other WAMZ member countries with respect to average outcomes of price stabilization efforts and better independent monetary policy pursuits. Third, Sierraleone and Ghana utilized more monetary policy

instruments and determinants of less inflation divergence in the pursuit of a well-represented interest rates and some contractionary monetary policies which increased credit and diminished output supply/demand gaps.

Convergence and Divergence

The convergence and divergence in WAMZ are examined by smoothed regime in the Pre and Post WAMZ formation. The convergence of these six countries reflects the co-movements of the member states during the entire period and how Nigeria took the lead from the beginning, given its large economy and bear market regime. The criteria set by WAMZ for achieving convergence has its origin in the traditional Optimum Currency Area (OCA) theory which opines that countries that are exposed to similar symmetric shocks, business cycles and asymmetric shocks find it optimal to adopt a common currency.

Frankel and Rose (1998) posit that the inter-relationships between these countries for potential OCA focuses on four factors:

1) The extent of trade
2) The similarity of the shocks and cycles
3) The degree of labour mobility
4) System of fiscal transfers.

These countries and the four inter-relationship criteria have a greater linkage with the need for common currency (Balogun, 2008). Although the primary and secondary criteria set up by WAMZ have been used as the criteria, these four factors are already encapsulated in the primary and secondary criteria. Meeting of the convergence criteria has not been consistent among member countries. Some of the countries met some of

the primary or secondary criteria earlier but fell short of meeting the same criteria ten years later due to inconsistencies, weak institutions, and poor leadership.

The prospect for macroeconomic convergence appears slim largely due to limited trade relations among WAMZ member countries and the Sub-Saharan African countries. Balogun (2008) assert that the low level of trade relations is caused using multiple inconvertible currencies within the zone, the narrow state of tradeable products in member countries, presence of tariff and non-tariff barriers to trade, multiple borders that exist among the countries, poor regional transportation infrastructure etc.

Regional integration through the monetary union is very important to stimulate trade relations. Ab initio, WAMZ was created to promote trade among member countries in addition to other reasons for WAMZ. Adoption of single currency agenda; implementation of ECOWAS Trade liberalization Scheme (ETLS) and adoption of a Common External Tariff (CET) can quickly drive us towards increased volume of trade and macroeconomic convergence. Efforts at macroeconomic stabilization have shown wide divergence among participants with large disproportionate weight given to Nigeria which now appears like an outlier in the proposed convergence club. The pursuit of optimal macroeconomic stabilization policy has resulted in negative spillover effects on the efforts towards convergence.

5.0: CONCLUSION

More broadly, this study considers the effects of different monetary and fiscal policies of the monetary union in West African Monetary Zone (WAMZ). Monetary union involves some costs and benefits for integrating countries following the real experience of European Monetary Union (EMU). An economic union promotes regional growth and

stability which is needed for economic convergence among member states. The monetary union formation involves having optimum currency area (OCA) and WAMZ following the experience of EMU has and the objective of ensuring rapid integration of the six economies of West African countries into a formidable monetary union. A strong monetary union requires the presence of intra-regional trade, adoption of a single currency for members and prospective members, high degree of mobility with the union, wage, and price flexibility etc.

Thus, utilizing data for a 63-year period spanning 1960 -2022, this study investigates the economic effects and reasons why economic convergence have not been achieved in WAMZ. This study draws evidence from six countries who are members of WAMZ namely: Ghana; Guinea; Nigeria; The Gambia; Sierra Leone and Liberia. Studies show that policy co-ordination in WAMZ has been weak in the last decade, but it appeared strong in the first 10 years between 2001 and 2011.

In all, three main results can be discerned from this study. First, for bilateral trade, even though a partner's exchange rate is important and positively influences the collective export of the two countries to the rest of the world, our results tend to validate our assertion that exchange rate does not matter as such in the intra WAMZ exports to warrant its use as an instrument of bilateral trade stimulation. However, it can be potentially useful as a common tool for balance of payment adjustment against the rest of the world. We can infer that the maintenance of an independent flexible exchange rate policy by either country in the bilateral trade makes no difference in export performance.

Second, monetary integration and success of monetary union have been stymied by lack of economic convergence. Lack of policy co-ordination and economic convergence have made it difficult to achieve monetary integration. Inflation and exchange rate issues have prevented convergence, especially given the vulnerability of WAMZ countries to external shocks and the experience of volatile inflation and exchange rates across the zone. The shocks emanating from COVID -19 pandemic have not been fully recovered.

Third, WAMZ member countries experience divergent real exchange rates prior to the creation of WAMZ in 2001. The real exchange rate post WAMZ shows an improvement in convergence among Nigeria, SierraLeone, Gambia and Liberia. This implies that there are high possibilities for the Central Banks of Nigeria, SierraLeone, The Gambia, Liberia to have unification albeit less harmonious movement at some points. The minimal convergence observed among four countries out of six implies that the journey is still long as some member states appear more convergent than others. Ghana and Sierraleone achieved convergence from their average growth. Also, we reveal an improvement when compared to pre- WAMZ statistics, which then suggests that the zone is moving in the right direction if they can execute more policies that will enhance integration.

For the success of the monetary union based on this study, we recommend the following:

1) Strengthening of fiscal, exchange rate and monetary policies performances to drive growth. It includes the integration of WAMZ countries, promote trade and inter country business collaboration by allowing visa free travels, and enforce

various regional agreements especially the ECOWAS trade liberalization scheme.

2) Adoption of common set of monetary, fiscal and exchange rate policies for dealing with regular external and internal shocks which are rife in the economy and expected to impact countries. Strong and effective coordination of fiscal and monetary policy to ensure exchange rate stability can support these buffers.
3) WAMZ member countries should ensure that fiscal integration should precede the introduction of the single currency (ECO) after satisfying the primary and secondary criteria needed for convergence.
4) The government of WAMZ countries should collaborate more and form currency union. This can foster trade interactions, policy harmonization and the removal of barriers to factor mobility. Massive investment in infrastructure is necessary to allow free movement of people and goods, hence increasing foreign investment which can quickly drive the currency union.

CHAPTER 2

EFFECTS OF EXTERNAL DEBT ON INFLATION IN WEST AFRICAN MONETARY ZONE (WAMZ)

ABSTRACT

The understanding of the rising public debt profile, lack of developed financial market which has exacerbated the effect on inflation, the sustainability of that debt and rising inflation in many Sub-Saharan Africa countries especially WAMZ member countries remain an important research agenda. This research examined the effect of external public debt on Inflation in West African Monetary Zone (WAMZ) using annual data during the period 1960 to 2022. The study selected the six member countries of WAMZ namely: The Gambia; Guinea; Nigeria; SierraLeone; Liberia; and Ghana; capturing the economic well-being, growth performance, external debt and rise in the inflation in the 63-year period. This study is unique because it examines three periods namely: pre WAMZ (1960 to 2000); during WAMZ (2001 to 2022); and the entire period (1960 to 2022), extends previous studies by using updated data and then show the long run positive effect of external public debt on Inflation in WAMZ. WAMZ showed different relationships and macroeconomic outcomes among the variables. The creation of WAMZ and the period during WAMZ changed some of the macroeconomic outcomes of the variables. The outcome for some of the variables in the tests and regressions differ in the three periods for the same variable. It employs NARDL approach to cointegration to examine whether external public debt has symmetric or asymmetric link with inflation in WAMZ countries. Furthermore, we use time series data to explain each country's economic effects and use panel data, regression, cointegration and employ fixed effect

to correct for endogeneity. Several tests such as Granger causality test, Random effect, unit root test etc. were performed to show how different variables affect inflation and external public debt. Our results show a positive and negative relationship between the variables and inflation. The cointegration test results reveal evidence of stable long run asymmetric relationship between public debt and Inflation. External public debt has a positive relationship with Inflation in the three periods examined. In terms of policy recommendation, the study suggests need for monetary policy and fiscal policy co-ordination between the Central Banks and Ministry of Finance; fiscal prudence, more production, and less borrowing; and intensify fight against corruption by strengthening political, financial and governance institutions.

Keywords : *Monetary policy, public debt, inflation, revenue, corruption, cointegration.*

1.0: INTRODUCTION

Developing countries including WAMZ member countries face the problem of high budget deficit and consequent savings -investment gap caused by mismanagement of resources, corruption, and embezzlement. The government of these countries burrow to increase welfare and stimulate growth especially through taxation, debt or seigniorage (Ngangnchi & Joefendeh, 2021). Nevertheless, the government has failed to productively utilize these burrowed funds and has resulted in an increase in external debt stock of the country and inflationary pressure (Kwon et al, 2006a; Sims, 2016). Enormous borrowings by these countries can result in debt repayment difficulties. Exchange rate fluctuations in the FOREX market largely determine the repayments of these debts and this increase in the cost of payment of this debt and this increase in cost of payment of the debt can be through inflation. This shows the effect of

inflation pressure due to exchange rate appreciation and public debt. (Philip and Oseni, 2012).

Further, the monetarist believes that inflation is a monetary phenomenon, and they argue in the short run, price level and real output increase due to expansionary monetary policy but in the long run, only price level may increase (Friedman, 1968). However, other researchers and studies posit that inflation is no longer a monetary phenomenon, but it is a fiscal policy problem. (Lin & Chu, 2013; Nastansky & Strohe, 2015). In WAMZ member countries and developing countries, high inflation, high debt stocks and poor economic performance are largely due to fiscal deficit (Islam & Wetzel, 1991).

The World Bank data for WAMZ member countries show that total external debt has been rising since 2011 and some countries including Nigeria are high risk of external and overall debt crisis because the value of the public debt to GDP ratio is now above the benchmark (Vivek et al, 2022). The increase in external debt have precipitated a continuous rise in inflation through increase in price and this high level of debt hinders the economies' ability to invest because their income is used in debt servicing causing a vicious cycle of debt and further exposing the country to exchange rate risk. Atique & Kamran (2012) posit that many poor countries become poorer after borrowing externally from World Bank, IMF, and Paris Club. The rising deficit financing worsens inflation and leads to political pressure (Veronique & Jack, 2022).

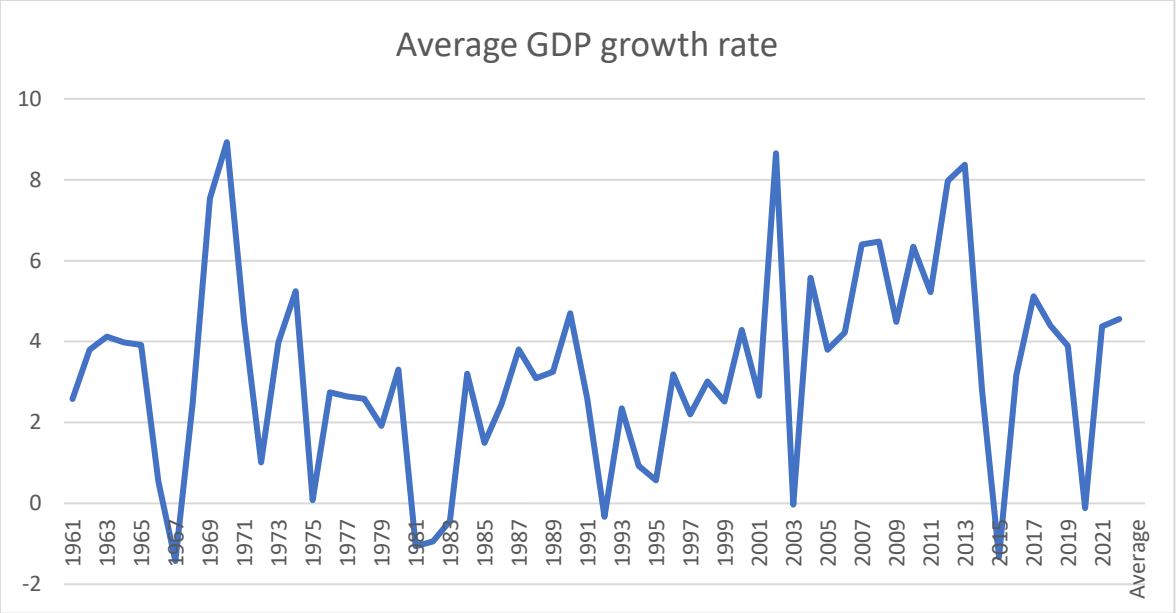
Further, excess debt affects interest rates which then crowds out private sector investments and then leads to lower productivity and small wages. External debt can exert nonlinear impacts on inflation in a situation where low debt level causes low

inflation while high debt level causes high inflation. Asymmetric relationships between external debt and inflation do not have many studies previously done and this study provides answers to questions on non-linearity in the inflation and external debt nexus. This study is germane because WAMZ members countries do not have stable inflation rates.

Research shows that debt financing is inevitable for many countries and debt overhang is problematic for Africa. Prichard et al (2021) opine that there are key drivers to debt build up. With increasing government expenditure relative to government revenue, the budget deficit increases which then requires government to burrow more. In attempt to reduce the increase in public debt, Governments in Africa are trying to use a contractionary fiscal policy and then improving the tax system efficiency to boost their revenue and reduce the budget deficit (Appiah-Kubi et al, 2021).

Boariu & Bilan (2007) opine that debt issuance exhibits low inflationary characteristics and suggest that the impact of public debt on inflation depends on how the deficit is financed and the level of public debt. The rise in fiscal deficit challenges and increase in public debt leads to increase in pressure to use monetization to finance the deficit. The excessive debt linked with economic uncertainty compels government to use financially repressive policies to control inflation and then seignorage to meet financial needs which then reduce government spending on interest paid (Mweni et al, 2016). Hence, this results in high spending, high inflation and adversely affects the conduct of monetary policy.

Research shows that high fiscal deficit with its economic effects is interrelated with inflation, capital formation, economic development, and income distribution.


Average GDP growth rate
10
8
6
4
2
0
-2
1961
1963
1965
1967
1969
1971
1973
1975
1977
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1981
1983
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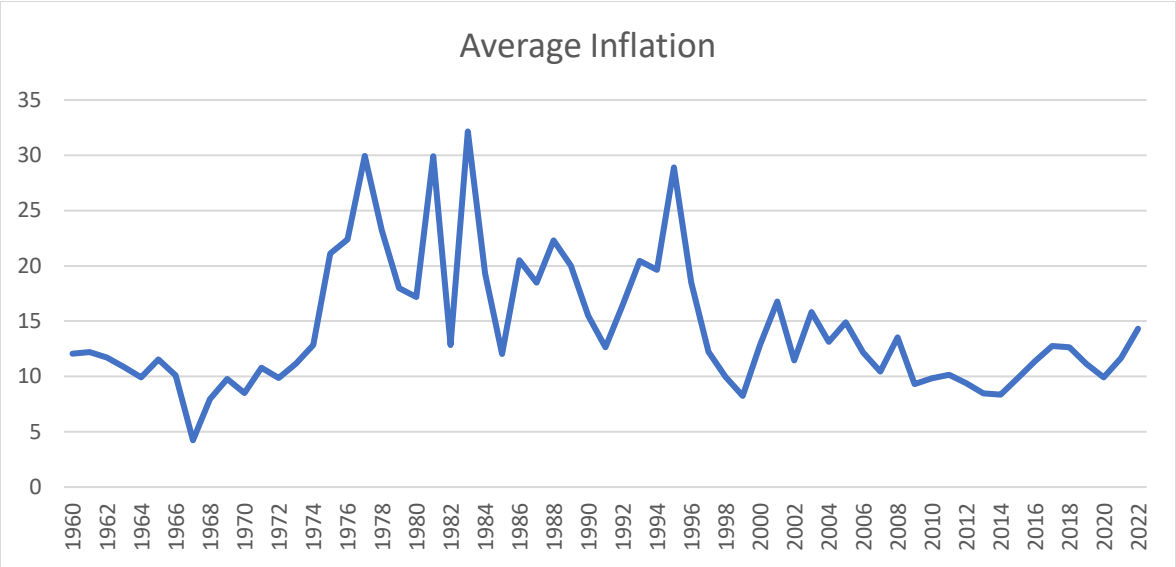
Average Inflation
35
30
25
20
15
10
5
0
1960
1962
1964
1966
1968
1970
1972
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1982
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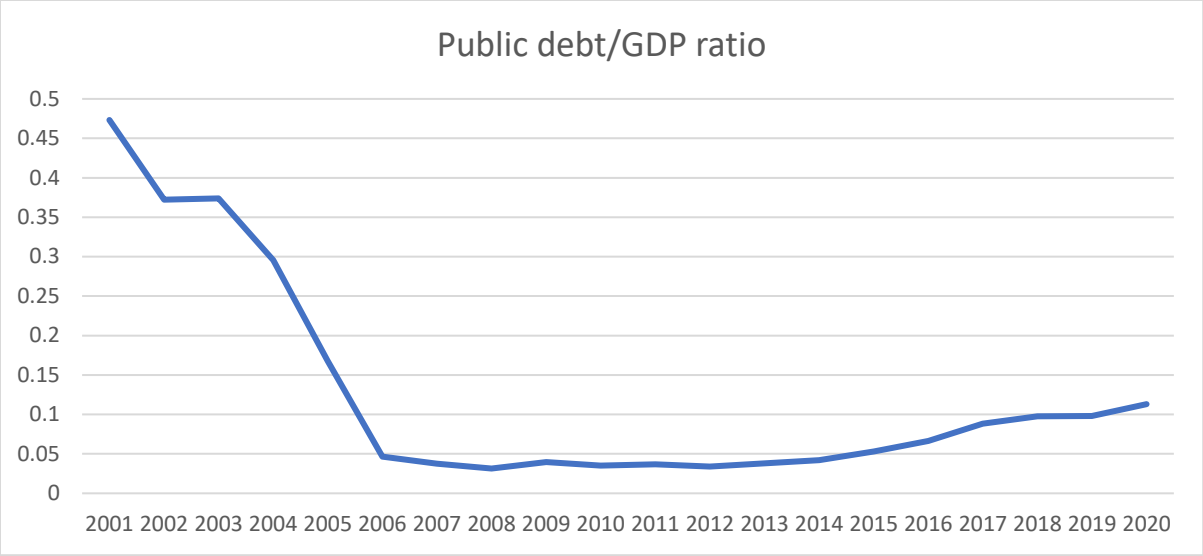


Research Problem

Monetary policy can be effective in controlling inflation by depending on co-ordination with fiscal policy and debt policy. Autonomy of the Central Bank can help accommodate prudent fiscal policies and curb inflation. Few studies that have examined the relationship between inflation and public debt for African countries posit that a significant gap still exist.

The main objective of this study is to assess the impact of public debt on inflation in the WAMZ member countries using Autoregressive Distributed Lag (ARDL) approach and other econometric methods.

External debt shows increasing and decreasing effects on inflation. The non-linear ARDL and the standard ARDL capture linear or symmetric relationship between variables but not non-linear or asymmetric linkage present (Shin et al, 2014).

The research question is:

What is the asymmetric relationship between public debt and inflation using non-linear autoregressive distribution lag (NARDL) technique? Is the dynamic relationship among the member countries symmetric or asymmetric?

Motivation for the Study

Nigeria and other WAMZ countries have been caught up in debt overhang, debt servicing, high borrowing, and excessive spending. Funding the government budget, expenditures, government institutions, profligacy etc. have been driven by debts, high debts accrued now will take many years to pay. In the last 10 years, there has been a high increase in population of citizens, increase in government expenditure, increased unemployment, reduced production, weak institutions, and massive corruption. The financial demand for the maintenance of government bureaucracy has increased. The government of WAMZ tends to borrow funds and loans from IMF, World bank and many institutions. These borrowed funds have increased and are largely used from consumption and not investment in infrastructural development which is the aim for the borrowing and what the governments tell its' creditors.

Also, the reasons for the excessive borrowings are lack of clear development plans for of the use and implementation of the borrowed money, funding large government bureaucracy, fall in revenue, excessive spending lifestyles of the political class and corruption. The absence of a well-developed financial market, lack of adequate production activities in the economy in the last 10 years, absence of regulatory and accountability structures of governance have accentuated the effect of debt on inflation.

The inflation in Nigeria and other WAMZ countries have been rising consistently in the last 10 years. The political class especially the President controls the Central Bank Governors because of the absence of the independence of the Central Bank in real terms. For example, in Nigeria, the Central Bank of Nigeria act 2007, clearly stipulates the independence of the Central Bank, but that law has not been followed in the last ten years because of the kinds of Presidents Nigeria has had and the kind incompetent persons appointed as Central bank Governors and Ministers of Finance. Further, the Governors of Central Banks have been taking orders from the President, in some cases reduced to cashiers of the government and have been printing money excessively. E.g the Governors of Central banks of Nigeria and Ghana have been printing money excessively at the behest of the President. The seignorage practiced by these WAMZ countries fuels inflation. The lack of investment and adequate infrastructural development to generate adequate revenue have been lacking. The government do not massively involve in production activities e.g manufacturing, agricultural production etc. Consequently, the absence of production activities has resulted in high unemployment, food insufficiency, protests, riots and many forms of social unrest.

Leadership failure from political leaders and incompetent people heading the Central banks and key financial institutions have exacerbated the economic crisis that is rife in the last 10 years in WAMZ. With the increasing youth population in WAMZ countries, there is a paradigm shift in the leadership expectations among citizens, but it is not met by the government.

Additionally, the WAMZ countries are endowed with many natural resources and minerals which should be used to create abundant wealth for the citizens, but they are marginally tapped and utilized. The leaders lack good creative thinking, lack skills, technology and capacity to process these minerals into finished products to be sold and exported for huge revenue inflow. E.g Nigeria and Ghana have huge gold deposits, bitumen and many minerals which have not been tapped and are underutilized in many cases. Funding is a problem for Governments, and they resort to borrowing and increasing the debt profile which contributes to inflation. Inflation is mainly cost push inflation and lack of adequate production makes prices of goods rise given the high demand. The rising inflation makes citizens poorer because it reduces disposable income and purchasing power.

The absence of accountability, lack of enforcement of laws to control the excessiveness of government powers, corruption, lack of production, inability to create wealth, political interference in Central bank etc. have driven increased borrowing and debt in these countries which have in turn contributed to high inflation.

The increased attention on the relationship between public debt and macroeconomic variables especially inflation since the global financial crisis of 2008 has risen and the recent increased borrowings by governments for funding budget deficits due to revenue shortfalls from the worldwide Coronavirus disease (COVID-19) macroeconomic fall out have attracted more attention to public and external debt. The central governments of Gambia, Nigeria and other WAMZ member countries have acquired large deficits and public debt due to revenue shortfalls and COVID -19 economic fallouts. The increasing trends in government indebtedness for the funding of

fiscal deficit are raising concerns among citizens and policy makers. Following the COVID -19 pandemic, a good understanding of the macroeconomic effects of public debt on inflation and the nature of the link between public debt and inflation in WAMZ cannot be overemphasized (Aimola and Odhiambo, 2022). A low and stable inflation rate will increase real return on investment which then enables economic players to respond to various investment opportunities and open opportunities for new and existing investors for the promotion of economic growth in WAMZ. But the budget deficit has been largely financed through borrowing aimed at promoting economic growth. Hence, the relationship between public debt and inflation in WAMZ is important because COVID -19 pandemic has increased government indebtedness in the act of funding budget deficit.

Further, from a theoretical perspective, the Fiscal Theory of Price level (FTPL) determination within the non-Ricardian environment holds that price level is induced by public debt with monetary policy playing an indirect role (Woodford, 1995; 1998). The rise in government debt adds to household wealth which leads to demand for goods and services and then price pressures. Nastansky and Strohe (2015) posit that debt financed government expenditure would arouse macroeconomic demand in the short run and then increase pressure on inflation in the medium or long term.

Studies by Musgrave (1949); Phelps (1973) acknowledge the relationship between government borrowings and inflation especially in developing countries. Also, Lopes des Veiga et al (2016); Aimola and Odhiambo (2021b) argue that public debt largely influences inflation rate in developing countries where the financial market is relatively developed. Nevertheless, the relationship between variables of public debt and inflation

might be asymmetric or non-linear. While some studies such as Lopes de Veiga et al (2016) suggest that the relationship between public debt and inflation is non-linear or asymmetric and Reinhart and Rogoff (2010) show positive relationship between inflation and public debt, there are studies such as (Wheeler, 1999; Taghavi, 2000) which corroborate a negative relationship.

The assumption of a symmetric relationship between public debt and inflation, especially in developing countries, has been questioned due to significant reduction in public debt to GDP ratio after external public debt relief. For Gambia and some WAMZ countries, the situation appears to support an asymmetric relationship between public debt and inflation. Aimola and Odhiambo (2022) suggest that Data on both public debt and inflation rate portray features of asymmetric structure in the trends. This study on the asymmetric relationship between public debt and inflation for WAMZ member countries requires more work done on that and filling the gap by examining the dynamic relationship between public debt and inflation to corroborate whether it is symmetrical or asymmetric.

Additionally, time series data were used in these studies but did not make any attempt to address the issue of structural breaks especially as Ghana economic history registered structural changes over time and all the WAMZ member countries experienced structural changes during the Structural Adjustment Program (SAP) in the 1980s and early 1990s. “If long-term debt is outstanding, the government can smooth inflation by occasionally and unexpectedly devaluing long-term bonds, trading a lower price level today for a higher price level in the future. This action can smooth inflation after a shock has hit” (Cochrane, 2001). Increasing sales of long-term debt can lower

the price level today and then raise the price in future when some of the long-term debt is outstanding and there are no changes in surpluses. Dupor (2000) opine that debt policy affects price level and the policies optimally smooth inflation. The optimal fixed - debt policy and active debt policy are used by government to adjust level of debt of various maturities to enable it offset surplus shocks. On the one hand, a short maturity structure smooths inflation if surpluses have a large transitory component while on the other hand, a long maturity structure will smooth inflation when surpluses build after a shock.

Furthermore, the impact of public debt on inflation depends on how the deficit is financed and the level of public debt. The effect of budget deficit on inflation is important for developing countries including WAMZ because the rise in budget deficit in recent years has resulted in a rapid increase in the public debt to GDP ratio (Eita et al, 2019). The overall fiscal balance for WAMZ member countries has average -6.0 percent of GDP between 2013/14 and 2017/18 reached its peak at -8.0percent of GDP in 2015/16 according to WDI data base. In some WAMZ member countries, the fiscal deficit has widened further particularly from 2009/10 to 2019/20 fiscal year. The widening fiscal deficit has led to government cutting cost under the consolidation initiative since late 2016 which has caused a negative impact on growth of the economy in the short term. Hence, the government is faced with the challenge of generating enough resources to finance government expenditure which has led to rising public debt and raised macroeconomic instability concerns.

Contributions of the Study

Copious literature tends to suggest that the impact of contribution of public debt on inflation depends on level of public debt and how deficit is financed. The contribution of debt issuance largely depends on whether the deficit is financed through domestic or external debt. (Ahmad, Sheikh and Tariq, 2012). The rise of fiscal deficit and public debt increase puts pressure on the use of monetization to finance deficit.

Further, the act of stabilizing price levels plays an important role in determining the growth of an economy. Hence, monetary authorities in many countries implement monetary policies to control and contain inflation. (Radukic, Markovic & Radovic, 2015). High fiscal deficits exert economic effects which are interrelated in numerous ways with inflation, capital formation, income distribution and economic development.

For WAMZ countries and developing economies, the understanding of the relationship between fiscal and monetary policy is important particularly since monetary policy faces some restriction from the exchange rate regime.

Aimola and Odhiambo (2018) assert that the effectiveness of monetary policy in controlling inflation largely depends on co-ordination with fiscal policy. This suggests that the fiscal authority can influence inflation irrespective of monetary policy. From 1983 to 2018, data show that Ghana recorded high inflation rate and exceeded 25 percent (Bank of Ghana, 2019). According to Masson, Savastano, and Sharma (1997), a country would be unable to rely on monetary policy only when the theory of monetary policy is to target or achieve stable and reduced inflation. The relationship between public debt and inflation is very important in countries such as Ghana and such changes in a country such as Ghana can change its base.

Studies by Burhanuddin et al (2017), public debt plays an essential role in every economy. Public debt as a means of finance helps countries to finance their public expenditures which enhances social welfare and boosts economic growth and development through capital accumulation.

Moreover, developing countries who experience the constraint of insufficient stock of capital can get capital to commence investment opportunities that on board would not have been possible (Cooray et al, 2017). Belguith and Omrane (2017) assert that public debt plays an important role in promoting financial safety and stabilizing the financial sector. And fiscal authorities are important in stimulating and propelling economic growth by stabilizing the economy.

2.0: LITERATURE REVIEW

Inflation, Public Debt and Economic Growth in WAMZ

Low inflation is required to propel economic growth in the West African Monetary Zone (WAMZ). At the formation of WAMZ in 2001, Single digit inflation was and remains one of the primary convergence criteria required among member countries. Attaining the single digit inflation consistently for these member countries has been elusive. These WAMZ countries have been challenged by internal country specific economic difficulties, external shocks like hikes in oil prices, exchange rate depreciation, negative terms of trade e.tc which have worsened inflationary pressure. Additionally, inflation has been an issue in the WAMZ member countries in recent decades as it hovered around single, double, and triple digits. In the last 22years, inflation averaged 12 percent for the average in the WAMZ countries. Among the countries individually, Ghana had the highest rate of inflation. Data shows that between 1983 and 2018, Ghana recorded

many experiences of high inflation rate above 25 percent which suggest that it was unable to rely on monetary policy alone for stable and reduced inflation rate (Masson et al, 1997; Bank of Ghana, 2019).

Many African countries experienced high inflation in the 1980s and 1990s with Ghana having all-time high inflation of 122.8 percent in 1983 and as low as 7.13 percent in 2012 according to the World Bank development Indicator (WDI). The very high inflation in the 1980s was largely due to excessive demand pressures because of the government's expansionary fiscal operations (Sowa, 1991). Fall in inflation can be attributed to Implementation of the Economic Recovery Programme (ERP) which focused on reducing budget deficit and reliance on bank financing of the budget deficit. (Sowa, 1991). Adom et al, (2015) opined that the high rate of inflation reflects demand pressures driven largely by fiscal expansion, money growth and weak economic growth. In all, the major changes in inflation in WAMZ member countries in 1980s, 1990s, 2000s etc. can be attributed to excess domestic demand generated by expansionary fiscal and monetary policies of government.

In The Gambia, the economy in 1980s was marred by adverse external and internal shocks, declining economic activities, and rising inflation. Even though the Structural Adjustment Programme introduced in 1986 was aimed at reversing the economic downturn of the early 1980s and improving macroeconomic environment, the real GDP remained low. Tarawalie and Ahortor (2012) opine that the decline was due to slower growth in agricultural output, tourism and military coup of 1994 which largely disrupted economic activities in the tourism sector. In Ghana, the economy experienced sluggish macroeconomic performance in the 1980s, high inflation and declining growth.

The Economic recovery programme (ERP) which was adopted in the early 1980 did minimize both external and internal imbalances and then positioned the economy on a path of sustainable growth. Between 1990 and 2004, Inflation remained high averaging above 20.0 percent, largely driven by demand pressure and sustained by excessive fiscal expansion and accommodating monetary growth.

Further, in Guinea, inflation was also high in the 1980s and was attributed largely to increased money growth used in financing government fiscal deficit, energy crisis and persistent depreciation of Guinea franc. The monetary and fiscal reforms of the 1990s paved the way for a reduction in inflation and increased agricultural output. In the 2000s, Guinea witnessed another rise in inflation as average inflation increased from 11.8 percent in 2000 – 2004 up to 22.8 percent between 2005 – 2008 driven largely by increase in non-food prices, exchange rate depreciation and increased money growth. The economy witnessed growth in the 2000s driven by increased economic activities in mining, agricultural and service sectors.

In Liberia, the 1980s and 1990s, the economy was characterized by high inflation and negative real GDP growth. The first civil war largely deteriorated the economy and real GDP growth declined from 2.5 percent in 1980 -1984 to -6.4percent in 1985 -89 (Tarawalie and Ahortor, 2012). Between 1995 – 2004, the country enjoyed growth driven by economic resuscitation and relative peace experienced after the civil war. Unfortunately, a second civil war (1999 – 2003) obliterated the economic gains experienced and plunged the country back into quagmire. After the civil war, the economy returned to the path of growth but experienced a low trajectory of growth.

In Nigeria, the 1980s witnessed high inflation and downturns in the Nigerian Economy. The spike in inflation experienced in the 1980s was largely due to the collapse of the world oil market, import restrictions, and foreign exchange constraints. In the 1990s, Nigeria also witnessed high inflation caused by excess money supply, severe shortage in commodity supply and labor and political unrest. In the 1980s, the economic growth was negative, increased to about 5.7 percent in the late 1980s following the Structural Adjustment Program (SAP). Real GDP growth remained positive from 1985 to 2020.

In Sierra Leone, the economy also witnessed high inflation in the 1980s and 1990s. The inflation rate accelerated from an average of 39.7 percent between 1980 and 1984 to an average of 86.2 percent between 1985 to 1989. The spike in inflation was largely caused by monetization of government fiscal deficit, removal of fuel subsidy following the adoption of SAP and depreciation of the Leone. Inflation witnessed a decline in the 1990s driven by a fall in local demand for factories and business products. The end of the civil war in 2002 was ensued by relative peace and stability which led to a decline in average inflation after 2004, increased business and consumer confidence.

Inflation and Economic Relations

Alhassan, Sare and Ibrahim (2019) examined the threshold impact of Inflation. They discovered that the amount of broad money supply is a mediating factor in inflation-growth nexus. Their research acknowledges that inflation hinders economic growth, and it becomes substantially more severe when the broad money supply exceeds 21.57% of GDP. Joseph and Eric (2010) conducted research using threshold regression model to estimate inflation threshold, this study investigated the threshold

effect of inflation in Ghana for the period 1960 – 2008. The study reveals proof of an inflationary threshold effect on Ghana's economic expansion.

Further, Akosah (2013) analyze the dynamic relationship that exist between inflation and financial development in Ghana using time series data for the period 1964 to 2012. The study emphasized on whether causality between two variables varies in the short and long term. The article discovers a bidirectional negative link between the two variables in the short run, while the long run econometric analysis shows a unidirectional negative impact of inflation on financial development.

Also, Shitundu and Luvanda (2000) utilized the Least Trimmed Squares (LTS) approach to examine how Tanzania's inflation affects economic growth. Their empirical findings reveal that Tanzania economic growth has been harmed by inflation. Hence, Bawa and Abdullahi (2012) investigates the inflation threshold for Nigeria using quarterly time series data for 1981 through 2009. Their analysis reveal that Nigeria should have inflation not higher than 13%. However, this does not correspond with reality in Nigeria as Inflation stood at 27% in October,2023.

They assert that inflation has a minimal impact on the economic activity that happens below the threshold level but has a significant negative impact on growth when it rises above the threshold level.

The inflation in Nigeria has been rising steadily since 2021 largely driven by increasing debt, low production, rising food prices and macroeconomic instability.

Debt

Governments of most developing countries including WAMZ rely on borrowing to bridge the gap in financing, they borrow either internally or externally. Public debt is the

outcome of burrowing. Burhanuddin et al (2017) opine that public debt is important in an economy because it's a means of finance for public expenditure, used to improve social welfare capital accumulation. An increase in public investment leads to an increase in government expenditure and then an increase in public debt, and this can promote economic growth and development. Belguith and Omrane (2017) assert that public debt can provide access capital constraint, promote financial safety by stabilizing the financial sector and stimulate growth. Debt overhang occurs when countries are involved in overborrowing and imprudent allocation of the borrowed funds. Several studies have attempted to determine the debt threshold for African countries including WAMZ. Researchers have come up with different debt thresholds and attempt to go beyond that can hinder economic growth. For African countries, Mensah et al (2019) suggest 50 -80percent of GDP while Ndoricimpa (2020) opines a range of 58 -63 percent of GDP and African Monetary Co-operation Program (AMCP) suggest 60 percent of GDP.

Theoretical Review

Inflation has long been considered a monetary phenomenon. Friedman (1968) lend credence to this fact when he asserted that an expansionary monetary policy would increase both real output and general price level in short run and then only the long run in the price level. However, recent literature posits that inflation is not only a monetary phenomenon but also a fiscal concern especially as fiscal variables influence price stability. Studies by Sargent and Wallace (19810, Leeper (1991) and Woodford (1994, 1996, 2001) assert that fiscal and monetary policy interaction is necessary for establishing links between public debt and inflation. Consequently, the control of

inflationary pressure in an economy does not solely depend on the control of money supply.

The Fiscal Theory of Price Level (FTPL) closely looks at the nexus that exist among fiscal policy, public debt, inflation, and money supply and then explain that inflation is not only influenced by money supply but also by fiscal deficit and the debt (Farmer & Zabczyk, 2019). The theory suggests that if the government has an unsustainable fiscal policy, then the best option to pay off is by inflating the debt away and price level is determined by government debt. FTPL is germane in developing countries including WAMZ because they tend to lack the fiscal capacity to mobilize revenue, and this gives rise to interest rates, higher taxes, and inflation.

The Fiscal Theory of Price level (FTPL) is embedded in the non-Ricardian policy and tends to have particular relevance for developing economies and WAMZ countries because they provide domestic currency debt and largely lack the fiscal capacity to mobilize the real tax revenues which leads to active fiscal authority while the concerns for capital flows show that monetary policy tends to be passive (Beck-Friis and Willems, 2017). Given the presence of large public debt among developing countries, Blanchard (2004) and Favero and Giavazzi (2004) opine that an increase in interest rate in an economy with large public debt which aims at controlling inflation within the target range is likely to increase the cost of debt service, debt level, default probability and country premium, which can spark capital outflows and then exchange rate depreciation that subsequently affect inflation expectations and then inflation itself. Thus, Woodford (1995, 1998) opines that the source of change in price level can be explained by FTPL

by using the positive wealth effect of government debt policy on private consumption demand or increase private spending.

Branson (1989), Elmendorf and Mankiw (1999) and Wickens (2008) assert that expansionary fiscal policy in the Keynesian view or increased level of debt or reduction in tax rates affect aggregate demand in the short run by increasing disposable income and propagating positive wealth effects which leads to price level pressures. Sargent and Wallace (1981) Leeper (1991) and Woodford (1994, 1996, 2001) have also portray the assertion that fiscal and monetary policy interaction is necessary in establishing relationship between public debt and inflation. Thus, the control of inflationary pressures in an economy does not solely depend on the control of money supply.

Overall, the relationship between public debt and inflation can either be direct or indirect (Nastansky and Strohe (2015). The relationship is considered direct when the Central bank buys public bonds and considered indirect relationship when the demand for public bonds is made by the private sector. It can also be considered indirect thorough the banking sector's demand for public bonds and through inflation expectations of the economic agents a result of high level of public debt.

Empirical Review

Empirical literature for the study portrays the negative and positive impact of public debt on inflation. Initial works by Musgrave (1949) and Phelps (1973) began the debate on the relationship between public debt and inflation. Even though the study emphasized on the contribution of domestic public debt policy to economic stability and checking inflation, Musgrave asserted that during some periods, private holders of government securities strived to liquidate all, or major portion of their portfolios and the

volume of bank credit would expand quickly if the fiscal authorities were the only buyers. Sargent and Wallace (1981) stands out as one of the most referenced empirical work on the study of government debt and inflation process, they used the framework of Phelps (1973) on public finance approach to inflation to examine the relationship among debt management, monetary policy and inflation. Sargent and Wallace's Unpleasant Monetarist Arithmetic framework showed that it is possible for fiscal authority to affect the level of prices despite the Ricardian policies. They further asserted that with active fiscal and passive monetary policy, monetary policy would react by setting growth rate of money to generate the money seigniorage relevant to satisfy government budget constraint. This is antithetical to the monetarist view that only monetary aggregates drive inflations if fiscal authority exerts dominance through expansionary fiscal policy. Sargent and Wallace (1981) and Walsh (2010) have posited that whether government debt is ultimately paid for by printing more money or taxes, it is necessary in the monetary policy process.

Nguyen (2015) applied PMG estimation and different GMM to investigate the effect of public debt on inflation in 15 less developed Asia countries for 22years. The study reveals that public debt has positive and significant effect on inflation for GMM estimates while PMG estimation reveal that public debt is deflationary in the short run, but inflationary in the long run. Similarly, Heba (2021) found that external debt raises prices both in the short and long run in Egypt. His discoveries are consistent with the findings of Aisen & Veiga (2006) and they conclude that external finance deficit increases inflation and interest rates. Ekinci (2016) utilizes simple linear regression and then conclude that a strong positive nexus is present between consumer price index

and external debt in Turkey from 2003 to 2015. In the same vein, Mweni et al (2016) show that rising inflation rate increases the level of external debt in Kenya using OLS from 1972 to 2012. Their discoveries are contrary to that of Assibey-Yeboah & Mohsin (2004) who reveal that external debt decreases when the inflation rate increases. Helmy (2021) utilizes Egypt as a case study and assert that in the short run and long run, external debt worsens inflation. Boshra (2023) shows that in the short and long run, inflation displays a decreasing impact on external debt. Gathendu (2021) utilizes the VECM in Kenya, Uganda and Tanzania for 30 years and discover that external debt has positive effect on inflation in the long run. He further posits a unidirectional relationship between both inflation and external debt. Lopes Da Veiga et al (2016) using 52 African countries from 1950 to 2012 discover a positive link between high levels of public debt and inflation. The discoveries are consistent with that of Afonso & Ibraimo (2018) who revealed a positive link between public debt and inflation in Mozambique using VAR. These discoveries are in consonance with that of Lopes Da Veiga et al (2016) who further affirm that developing countries that have high public debt experience a high rate of inflation.

Kwon et al (2006) assert that rising public debt exacerbates inflation for indebted developing countries, but it partially leads to inflation for non-indebted developing countries but absent in developed countries. Sunder-Plassman (2020) examines the link between sovereign debt, default, and inflation. The results show that increasing nominal foreign debt leads to inflation tendencies. Additionally, Aimola & Odhiambo (2022) utilizing NARDL for 41 years, assert that the total public debt and inflation have asymmetric relationship in the Gambia.

Further, studies by Cardoso and Fishlow (1990), Leeper (1991) Janssen, Nolan and Thomas (2002), Bildric and Ersin (2007), Kwon, McFarlene and Robinson (2006) Karakaplan (2009) Reinhart and Rogoff (2010), Faraglia et al (2012), Ahmad Sheikh and Tariq (2012) deVeiga Ferreira-Lopez A and Sequeira (2016), Ezirim, Amuzie and Mojekwu (2014) Ngerebo (2014 made known a positive impact of public debt on inflation. On the other hand, a smaller number of studies have shown that public debt has a negative impact on inflation. Such studies include Wheeler (1999), Taghavi (2000) , Karakaplan (2009) Reinhart and Rogoff (2010), Castro Resende and Ruge-Murcia (2003), Ezirim, Amuzie and Mojekwu (2014) et.c. Based on the survey of copious literature for this study and relationship between public debt and inflation differs according to countries, sample periods and method of estimation.

3.0: METHODOLOGY

Studies posit that when a high budget deficit is persistently experienced, the results lead to an increase in price levels in the economy which consequently affect the effectiveness of monetary policy transmission to all aspects of the economy. Boariu &Bilan (2007) discovered that debt financing of budget deficit causes inflation and their results show that developing economies have high inflation largely caused by high budget deficit.

The study of the effect of debt level on inflation uses data from World bank WDI, Organization for Economic Co-operation Development (OECD) and West African Monetary Institute (WAMI) database for the period 1960 – 2022. The reason for testing the hypotheses with selected variables is to show the government's high dependency on external debt, especially in recent decades with the result of having few jobs created

for the people. The ordinary least square was used to assess the causal relationship between variables, especially public debt on the inflation and overall well-being of the people of WAMZ.

Theoretical Model

The Quantity Theory of Money (QTM) provides the basis for the view of how fiscal policy influence monetary policy through its effects on price level. Baldini & Ribeiro (2008) posit that fiscal deficit cause inflation because many governments overtime run persistent fiscal deficit and tend to embark on money creation to finance the deficit (Seigniorage). If deficit is financed through monetization, then the assertion that fiscal deficit and debt financing lead to inflation appears settled.

Additionally, Monetarism insists that controlling money supply is the way to control inflation. Monetarists assert that inflation is always a monetary phenomenon, increasing money supply provided a temporary expansion in economic growth, job creation and boost economic growth in the short run and raise inflation in the long run. The monetarist always believes that the effect of budget deficit financing on inflation will always be positive. When the budget deficit financing increases, the money creation or money supply also increases especially through borrowing, then we have higher inflation.

Keynesians and Monetarists have different views on the role of budget deficit. The Keynesian view posits that budget deficits are inflationary, and they stimulate aggregate demand while monetarists opine that budget deficits are inflationary, and they cause money supply growth in the economy. “Literature generally believes that deficit

financing mechanisms play a major role in determining the theoretical divergence" Eita et al (2019).

Theoretical model of Solomon & de Wet (2004) is used to estimate the effect of budget deficit on inflation and the model starts with budget constraint for the government in the long run. The paper which investigates the deficit-inflation relationship for Tanzania economy concludes that a causal link runs from budget deficit to the inflation rate using cointegration analysis for a 35-year period 1967 -2001. The paper uses dynamic simulations and asserts that due to monetization of the budget deficit, there is significant inflationary pressure that explains the increase in budget deficit. This is:

$$D_{t-1}/P_t = \Sigma X_{t+j}/(1+ij)^1(Tax_{t+j} - GE_{t+j} + (M_{t+j} - MS_{t-1-j}/P_{t+j})] / (1 + i_j)^j \text{.....(1)}$$

$j = 1$

Where :

D_{t-1}/P_t : Government debt

X_{t+j} : strong revenue

Tax_{t-j} : Total tax revenue

GE_{t+j} : Total government expenditure

MS_t : Broad money supply

Solomon & de Wet (2004) opine that a scenario where public debt cannot grow, then the entire budget deficit is financed through seigniorage. In many African countries, including WAMZ countries, the Federal government uses seigniorage to finance its budget deficit and some other expenditure. The fiscal recklessness through excessive printing of money by the Central Banks to please the Federal Government is largely

caused by the lack of real independence of the Central Banks of WAMZ. Example, in Nigeria, seigniorage have been used a lot in the last five years and it has contributed to a spike in inflation and debt level experienced leading to economic downturn.

On the contrary, if restrictions are imposed on public debt, then the short run budget constraint

$$D_{t-1}(t)/P_t = Tax_t - GE_t + ((MS_t - MS_{t-1})/P_t) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(2)$$

D(t) : the debt with the maturity in period t that has to be paid and not rolled over. Then it becomes

$$D_{t-1}(t)/P_t - Tax - GE_t = (MS_t - MS_{t-1})/P_t) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(3)$$

The left hand side term of eqn (3) explains the budget deficit formed from the fiscal deficit and repayment of public debt in period t while the term on the right hand side is seigniorage revenue.

Seigniorage is expressed as a function of inflation rate and real money supply.

$$SEIN = f(INF_t)\, MS_{t-1}/P_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(4)$$

Expectedly, the seigniorage revenue increases when inflation increases, then the combination of eqn (3) and eqn (4) will give us budget deficit and money supply that explain inflation rate.

$$INF = \beta DEF_t P_t/MS_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(5)$$

β= the inverse linear multiplier

DEF_t = budget deficit

where $DEF_t = GE_t - Tax_t - D_{t-1}$

M/p = real money supply

This model works in WAMZ largely because seigniorage is practiced and there is no real independence of Central Bank. Since the Covid -19 pandemic, the economy of the WAMZ countries have applied seigniorage more than previous years and this has raised the inflation and debt levels.

Data Source:

The data used for this study is secondary data obtained from the World Development Indicators data base of the World Bank and IMF data base. We will utilize panel data for the six member countries of Ghana, The Gambia, Sierra Leone, Liberia, Guinea, and Nigeria. Our sample size of 63-year period was largely due to available, reliable, and credible information from the period 1960 – 2022. Time series data will also be used for the same period. The choice of the data and variables were largely influenced by several other empirical studies. The data covers the main variables of interest namely: Inflation and Public debt. Also, other control variables data such as Broad money for money supply, real GDP per capita for economic growth, Gross fixed capital formation for private investment, and trade openness.

The Model

The model captures the pre-WAMZ, during WAMZ and the entire period. The model will enable us to see the qualitative changes in dynamics during the WAMZ period vs pre- WAMZ period. The model will enable us to ascertain if the WAMZ period of 2000 to 2022 portrayed asymmetric or symmetric effect of external debt on inflation. The choice of variables for the model builds on the variables from Solomon & de Wet (2004) and Aimola and Odhiambo (2022)

The model is specified as:

$INF = f(PD, MS, GDPC, GFCF, TOP)$

$INF_{it} = \alpha + \beta_1 PD_{it} + \beta_2 MS_{it} + \beta_3 GDPC_{it} + \beta_4 GFCF_{it} + \beta_5 TOP_{it} + \delta_t + \alpha_i + \mu_{it}$

Where: INF = inflation PD = External Public debt

GDPC = economic growth proxy for real gross domestic product per capita

MS = Broad money supply as a % of GDP

GFCF = private investment proxy for Gross fixed capital formation (% of the GDP)

TOP = trade openness measured as the sum of export and import divided by GDP or % of GDP

δ_t=time fixed effect

α_i= country fixed effect

μ_{it} = error term

Using timeseries to explain the model for each country,

For Ghana

$$INF_t = \alpha + \beta_1 PD_t + \beta_2 MS_t + \beta_3 GDPC_t + \beta_4 GFCF_t + \beta_5 TOP_t + \mu_t$$

For Guinea

$$INF_t = \alpha + \beta_1 PD_t + \beta_2 MS_t + \beta_3 GDPC_t + \beta_4 GFCF_t + \beta_5 TOP_t + \mu_t$$

For The Gambia

$$INF_t = \alpha + \beta_1 PD_t + \beta_2 MS_t + \beta_3 GDPC_t + \beta_4 GFCF_t + \beta_5 TOP_t + \mu_t$$

For Sierra Leone

$$INF_t = \alpha + \beta_1 PD_t + \beta_2 MS_t + \beta_3 GDPC_t + \beta_4 GFCF_t + \beta_5 TOP_t + \mu_t$$

For Nigeria

$$INF_t = \alpha + \beta_1 PD_t + \beta_2 MS_t + \beta_3 GDPC_t + \beta_4 GFCF_t + \beta_5 TOP_t + \mu_t$$

For Liberia

$$INF_t = \alpha + \beta_1 PD_t + \beta_2 MS_t + \beta_3 GDPC_t + \beta_4 GFCF_t + \beta_5 TOP_t + \mu_t$$

For Ghana

$$INF_t = \alpha + \beta_1 PD_t + \beta_2 MS_t + \beta_3 GDPC_t + \beta_4 GFCF_t + \beta_5 TOP_t + \mu_t$$

The model will explain how the debt level affects inflation and how other variables drive inflation in WAMZ. All the variables chosen will capture individual effect and contributions to what influences the rising inflation in the WAMZ. The endogenous variable is Inflation while the explanatory variables are external Public debt, money supply, Gross real GDP per capita, Gross fixed capital formation and Trade openness.

H_0: External public debt has NO effect on Inflation.

H_1: External public debt has effect on Inflation.

Inflation: Inflation is the dependent variable, and it is measured by the Consumer Price Index. The rise in public debt increases the expectation of higher rates of inflation and the erosion of confidence in the currency of the WAMZ countries. Inflation has consequences on external debt especially distorting standard statistical measures of current account, balance of payment, interest payment and debt service payment. Baumgartner et al (1981) opine that the effect of inflation on external debt depends on whether foreign borrowing is subject to fixed or floating interest rate and the extent to which inflation is expected. The extent to which inflation is expected tends to influence the extent to which actual inflation is reflected in the movement of the nominal interest rate. Also, the five variables have different effects on inflation for the 63-year period. In addition to the variables driving inflation, Inflation can arise due to increase in

production cost such as raw materials and wages, spike in demand for products and services.

External Public Debt: Public Debt tells us the amounts owed by the different levels of government which are used to finance public deficits that emanate from higher spending above the budgeted income. The theoretical model shows how external debt determines the budget deficit and affects the deficit-inflation relationship. Aimola and Odhiambo (2022) show how inflation affects external debt. Public debt largely influences inflation because it drives up the price. The real debt burden of the debtor is reduced by unanticipated inflation when it lowers the real value of interest and amortization payment. The effect is transmitted through interest rates which rise due to inflation, then the net interest rate rise increases the annual deficit which then increases the public debt. In WAMZ countries and emerging market economies in general, debt raises long term inflation expectations in a persistent way, but this is not so in advanced economies. The weaker financial markets and monetary policy frameworks in WAMZ make the increased debt levels a strong driver of high inflation. Hence, this variable is important in the model.

Money Supply: Money supply variable helps us to explain The Quantity Theory of Money in the theoretical framework. In the theoretical model of Solomon & de Wet (2004), money supply was also used to explain the effect on budget deficit and Government debt. The variable of broad money provides the data used to capture money supply in our model. Money supply causes inflation when the money supply increases at a faster rate than the ability of the economy to produce goods and services. Lax monetary policy can lead to high inflation. The lax monetary policy can

make the money supply grow so big relative to the size of the economy which leads to a reduction in the unit value of the currency. Hence, there is a fall in purchasing power and rise in price. Given the importance of money supply in explaining inflation, the variable is important in the model.

Real GDP per capita: This variable is a measure of economic growth in WAMZ. It captures the well-being of the people. Aimola and Odhiambo (2022) use a per capita GDP to measure the economic growth, but we use the real GDP per capita because the real GDP takes inflation into account, and it influences the value of the GDP per capita. The real GDP per capita measures the actual growth of production without any distorting effects from inflation per person in the population. The real GDP per capita does not easily change and the change in the inflation cannot necessarily bring change in the per capita income of the country. The real GDP per capita is important in this model because the real GDP is always adjusted for inflation.

Gross Fixed Capital Formation (Private investment): Gross fixed capita formation is a proxy for private investment, and it tells us about resident producers' investment, deducting disposal in fixed asset for a given period and this leads to more money swirling around the economy. If prices of goods are expected to rise (inflation), a different mix of investment will ensue. Aimola and Odhiambo (2022) use Gross fixed Capita formation to explain private investment in their model. This variable is important because it explains how investors will allocate their private investment to different investment resources. Gross fixed capita formation is important in the model because a rise in prices of investment can be due to inflation. Inflation exerts pressure in distribution of Physical assets which investors seek to acquire with their available funds

especially the influence in the making of investment in long term projects with long gestation period.

Trade Openness: Trade openness has an important effect on inflation because it reduces inflation and encourages competition in the domestic market and reduces the firm's pricing power. Trade openness is calculated by export plus import divided by the GDP. Baumgartner et al (1981) assert that the rise in the volume of exports of goods and services limited the growth in real debt service and that many developing countries' exports of goods and services were pre-empted by principal and interest charges on their outstanding debt. Stronger competition in the market can make monetary policy more prudent and less inflationary. In low-income countries including WAMZ countries, trade openness has a negative and significant effect on financial development, capital accumulation and economic growth. Trade and trade openness can be affected by inflation when goods produced in the country become more expensive because of rise in price and cost in any country, then the goods become more expensive than similar goods produced abroad.

Trade openness is an important variable in this model because it helps us see the effect on trade, the expansion in domestic output, and the relationship between inflation and the imports/exports.

Research question:

What is the asymmetric relationship between public debt and inflation using non-linear autoregressive distribution lag (NARDL) technique? Is the dynamic relationship among the member countries symmetric or asymmetric?

The study utilizes the non-linear ARDL to explore the increasing and decreasing effect public debt has on inflation. The NARDL frame can analyze the debt-inflation relationship in WAMZ over the period of study. The standard ARDL is extended to contain the non-linear dynamics present among variables but still maintains all the qualities of the conventional ARDL.

Shin et al (2014) opine on the need for unified model that can combine non-linearities in the long run relationship and error correction mechanism coherently. This non-linear modelling framework based on ARDL is important because it can provide a simple and flexible vehicle for the analysis of joint long and short run asymmetries. The simple and flexible non-linear dynamic framework is capable of simultaneously and coherently modelling asymmetries both in the hidden long run relationship and dynamic adjustment. The dynamic error correction that is linked with the asymmetric long run cointegrating regression gives rise to the Non-linear autoregressive distributed lag (NARDL). This accommodates long and short run asymmetry.

Using this model for asymmetric cointegration based on partial sum decomposition used by Schorderet (2001) for non-linear relations, we use positive and negative component for the sum of underlying variable used in our model in a bid to show cointegrating relationship between inflation and public debt. The explanatory variable has positive and negative signs which show the positive and negative effects of the partial component of the explanatory variable X. Schorderet (2003) applies some of this concept and defines stationary linear combination of the partial sum of the components.

$$Z_t = \beta^{+}_0 Y^{+}_t + \beta^{-}_0 Y^{-}_t + \beta^{+}_1 X^{+}_t + \beta^{-}_1 X^{-}_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

From equation (1), if Z_t is stationary, then Y_t and X_t are considered asymmetrically cointegrated. The standard linear cointegration is obtained if $\beta^+_0 = \beta^-_0$ and $\beta^+_1 = \beta^-_1$

Shin et al (2014) uses the NARDL which is an extension of standard autoregressive distributed lag approach and contains short run and long run non-linear or asymmetric dynamics present between variables and it retains the advantages of the standard autoregressive distributed lag model. NARDL will help us investigate whether public debt has a symmetric or asymmetric effect on inflation in the WAMZ. This study utilizes the NARDL technique suggested by Shin et al (2014).

The NARDL model specification is :

$$lnINF_{it} = \alpha_0 + \alpha_1 lnPD^+_{it} + \alpha_2 lnPD^-_{it} + \alpha_3 lnMS_{it} + \alpha_4 lnGDPC_{it} + \alpha_5 lnGFCF_{it} + \alpha_6 lnTOP_{it} + \gamma_t + \alpha_i + \varepsilon_{it} \quad \text{.....................................}(2)$$

where

ln = natural logarithm

PD^+ = partial sum of positive changes in total public debt

PD^- = partial sum of negative changes in total public debt

INF = Inflation MS = Money supply

γ_t=time fixed effect α_i = country fixed effect

GDPC = economic growth known as real GDP per capita

GFCF = private investment known as Gross fixed capita formation as a % of GDP

TOP = trade openness

The partial sum of negative and positive changes in public debt is presented as:

$$lnPD^+_{it} = \Sigma\Delta lnPD^+_{ij} = \Sigma max\ (\Delta lnPD_j, 0)$$

$$\ln PD^{-}_{it} = \Sigma \Delta \ln PD^{-}_{ij} = \Sigma \min (\Delta \ln PD_j , 0) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

The variables in the model has both short run and long run asymmetric effects of total public debt on inflation and the full representation of the NARDL model is given by:

$$\Delta \ln INF_{it} = \delta_0 + \Sigma \delta_{1it} \Delta \ln INF_{t-1} + \Sigma \delta_{2i} \Delta \ln PD^{+}_{t-1} + \Sigma \delta_{3^{-}it} \Delta \ln PD^{-}_{t-1} + \Sigma \delta_{4it} \Delta \ln MS_{t-1} + \Sigma \delta_{5it} \Delta \ln GDPC_{t-1} + \Sigma \delta_{6it} \Delta \ln TOP_{t-1} + \Sigma \delta_{7it} \Delta \ln GFCF_{t-1} + \delta_8 \ln INF_{t-1} + \delta_9^{+} \ln PD^{-}_{t-1} + \delta_{10}^{-} \ln PD^{-}_{t-1} + \delta_{11} \ln MS_{t-1} + \delta_{12} \ln GDPC_{t-1} + \delta_{13} \ln TOP_{t-1} + \delta_{14} \ln GFCF_{t-1} + \varepsilon_{it} \ldots\ldots\ldots (4)$$

δ_0 = constant $\delta_1 - \delta_7$ = short run coefficient

$\delta_8 - \delta_{14}$ = long run coefficient Δ = difference operator

ln = natural logarithm n = lag lengths

ε_{it} = white noise error term

The NARDL is relevant because it observes asymmetric adjustment paths and the duration of the disequilibrium but do not directly model asymmetric error correction present.

From the equation 4, δ^{+}_{2i} and δ^{-}_{3i} shows the short run asymmetric coefficients while δ^{+}_{9} and δ^{-}_{10} is the long run relationship.

The Hypothesis

The Null Hypothesis: H_0: The variables are not asymmetrically cointegrated.

H_0: $\delta_8 = \delta^{+}_{9} = \delta^{-}_{10} = \delta_{11} = \delta_{12} = \delta_{13} = \delta_{14} = 0$

H_A: The alternative hypothesis is that there is asymmetric cointegration among the variables.

H_A : $\delta_8 \neq \delta^{+}_{9} \neq \delta^{-}_{10} \neq \delta_{11} \neq \delta_{12} \neq \delta_{13} \neq \delta_{14} \neq 0$

If the computed F-statistics is greater than the critical values for the upper bound, then we conclude that cointegration is present. The use of Wald test is necessary to

ascertain if we have long run or short run asymmetric relationship present between inflation and public debt.

Using Wald test,

The null hypothesis: H_0 : there is long run symmetry

The alternative hypothesis: H_A: There is no long run symmetry. There is long run asymmetry. (Aimola & Odhiambo, 2022)

The Error Correction model has short run dynamic in the non-linear relationship, and it is expressed as:

$$\Delta \ln INF_{it} = \delta_0 + \Sigma\delta_{1i}\Delta \ln INF_{t-i} + \Sigma\delta^{+}_{2i}\Delta \ln PD^{+}_{t-i} + \Sigma\delta^{-}_{3i}\Delta \ln PD^{-}_{t-i} + \Sigma\delta_{4i}\Delta \ln MS_{t-i} +$$

$$\Sigma\delta_{5i}\Delta \ln GDPC_{t-i} + \Sigma\delta_{6i}\Delta \ln TOP_{t-i} + \Sigma\delta_{7i}\Delta \ln GFCF_{t-i} + \phi_1 ECM_{t-i} + \varepsilon_{it}$$

The ECM_{t-1} is one period lag and known as one period lagged error correction term. The coefficient ϕ_1 is the speed of adjustment and we expect it to be negative and statistically significant to make us conclude that there is long run convergence after a shock.

Unlike previous studies on impact of public debt on inflation (Ersin, 2007; Karakaplan,2009; Nguyen, 2015) which assumed linear relationship even without testing for non-linearity, the study by Aimola and Odhiambo (2022) investigate the clear possibility of non-linear structure in the data series and discovered such.

Estimation Technique

The panel data was used to show the data for the variables of these countries. In the model, the estimation will be done using Cointegration using the linearized values and an NARDL model evolved from Arellano and Bond (1991). We use the dynamic panel estimator to correct simultaneity bias and precise nation effects with the help of

transforming the version to the first level thereby eliminating country specific outcomes. We use fixed effect and random effect because it's control for endogeneity and more appropriate for long periods and many observations. Arellano and Bover (1995). Fixed effect test will be done as well to correct for endogeneity bias especially from reverse causality that may exist between public debt and government investment.

The Ordinary Least Squares (OLS) regression technique will be used with the conditional least square techniques to estimate the threshold level of inflation. Stationary tests would be conducted on the model variables using Augmented Dickey-Fuller unit root test. Also, Wald test, cointegration and Granger causality will be applied.

4.0: ANALYSIS, INTERPRETATION AND DISCUSSION OF RESULTS

WAMZ Country-by-country summary Statistics

Inflation

	The Gambia Inflation	Ghana Inflations	Guinea Inflation	Liberia Inflation	Nigeria Inflation	Sierra Leone Inflation
Mean	7.928	26.716	14.638	10.632	15.822	10.893
Median	6.128	18.042	14.638	10.479	12.095	11.070
Maximum	56.560	122.874	34.695	23.563	72.835	27.208
Minimum	-4.535	-8.422	4.684	5.300	-3.726	4.639
Standard Deviation	8.458	25.730	4.325	2.554	15.026	3.141
Skewness	3.335	2.266	2.251	2.240	2.017	2.201
Kurtosis	18.830	8.483	12.514	12.985	6.890	13.240
Jarque-Bera	774.656	132.872	290.821	314.442	82.443	326.154
Probability	0.000	0.000	0.000	0.000	0.0000	0.0000
Sum	499.467	1683.100	922.189	669.826	996.796	686.269
Sum Sq Deviation	4436.082	41047.500	1159.918	404.523	13998.380	611.951
Observations	63	63	63	63	63	63

Source: Researcher's computation from WDI data

Ghana recorded the highest level of average inflation in the 63-year period of the study while The Gambia recorded the least level of average inflation during the period of study. Ghana experienced the worst form of inflation in the 1980s. Aimola and Odhiambo (2021) posit that the high inflation of more than 122 percent in 1983 and high inflation in those periods was due to excessive demand pressures from government expansionary fiscal operations. However, the attainment of common currency -Eco – and single digit inflation stated in the convergence criteria has not been achieved because of high inflation in the last two decades. Achieving moderate and single digit inflation will stimulate economic growth while the present rate of high rate of inflation is detrimental to economic growth.

External Public Debt

	The Gambia External public Debt	Ghana External Public Debt	Guinea External Public Debt	Liberia External Public Debt	Nigeria External Public Debt	Sierra Leone External Public Debt
Mean	3.49E+ 08	6.09E+ 09	2.02E+09	7.45E + 08	1.59E +10	8.18E + 08
Median	3.41E + 08	5.06E + 09	1.99E + 09	7.41E+08	1.56E +10	8.10E +08
Maximum	8.08E + 08	2.74E + 10	3.59E + 09	1.24E +09	3.44E +10	1.57E + 09
Minimum	507,600,0	5.07E + 08	3.28E +08	1.58E +08	4.52E + 08	614,000,32
Standard Deviation	2.12E+08	6.44E +09	8.60E +08	3.51E +08	1.09E+10	3.75E + 08
Skewness	0.088	188,771,2	-0.162	-0.425	0.092	-0.250
Kurtosis	2.561	6.005	2.014	1.859	1.635	2.401
Jarque – Berra	0.586	61.123	2.828	5.318	4.977	1.598
Probability	0.746	0.000	0.243	0.070	0.083	0.449
Sum	2.20E +10	3.84E+11	1.27E + 11	4.69E+10	1.00E + 12	5.15E +10

Source: Researcher's computation from WDI data

The average public debt of Nigeria and Ghana are the highest average over the 63-year period. The highest debt is largely due to more borrowings by Nigeria to finance large government expenditure and bureaucracy. Countries, especially WAMZ use public

debt as a means of finance for their public expenditure, public services, financing budget deficit and some consumption expenditure. Even though public debt promotes financial safety and stability for the economy, high public debt leads to a rise in inflation and is detrimental to economic growth and development.

WAMZ countries

The regression results for the WAMZ countries: Ghana; The Gambia; Guinea; Nigeria; Sierraleone and Liberia show the effects of the various independent variables on Inflation for the 63-year period examined.

Ghana

Variable	Coefficient (Standard Error)	P-value
Dependent Variable: Inflation		
Real GDP per capita	-0.061031 (0.022438)	0.0086
Trade Openness	-0.196771 (0.142177)	0.1718
Gross Fixed Capita Formation	2.21E -09 (1.52E -09)	0.1521
External Public debt	-8.18E -10 (1.64E – 09)	0.6203
Broad Money	2.41E -10 (2.61E -10)	0.3611
Constant	103.0168	
R-squared	0.300270	
Adjusted R-squared	0.238890	

There are five independent variables which explain Inflation CPI for the 63-year period. Among the variables, the real GDP per capita is statistically significant while the other variables Trade openness, Gross fixed capita formation, External public debt and broad money are not statistically significant in explaining Inflation. For the real GDP per capita, we reject the null hypothesis and conclude that public debt has an effect on

inflation. The negative relationship from the result is in consonance with economic theory because high economic growth -explained by higher real per capita income- should lead to lower inflation. From the result, if the real GDP per capita increases by one unit, then the inflation CPI will decrease by 0.061031 while holding other variables constant. The external public debt has a negative relationship with inflation CPI and is not statistically significant, hence we fail to reject the null hypothesis. The negative relationship from the result is not in consonance with economic theory. Economic theory posits that debt drives inflation and they move in the same direction. The result implies that if the external public debt increases by one unit, then we expect the inflation to decline by 8.18E -10 units while holding other variables constant. Moreover, Ghana adopted inflation targeting policy at the beginning of WAMZ in a bid to stop rising inflation driven by other macroeconomic environmental factors, but this has not achieved the expected result. The external debt in Ghana contributes to the rising inflation in Ghana and the control of inflation depends on co-ordination with fiscal policy.

The Gambia

Variable	Coefficient(Standard Error)	P -value
Dependent variable: Inflation		
Real GDP per capita	0.062984 (0.026937)	0.0229
Trade Openness	-0.001951 (0.010714)	0.8561
Gross Fixed Capital Formation	-1.72E-08 (1.85E -08)	0.3556
External Public Debt	-1.64E -08 (6.98E-09)	0.0227
Broad money	2.79E -10 (2.29E-10)	0.2295
Constant	-25.60348	
R-squared	0.191532	

Adjusted R-squared	0.120613	

The five independent variables explain inflation CPI for The Gambia for the 63-year period. The variables of real GDP per capita and external public debt are statistically significant while trade openness, gross capita formation and broad money are not statistically significant. This means that we reject the null hypothesis and conclude that real GDP per capita and external public debt have effect on the Inflation in The Gambia while we fail to reject the null hypothesis for the variables of broad money, trade openness and gross fixed capita formation and conclude that they have no effect on the Inflation. For the real GDP per capital, this has a positive relationship with Inflation and if it increases by one unit, then we see a rise in Inflation by 0.062984 units while holding other variables constant. The external public debt has a negative relationship with inflation and it the debt rises by one unit, then we expect the inflation to reduce by 1.64E -08 units while holding other variables constant. In The Gambia, they have experienced large budget deficit in recent years driven by increased government borrowings due to shortfalls in revenue emanating from the worldwide Coronavirus (COVID 19) and the macroeconomic fallout. The increase in external public debt in driving inflation in the Gambia and this is raising concerns among policy makers and the central government in the Gambia.

Guinea

Variable	Coefficient (Standard Error)	P-value
Dependent variable: Inflation		
Real GDP per capita	7.09E-05 (0.007758)	0.9927
Trade openness	0.015070 (0.022491)	0.5055

Gross Fixed Capita Formation	-9.42E -10 (1.08E – 09)	0.3871
External Public Debt	1.78E -09 (6.51E -10)	0.0083
Broad money	-1.45E -13 (1.26E-13)	0.2560
Constant	11.37102	
R-squared	0.220434	
Adjusted R -squared	0.152051	

The five independent variables explain the Inflation CPI for Guinea in the 63-year period. The variable of external public debt is statistically significant while the variables of broad money, gross fixed capita formation, trade openness and real GDP per capita are not statistically significant. This implies that we reject the null hypothesis for the external public debt and conclude that the debt has an effect on the Inflation while we fail to reject the null hypothesis for real GDP per capita, trade openness, gross fixed capital formation and broad money and then conclude that they have no effect on the inflation. The positive relationship between the external public debt and inflation is in consonance with economic theory. From the result, if the external public debt increases by one unit, then the inflation will rise by 1.78E -09 units while holding other variables constant. Just like other WAMZ countries, Guinea is experiencing rising inflation in recent which is driven by increased borrowings and debt from the central government of Guinea.

Liberia

Variable	Coefficient (Standard Error)	P -value
Dependent variable: Inflation		
Real GDP per capita	0.004794 (0.008247)	0.5633
Trade Openness	0.006214 (0.004405)	0.1637
Gross Fixed Capita Formation	-0.001696 (0.003417)	0.6216
External Public Debt	2.32E -09 (1.43E -09)	0.1094
Broad money	3.60E -09 (2.38E -09)	0.1365
Constant	4.906504	
R-squared	0.061745	
Adjusted R-squared	-0.020558	

Inflation CPI in Liberia is explained by five independent variables for the 63-years period. The variables of real GDP per capita, Trade openness, Gross fixed capita formation, external public debt and broad money help explain the Inflation CPI and none of the variables was significant for the period. This implies that we fail to reject the null hypothesis and conclude that real GDP per capita, trade openness, gross fixed capita formation, external public debt and broad money have no effect on Inflation in Liberia. The external public debt has a positive relation with the Inflation which is in consonance with economic theory. This means that if the debt increases by one unit, then we expect an increase in Inflation by 2.32E -09 units holding other variables constant. Meanwhile, about half of the 63-year period, Liberia experienced wars and conflicts which largely

affected their macroeconomic and political stability, but the economy has experienced recovery in the last two decades. The debt is not rising as much as other WAMZ member countries and the inflation has experienced a slow increase in recent years.

Nigeria

Variable	Coefficient (Standard Error)	P-value
Dependent variable: Inflation		
Real GDP per capita	0.017090 (0.011077)	0.1284
Trade Openness	-0.159054 (0.202249)	0.4349
Gross Fixed Capita Formation	-1.12E -10 (9.32E -11)	0.2357
External Public Debt	7.00E -10 (3.07E -10)	0.0261
Broad money	-5.15E -13 (4.25E -13)	0.2307
Constant	-13.13036	
R-squared	0.176445	
Adjusted R – squared	0.104204	

Nigeria's Inflation CPI have been influenced by these five independent variables in the 63-year period. The variable of external public debt is statistically significant while the variables of real GDP per capital, Trade openness, Gross fixed capita formation are not statistically significant. For the external public debt, we reject the null hypothesis and conclude that the external debt has effect on inflation. On the other hand, we fail to reject the null hypothesis and conclude that real GDP per capita, Trade openness, Gross fixed capita formation and broadmoney have no effect on the Inflation in Nigeria. The external public debt has a positive relationship with Inflation and this is in consonance with economic theory. If the external public debt increases by one unit, then we expect an increase in Inflation by 7.00E-10 while holding other variables constant. In

the last decade, Nigeria central government has increased its borrowings and have experienced large budget deficit, and the COVID 19 pandemic with the macroeconomic fallout have accelerated the borrowings and external debt. The high level of external public debt has contributed to a steady rise in inflation in Nigeria.

Sierra Leone

Variable	Coefficient (Standard Error)	P-value
Dependent variable : Inflation		
Real GDP per capita	0.002448 (0.005429)	0.6537
Trade Openness	0.005103 (0.009459)	0.5917
Gross Fixed Capital Formation	-6.88E -09 (1.78E -09)	0.0003
External Public Debt	-3.18E -09 (1.30E -09)	0.0176
Broad money	7.78E – 10 (1.45E -10)	0.00000
Constant	12.52216	
R- squared	0.414327	
Adjusted R-squared	0.362952	

The Inflation CPI in Sierra Leone has been affected by five independent variables. The variables of Gross fixed capita formation, external public debt and broad money are highly statistically significant while the variables of real GDP per capita and Trade openness are not statistically significant. This means that we reject the null hypothesis for the Gross fixed capital formation, external debt and broad money and conclude that they have an effect on the inflation in SierraLeone. Conversely, the variables of Trade openness and real GDP per capita are not significant, hence we fail to reject the null hypothesis and infer that they have no effect on inflation in Sierra Leone.

The Gross fixed capital formation has a negative relationship with the Inflation. This is in consonance with economic theory because an increase in private investment should lead to a decrease in inflation. From the result, if the Gross fixed capital formation increases by one unit, then the inflation is expected to decrease by 6.88E -09 while holding other variables constant. Also, the external public debt has a negative relationship with inflation. This is not in consonance with economic theory. The result shows that if the external public debt is increased by one unit, then we expected to have a decline in Inflation by 3.18E -09 while holding other variables constant. The broadmoney explains the money supply and the result show a positive relationship with inflation. Any one unit increase in broad money will lead to an increase in inflation by 7.78E -10 while holding other variables constant. Broad money is used by Central Banks to set monetary policy and a close link that exist among money supply, inflation and interest rate. The Central Bank of Sierra Leone or other Central banks use lower interest rate to increase money supply in attempt to stimulate the economy.

Panel Data Regression

The panel data regression involved five explanatory variables and the dependent variable of Inflation. Regression was done for three periods to enable us to compare the effects on the variable during the various changing times. The first period was the pre-WAMZ period (1960 -2000), the second period was during WAMZ (2001 – 2022) and the third period was the entire period of study (1960 – 2022).

$INF_{it} = \alpha + \beta_1 PD_{it} + \beta_2 MS_{it} + \beta_3 GDPC_{it} + \beta_4 GFCF_{it} + \beta_5 TOP_{it} + \delta_t + \alpha_i + \mu_{it}$

Pre-WAMZ period

Variable	Coefficient (Standard Error)	P -value
Dependent variable: Inflation		
Real GDP per capita	0.015531	0.0006

	(0.004455)	
Trade Openness	-0.034878 (0.012035)	0.0041
Gross Fixed Capital Formation	-3.80E -10 (8.52E-11)	0.0000
External Public Debt	2.83E-10 (2.00E -10)	0.1579
Broad money	-8.71E -12 (8.61E-12)	0.3130
Constant	8.090496	
R -squared	0.129388	
Adjusted R-squared	0.111250	

During WAMZ

Variable	Coefficient (Standard Error)	P-value
Dependent variable : Inflation		
Real GDP Per capital	-8.54E-05 (0.001648)	0.9588
Trade openness	0.004489 (0.008338)	0.5912
Gross Fixed Capita Formation	-2.31E-11 (3.95E -11)	0.5607
External Public Debt	1.89E -10 (9.14E -11)	0.0408
Broad money	2.60E -14 (6.77E – 14)	0.7022
Constant	10.57405	
R-squared	0.048690	
Adjusted R-squared	0.010939	

Entire period

Variable	Coefficient (Standard Error)	P-value
Dependent variable: Inflation		
Real GDP per capita	0.006047 (0.002617)	0.0214
Trade Openness	-0.024805 (0.008957)	0.0059
Gross Fixed Capital Formation	-1.80E -10	0.0012

	(5.50E -11)	
External Public Debt	2.18E-10 (1.26E-10)	0.0831
Broad money	-5.64E -14 (1.20E-13)	0.6388
Constant	11.71177	
R-Squared	0.065596	
Adjusted R-Squared	0.053037	

$$INF_{it} = 11.71177 + \beta_1 0.006047_{it} + \beta_2 -0.024805it + \beta_3 -1.80E\text{-}10_{it} + \beta_4 2.18E\text{-}10_{it} + \beta_5 -5.64E\text{-}14_{it} + \delta_t + \alpha_i + \mu_{it}$$

The five independent variables witnessed changes during the periods. The real GDP per capita changed and recorded its highest in the pre-WAMZ period compared to other periods. Since the real GDP per capita tells us the measure of economic growth, it appears that the economy of the WAMZ countries grew more on average in pre-WAMZ period. Trade openness changed during the periods; it had a positive coefficient and relationship with inflation during the WAMZ period, but it had negative relationship with inflation in the pre-WAMZ and entire period of the study. The fluctuations in the import/export ratio with GDP must have driven the change. Exports must have grown more during the WAMZ period compared to other periods. The Gross fixed capita formation had a negative coefficient throughout the three period and showed negative relationship with the Inflation. The value was highest during the entire period compared to pre-WAMZ and during WAMZ period. The negative relationship implies that Gross fixed capita formation (private investment) did not cause the steady rise in inflation experienced. The external public debt had a positive relationship with Inflation for the three periods and witnessed some changes. It was highest in the pre-WAMZ period compared to the entire period and during WAMZ. The decline in the value of the coefficient tells us the effect of monetary policy. Broad money coefficient was negative

and positive. It was negative in the entire period and pre-WAMZ period but was positive during the WAMZ period. The changes can be attributed to the effects of the money supply in its interaction with inflation and interest rates to determine monetary policy. Furthermore, for the entire 63-year period, four of the independent variables were statistically significant while one of the variables was not significant. The variables of real GDP per capita, Trade openness, Gross fixed capita formation and external public debt were statistically significant while the broad money was not significant. We reject the null hypothesis and conclude that the real GDP per capita, Trade openness, Gross fixed capita formation and external public debt have effect on the Inflation in WAMZ while we fail to reject the null hypothesis for the broad money and conclude that broad money has no effect on Inflation. For the real GDP per capita, an increase of one unit will lead to increase in the Inflation by 0.006047unit while holding other variables constant. The positive relationship with inflation shows the positive effect of real GDP per capita has on inflation. For the trade openness, a one unit increase will translate into a reduction of the inflation by 0.024805 unit while holding other variables constant. From the result, the trade openness negative relationship with inflation is in consonance with economic theory. The trade openness reduces inflation by encouraging competition in domestic markets and reduce the firm's pricing power. Monetary policy fosters more prudent and less inflationary economy driven by strong competition in the market.

Also, the Gross fixed capita formation has a negative relationship with Inflation and the coefficient is -1.80E -10. When the Gross fixed capita formation increases by one unit, then the inflation decreases by 1.80E-10 while holding other variables constant. The Gross fixed capital formation consists of resident producers investment

after deducting disposals. It is negative and shows that assets are disposed of and the transaction assets and how they are acquired and disposed of. The external public debt has a positive relationship with Inflation and the coefficient is 2.18E-10. When the external public debt increases by one unit, then we expect the inflation to increase by 2.18E -10 while holding other variables constant. The external debt raises long-term inflation expectations in WAMZ and developing countries in a persistent way. The effects are stronger when initial debt levels are already high. Rising debt likely frustrates the fight against inflation in WAMZ and developing countries, hence weakens the monetary policy framework.

Fixed Effect Regression Results

Fixed effect regression allows the intercept of the model to vary freely across individuals and groups for panel data to enable us control for specific variables that do not vary across time. The fixed effect regression was done to enable us to estimate the effect of intrinsic characteristics of individual variables in the panel data set.

$$Y_{it} = X^{1}_{it}\beta + \mu_{it} + \alpha_i$$

H_0 : There is no fixed effect

H_1: There is fixed effect.

Entire Period

Fixed Effect

Variable	Coefficient (standard Error)	P-value
Dependent Variable : Inflation		
Real GDP per capita	-0.015414 (0.003353)	0.0000
Trade Openness	-0.008959 (0.009600)	0.3513
Gross Fixed Capita formation	-1.18E – 10	0.0623

	(6.30E – 11	
External Public Debt	-1.10E -10 (1.28E -10)	0.3909
Broad money	3.18E – 13	0.0150
	(1.30E -13)	
Constant	30.37152	
R- squared	0.259296	
Adjusted R-squared	0.239113	
Durbin Watson stat	1.108030	

$$INF_{it} = c + \beta_1 X_{1it} + \beta_2 X_{2it} + \beta_3 X_{3it} + \beta_4 X_{4it} + \beta_5 X_{5it} + \mu_{it} + \delta_t + \alpha_i = 30.37152 + \beta_1 \text{-}0.015414 + \beta_2 \text{-} 0.008959 + \beta_3 \text{-}1.18E\text{-}10 + \beta_4 \text{-}1.10E\text{-}10 + \beta_5 3.18E\text{-}13 + \mu_{it}$$

The variables of real GDP per capita, gross fixed capital formation and broad money are statistically significant while the variables of trade openness and external public debt are not significant. This implies that we reject the null hypothesis for real GDP per capita, gross fixed capital formation and broad money and then conclude that they have fixed effect. Conversely, the variables of trade openness and external public debt being not significant implies that we fail to reject the null hypothesis and conclude that they do not have fixed effect.

Random Effect.

The use of random effect regression model estimates the effect of individual specific characteristics e.g grit that are not measurable and present in panel data studies. They have exogeneity and random effect have a factor which contribute to the outcome, but their levels are not fully sampled or understood.

The random effect is written as:

$$Y_{it} = X^1_{it}\beta + \mu_{it} + \alpha_i$$

The null hypothesis H_0: There is no random effect.

The Alternative hypothesis H_1: There is random effect.

Variable	Coefficient (Standard Error)	P-value
Dependent variable: Inflation		
Real GDP per capital	0.006047 (0.002346)	0.0103
Trade Openness	-0.024805 (0.008029)	0.0022
Gross fixed Capita formation	-1.80E -10 (4.93E -11)	0.0003
External Public Debt	2.18E-10 (1.13E-10)	0.0533
Broad money	-5.64E -14 (1.08E-13)	0.6005
Constant	11.71177	
		Rho
Cross -section random		0.0000
Idiosyncratic random		1.0000
R-squared	0.065596	
Adjusted R-squared	0.053037	

$$INF_{it} = c + \beta_1 X_{1it} + \beta_2 X_{2it} + \beta_3 X_{3it} + \beta_4 X_{4it} + \beta_5 X_{5it}\ \mu_{it} + \alpha_i$$

$$INF_{it} = 11.71177 + \beta_1 0.006047 + \beta_2 -0.024805 + \beta_3 -1.80E\text{-}10 + \beta_4 2.18E\text{-}10 + \beta_5 -5.64E\text{-}14 + \mu_{it}$$

The variables of real GDP per capita, Trade openness, Gross fixed capita formation and external public debt are statistically significant while Broad money is not significant. We reject the null hypothesis for real GDP per capita, Trade openness, Gross fixed capita formation and external public debt and conclude that they have random effect. Since broad money is not significant, it implies that we fail to reject the null hypothesis and conclude that broadmoney has not random effect.

From the result, the idiosyncratic random is more significant and it contributes 100percent to the error term while the cross section random contributes zero percent to the error term in the regression.

Unit root

The presence of unit root causes a spike in output which leads to higher levels of output being higher than the past trend. Unit root measurement tells us how much stationarity a time series model has.

ADF test – Augmented Dickey Fuller test

$$\Delta Y_t = \alpha + \gamma Y_{t-1} + \delta_1 \Delta Y_{t-1} + \ldots\ldots\ldots\ldots + \delta_p \Delta Y_{t-p} + \varepsilon_t$$

H_0 : The residuals have unit root

H_1: There is no unit root in the residuals.

Method	Probability	Observation
Null hypothesis: Unit root		
Levin,Lu & Chu	0.0030	360
Lm, Pesaran and Shin W-stat	0.0003	360
ADF -Fisher Chi-Square	0.0001	360

The unit root result shows that the model variables were statistically significant at just level differencing. Hence, we reject the null hypothesis and conclude that the variables do not have unit root.

Cointegration

Cointegration tests are used to test the presence of correlation between two or more non-stationary time series in the long run for a specified period, long run parameters and relationship for two or more variables are identified.

$$\Sigma Y_i Y_{it} = \mu_t$$

The presence of cointegration signifies the existence of long run equilibrium relationship between the variables highlighted.

Pre-WAMZ period

Method	Statistic	Prob	Statistic	Prob
Panel v-Statistic	-2.395007	0.9917	-1.986667	0.9765
Panel rho-Statistic	-2.145536	0.0160	-0.546203	0.2925
Panel -PP-Statistic	-4.610754	0.0000	-2.404484	0.0081
Panel ADF -Statistic	-1.195422	0.1160	-0.353542	0.3618
Group rho-Statistic	0.797318	0.7874		

Group PP-Statistic	-0.769310	0.2209		
Group ADF -Statistic	0.914363	0.8197		

During WAMZ period

Method	Statistic	Prob	Statistic	Prob
Panel v-Statistic	-1.336370	0.9093	-1.967901	0.9755
Panel rho-Statistic	-0.016892	0.4933	1.253891	0.8951
Panel PP -Statistic	-5.815597	0.0000	-2.932842	0.0017
Panel ADF -Statistic	-1.674940	0.0470	-3.262446	0.0006
Group rho-Statistic	1.914855	0.9722		
Group PP-Statistic	-4.859129	0.0000		
Group ADF-Statistic	-2.596037	0.0047		

Entire period

Method	Statistic	Prob	Statistic	Prob
Panel v-Statistic	-2.159542	0.9846	-2.338040	0.9903
Panel rho-Statistic	-5.523206	0.0000	-3.394541	0.0003
Panel PP -Statistic	-7.228069	0.0000	-5.803577	0.0000
Panel ADF-Statistic	-2.863967	0.0021	-5.156580	0.0000
Group rho-Statistic	-3.213396	0.0007		
Group PP-Statistic	-6.261242	0.0000		
Group ADF-Statistic	-5.485421	0.0000		

Cointegration involves modelling the variables to I(0) and it is a linear combination of those variables that have lower order of integration.

H_0: There is NO co-integration.

H_1: There is co-integration.

From the Johansen cointegration test results, the variables are statistically significant, p-values <0.05 hence, we reject the null hypothesis. Therefore, we conclude that the variables do not have cointegration. They are stationary.

The cointegration results of the three periods differ and show different long run relationships among the variables for the pre-WAMZ, during WAMZ and the entire period. In the pre-WAMZ era, three of the variables statistics are not significant while one of the variables statistics is significant. This means that we fail to reject the null hypothesis and conclude that there is no cointegration for the three variables and there is

cointegration in the one variable statistic that is significant. It appears that there was more of a no cointegration relationship and less long-term relationship in the pre-WAMZ period than other periods.

Also, during the WAMZ period the different cointegration results show that two variables statistic were significant while two variables statistic were not significant. Hence, we fail to reject the null hypothesis for the first and second variables statistic and then conclude that there is no cointegration. For the third and fourth variables statistic, we reject the null hypothesis and conclude that there is cointegration and long run relationship among the variables. It appears that half of the periods during WAMZ, the variables enjoyed good long run relationship while in the other half, there was no long run relationship. In the entire period of study, the results show that most of the variables' statistic were statistically significant while the first variable statistic was not significant. We reject the null hypothesis for the second, third and fourth variables statistic and conclude that they have cointegration and we reject the null hypothesis while the first variable statistic which is not significant does not have cointegration and we fail to reject the null hypothesis.

The entire period of study shows more cointegration and long run relationships among the variables than the no cointegration relationships. This means that more of the variables were non-stationary, and the coefficient estimates Y_{t-1} is now super consistent and then converges to zero. The stationary variables have asymptotic distribution of the F-statistic and will remain the same. And the series do not change over time and the statistical properties of the process which generates the time series do not change for the stationary variables.

Granger Causality

The entire period Granger causality test explains causations and the relationship between the two variables show that past values of one variable gives predictive information about the future values of another variable, more than the information contained in its own past values. This Granger causality test is important for deciding if a single equation model of Y and X variables has a right- hand side variable will be necessary for forecasting purposes. Granger causality test shows how to ascertain the usefulness of one variable to forecast another variable.

$H_0 : \Theta = 0$ No Granger Causality

The coefficient of past values in the regression is equal to zero.

$H_1 : \Theta \neq 0$ There is Granger Causality

The coefficient of past values is not equal to zero.

Variable	Observation	P-value
Real GDP per Capita does not Granger cause Inflation Inference: We fail to reject the null hypothesis and conclude that there is no Granger causality	366	0.3448
Trade openness does not Granger cause Inflation Inference: We fail to reject the null hypothesis and conclude that there is no Granger causality	366	0.3720
Gross fixed capita formation does not Granger cause Inflation	366	0.4155

Inference: We fail to reject the null hypothesis and conclude that there is no Granger causality		
External Public debt does not Granger cause Inflation Inference: We fail to reject the null hypothesis and conclude that there is no Granger causality	366	0.2323
Broad money does not Granger cause Inflation Inference: We fail to reject the null hypothesis and conclude that there is no Granger causality	366	0.9037
Trade openness does not Granger cause real GDP per capita Inference: We fail to reject the null hypothesis and conclude that there is no Granger causality	366	0.9745
Gross fixed capita formation does not Granger cause real GDP per capita Inference: We fail to reject the null hypothesis and conclude that there is no Granger causality	366	0.6917
External public debt does not Granger cause real GDP per capita Inference: It is statistically significant and we reject the null hypothesis. We conclude that there is Granger causality	366	0.0172
Broadmoney does not Granger cause real GDP capita	366	0.1390

Inference: We fail to reject the null hypothesis and conclude that there is Granger causality		
Gross fixed capita formation does not Granger cause Trade openness Inference: We fail to reject the null hypothesis and conclude that there is no Granger causality	366	0.6136
External Public debt does not Granger cause Trade openness Inference: We fail to reject the null hypothesis and conclude that there is no Granger causality	366	0.7565
Broadmoney does not Granger cause Trade openness Inference: We fail to reject the null hypothesis and conclude that there is no Granger causality	366	0.7627
External Public debt does not Granger cause Gross fixed capita formation. Inference: It is statistically significant and we reject the null hypothesis. We then conclude that there is Granger causality	366	0.0316
Broad money does not Granger cause Gross fixed capita formation	366	0.0008

Inference: It is statistically significant and we reject the null hypothesis. We therefore conclude that there is Granger causality		
Broad money does not Granger cause External Public debt. Inference: It is statistically significant and we reject the null hypothesis. We therefore conclude that there is Granger causality	366	0.0169

In the Granger causality test for the entire period, four of the joint variables were statistically significant while the remaining eleven joint variables were not significant. This implies that the four joint variables have one variable that will be useful in forecasting the other variable. From the result, external public debt will be useful in forecasting the real GDP per capita, External public debt will be useful in forecasting Gross fixed capital formation, broad money will be useful in forecasting Gross fixed capital formation and broad money will be useful in forecasting the external public debt.

Vector Autoregressive (VAR)

$$Y_t = \phi + \phi Y_{t-1} + \varepsilon_t$$

Vector Autoregression models are used for multivariate time series and it captures the relationship that exist between multiple quantities as they change over time. We chose to use Vector autoregression (VAR) because it captures intertwined dynamics of time series data and the model provides individuals with improved forecasting performance. VAR explains causal relationship among variables overtime and the forecast future observation.

H_0: There is no relationship between the variable population parameter, its past values, and the past values of other variables.

$$\phi = 0$$

H_1: There is a relationship between the variable, its past values, and past values of other variables.

$$\phi \neq 0$$

Variable	Coefficient
Inflation (-1)	0.425811 (0.05141) [8.28320]
Inflation (-2)	0.242471 (0.05129) [4.72706]
Constant	3.997779 (1.89319)
External Public debt	7.42E -11 (1.0E -10) [0.71717]
Broad money	-1.47E-14 (9.9E-14) [-0.14897]
Gross fixed capita formation	-5.25E-11

	(4.6E -11) [-1.13288]
Real GDP per capita	0.001803 (0.00217) [0.83125]
Trade openness	-0.008023 (0.00769) [-1.04320]
R-squared	0.3966686
Adjusted R-squared	0.384890

From the VAR results, two of the variables are statistically significant while the other variables are not statistically significant. The Inflation (-1) and Inflation (-2) are statistically significant which implies that we reject the null hypothesis and conclude that there is a relationship between the variables themselves and the past and past values of other variables. The remaining variables of External public debt, broad money, Gross fixed capital formation, real GDP per capita and Trade openness are not statistically significant, hence we conclude that there is no relationship between the variables' population parameters. Inflation is modeled as a linear combination of past values of itself, and past values of other variables present in the system.

Research Question: What is the asymmetric relationship between public debt and inflation using non-linear autoregressive distribution lag (NARDL) technique? Is the dynamic relationship among the member countries symmetric or asymmetric?

Non-linear Autoregressive Distribution Lag (NARDL) model is used to address this question. NARDL is chosen because it is useful for both linear and non-linear models and it is useful for both symmetric and asymmetric relationships. We used the same variables and model earlier, but now in a linearized form of the variables.

Pre- WAMZ period

Variable	Coefficient (Standard Error)	P-value
Dependent variable: lnInflation		
lnReal GDP per capita	0.129804 (0.160885)	0.4206
lnGross fixed Capita Formatioon	-0.013978 (0.012090)	0.2488
lnExternal Public Debt	0.089735 (0.040573)	0.0280
lnBroad money	-0.014246 (0.010482)	0.1754
lnTrade Openness	-0.220143 (0.075961)	0.0041
Constant	0.506004	
R-squared	0.104381	
Adjusted R-squared	0.085162	

During WAMZ

Variable	Coefficient (Standard Error)	P-value
Dependent variable: LnInflation		
LnReal GDP per capita	-0.400846 (0.124953)	0.0017
LnTrade Openness	0.041629 (0.068718)	0.5457
lnGross Fixed capita formation	-0.022646 (0.009408)	0.0175
lnExternal Public debt	0.319924 (0.049598)	0.0000
LnBroad money	0.018172 (0.013126)	0.1687
Constant	-0.861872	
R-squared	0.299707	
Adjusted R-squared	0.271918	

Entire Period

Variable	Coefficient (Standard Error)	P-value
Dependent variable: lnInflation		
lnBroad money	-0.018951 (0.007338)	0.0102
lnExternal public debt	0.128354 (0.032148)	0.0001
lnGross fixed capital formation	-0.006539 (0.0082630	0.4293
lnReal GDP per capita	0.022890 (0.106755)	0.8303
Lntrade openness	-0.145714 (0.054803)	0.0082
Constant	0.299294	
R – squared	0.104075	
Adjusted R-squared	0.091802	

$$lnINF_{it} = \alpha_0 + \alpha_1 lnPD_{it} + \alpha_2 lnMS_{it} + \alpha_3 lnGDPC_{it} + \alpha_4 lnGFCF_{it} + \alpha_5 lnTOP_{it} + \gamma_t + \alpha_i + \varepsilon_{it}$$

$$lnINF_{it} = 0.299294 + 0.128354 + -0.018951 + 0.022890 + -0.006539 + -0.145714 + \mu_{it}$$

In a bid to correct the autocorrelation in these results, we did the regression again and included another independent variable which is the lagged value of the dependent variable.

Pre-WAMZ period

Variable	Coefficient (Standard Error)	P-value
Dependent variable: LnInflation		
LnGross fixed capital formation	-0.001754 (0.008866)	0.8434
LnExternal Public Debt	0.033612 (0.031063)	0.2804
LnBroad Money	-0.008476 (0.007811)	0.2790
LnReal GDP per capita	0.067558 (0.117491)	0.5659
LnTrade Openness	-0.091145 (0.056410)	0.1075
LnInflation (-1)	0.616627 (0.047650)	0.0000
R-squared	0.491966	
Adjusted R- squared	0.478479	

During WAMZ

Panel data regression to correct autocorrelation

Variable	Coefficient (Standard Error)	P-value
Dependent variable: LnInflation		
LnGross fixed capita formation	-0.015182 (0.008895)	0.0905
LnExternal PublicDebt	0.176449 (0.052991)	0.0012
LnBroad Money	0.016121 (0.012175)	0.1880
LnReal GDP per capita	-0.248164 (0.120617)	0.0418
LnTrade Openness	-0.013497 (0.063983)	0.8333
LnInflation(-1)	0.398386 (0.081210)	0.0000
Constant	-0.324338	
R-Squared	0.403769	
Adjusted R-squared	0.373706	

Entire period

Variable	Coefficient (Standard Error)	P-value
Dependent variable: LnInflation		
LnReal GDP per capita	0.031587 (0.077125)	0.6824
lnTrade Openness	-0.058022 (0.040534)	0.1532
LnGross fixed capital formation	0.000269 (0.006036)	0.9645
LnExternal Public Debt	0.040345 (0.024643)	0.1025
LnBroad money	-0.009564 (0.005533)	0.0848
LnInflation(-1)	0.639177 (0.037898)	0.0000
Constant	0.116298	
R-squared	0.510875	
Adjusted R-squared	0.502561	
Durbin Watson	2.138361	

$$\ln INF_{it} = \alpha_0 + \alpha_1 \ln PD_{it} + \alpha_2 \ln MS_{it} + \alpha_3 \ln GDPC_{it} + \alpha_4 \ln GFCF_{it} + \alpha_5 \ln TOP_{it} + \gamma_t + \alpha_i + \varepsilon_{it}$$

$$INF_{it} = 0.639177 + 0.040345 + -0.009564 + 0.031587 + 0.000269 + -0.058022 + \mu_{it}$$

H_0 : There is long symmetry relationship among the variables

H_1: The is no long run (short run) symmetry relationship among the variables.

The three periods examined witnessed changes in the variables for the pre-WAMZ, during WAMZ and the entire period. The real GDP per capita was positive for the entire period and pre-WAMZ, but was negative during the WAMZ. Trade openness was negative in the entire period, negative in the pre-WAMZ period, but was positive in the during the WAMZ period. Also, Gross fixed capita formation was positive in the entire period, negative in the pre- WAMZ period and negative in the during the WAMZ period. External public debt was positive in all the periods, the public debt was highest in the entire period, higher in the pre-WAMZ period and least in the during the WAMZ period. The coefficient of the external debt for the pre-WAMZ was higher than the during WAMZ period which tells us that there was worsening effect of fiscal policy on inflation in the during the WAMZ era. The Broad money was negative in the entire period, negative in the pre-WAMZ and positive during the WAMZ period.

From the regression result for the entire period, linearized broad money is statistically significant while the linearized real GDP per capital, trade openness, Gross fixed capita formation and external public debt are not statistically significant. For the broad money, we reject the null hypothesis and conclude that broad money does not have long run symmetry relationship among the variables. This implies that broad money has short run symmetry relationship. Given that the variables of real GDP per capita, trade openness, gross fixed capita formation and external public debt are not

significant, we fail to reject the null hypothesis and conclude that these four variables have long symmetry relationship among the variables.

Cointegration

The Johanssen cointegration test was done using linearized values for the variables for the three periods. The linearized values were used in the model to capture the effect of NARDL on the model for the different periods.

H_0: There is no cointegration.

H_1: There is cointegration.

Pre-WAMZ period

Method	Statistic	P-value	Statistic	P-value
Panel v-Statistic	-18.33133	1.0000	0.433769	0.3322
Panel rho-Statistic	-0.255367	0.3992	0.382900	0.6491
Panel PP-Statistic	-1.946620	0.0258	-0.705094	0.2404
Panel ADF-Statistic	-0.150668	0.4401	0.428624	0.6659
Group rho-Statistic	1.078439	0.8596		
Group PP-Statistic	-0.710836	0.2386		

Group ADF Statistic	0.779573	0.7822		
Dependent variable	LnInflation			
Function	F (LnRGDPpercap, LnGFCG, LnExtPD, LnBroadM, LnTOP			
F-Statistic	0.000095			
Cointegration Status	COINTEGRATED			

During WAMZ

Method	Statistic	P-value	Statistic	P-value
Panel v-Statistic	-1.022186	0.8467	-1.173189	0.8796
Panel rho-Statistic	0.978896	0.8362	1.250356	0.8944
Panel PP- Statistic	-3.223627	0.0006	-2.934148	0.0017
Panel ADF - Statistic	-2.244129	0.0124	-2.691812	0.0036
Group rho-Statistic	2.119559	0.9830		
Group PP-Statistic	-3.883654	0.0001		
Group ADF Statistic	-2.298737	0.0108		

Dependent variable	lnInflation			
Function	F (LnRGDPpercap, LnGFCG, LnExtPD, LnBroadM, LnTOP			
F-Statistic	0.000000			
Cointegration Status	COINTEGRATED			

Entire Period

Variable	Statistic	P-value	Statistic	P -value
Panel v-Statistic	1.836547	0.0331	-1.736939	0.9588
Panel rho-Statistic	-2.996877	0.0014	-4.129609	0.0000
Panel PP-Statistic	-5.158566	0.0000	-7.968374	0.0000
Panel ADF-Statistic	-3.130580	0.0009	-7.138520	0.0000
Group rho - Statistic	-2.567354	0.0051		
Group PP -Statistic	-5.780924	0.0000		
Group ADF-Statistic	-4.031827	0.0000		

Dependent variable	lnInflation			
Function	F (LnRGDPpercap, LnGFCG, LnExtPD, LnBroadM, LnTOP			
F-Statistic	0.000000			
Cointegration Status	COINTEGRATED			

The entire period, pre-WAMZ and during WAMZ show that the model is Cointegrated. There is co-integration in the model because the F-Statistic is statistically significant and we reject the null hypothesis. However, among the variables, some of them do not have cointegration and we fail to reject the null hypothesis and conclude that it does not have long run relationship. In the pre-WAMZ period, all the four variable statistics are not significant, hence we fail to reject the null hypothesis and conclude that the variables have no cointegration. In the during the WAMZ era, some the variables are statistically significant while other variables are not significant. This means that some of the variables are cointegrated and have long run relationship while the other variables are not cointegrated and do not have long run relationship. Overall, there is Cointegration present, and we reject the null hypothesis of no cointegration.

Wald Test

Wald test can be considered as a parametric statistical measure used to confirm if a set of independent variables are collectively significant in the model or not. Wald test generally assesses the constraint present in the statistical parameters based on weighted distance between the unrestricted estimate and it's hypothesized value.

H_0: There is long run or short run symmetry.

H_1: There is long run or short run asymmetry.

WALD Test

Pre-WAMZ period

Test Statistic	Value	Probability
F – statistic	422.5338	0.0000
Chi-Square	2535.203	0.0000
C(1)	0.506004	0.480550
C(2)	0.129804	0.160885
C(3)	-0.220143	0.075961
C(4)	-0.013978	0.012090
C(5)	0.089735	0.040573
C(6)	-0.014246	0.010482

Null Hypothesis: C(1) =0,C(2)=0, C(3)=0, C(4) =0, C(5) =0, C(6) =0

During WAMZ period

Test Statistic	Value	Probability
F -statistic	741.6360	0.0000

Chi-square	4449.816	0.0000
C(1)	-0.861872	0.318274
C(2)	-0.400846	0.124953
C(3)	0.041629	0.068718
C(4)	-0.022646	0.009408
C(5)	0.319924	0.049598
C(6)	0.018172	0.013126

Null Hypothesis: C(1) =0,C(2)=0, C(3)=0, C(4) =0, C(5) =0, C(6) =0

Entire period

Test Statistic	Value	Probability
F-Statistic	75.90578	0.0000
Chi -square	379.5289	0.0000
C(1)	0.299294	0.303520
C(2)	0.022890	0.106755
C(3)	-0.145714	0.054803
C(4)	-0.006539	0.008263
C(5)	0.128354	0.032148
C (6)	-0.018951	0.007338

Null Hypothesis: C(1) =0,C(2)=0, C(3)=0, C(4) =0, C(5) =0, C(6) =0

For the three different periods, the F-statistic is statistically significant, and we therefore reject the null hypothesis and conclude that there is long run asymmetry between external public debt and inflation.

Test for Symmetries

Wald Test	F-Statistic	Decision
Long run symmetry	0.0000	Long run asymmetry relationship exists
Short run symmetry	0.0000	Short run asymmetry relationship exists

The Wald test for the presence of long-run and short run symmetry are reported for the relationship that exist between external public debt and Inflation. We test the null hypothesis of long run symmetry against the alternative hypothesis of long-run asymmetry. The table above shows that null hypothesis of long run symmetry is rejected. The results imply that in the long run, the positive and negative partial sums of squares differ significantly from each other, which then supports an asymmetric relationship. Hence, public debt influences inflation in the long run using different levels of positive and negative effects. Results show that in the short run, the null hypothesis is rejected as well. This implies that there is also an asymmetric relationship between external public debt and inflation in the short run.

Random Effect

In a random effect, the statistical model has model parameters which are random variables and the model assumes that the true effect could vary from study to study due to heterogeneity among different studies. The random effect regression model enables us to estimate the effect of individual specific characteristics. They have exogeneity and

random effect have factor which contribute to the outcome, but their levels are not fully sampled or understood.

The random effect is written as:

$$Y_{it} = X^{1}_{it}\beta + \mu_{it} + \alpha_i$$

The null hypothesis H_0: There is no random effect.

The Alternative hypothesis H_1: There is random effect.

We examine the random effect for the different periods captured namely the pre-WAMZ and during WAMZ .

Pre-WAMZ period

Variable	Coefficient (Standard Error)	P -value
Dependent variable: LnInflation		
LnReal GDP per capita	0.129804 (0.137711)	0.3469
LnTrade Openness	-0.220143 (0.065019)	0.0008
LnGross fixed capital formation	-0.013978 (0.010349)	0.1781
LnExternal Public Debt	0.089735 (0.034729)	0.0104
LnBroadmoney	-0.014246 (0.008972)	0.1137

Constant	0.506004	
	S.D	Rho
Cross Section random	0.00000	0.000000
Idiosyncratic random	0.285031	1.000000
R-squared	0.104381	
Adjusted R-Squared	0.085162	

During WAMZ

Variable	Coefficient (Standard Error)	P-value
Dependent variable: LnInflation		
LnReal GDP per capita	-0.400846 (0.130052)	0.0025
LnTrade Openness	0.041629 (0.071522)	0.5616
LnGross fixed capital formation	-0.022646 (0.009792)	0.0224
LnExternal Public Debt	0.319924 (0.051622)	0.0000
LnBroadmoney	0.018172 (0.013661)	0.1859

Constant	-0.861872	
	S.D	Rho
Period random	0.000000	0.000000
Idiosyncratic random	0.183760	1.000000
R-squared	0.2999707	
Adjusted R-squared	0.271918	

The performance of the variables differs during the two different periods. In the pre-WAMZ era, the variables LnTrade openness and LnExternal public debt were statistically significant while the other variables Lnreal GDP percaptia, LnBroad money and LnGross fixed capita formation are not significant. In the during the WAMZ era, the variables Lnreal GDPpercapita, LnGross fixed capita formation and LnExternaldebt were statistically significant while LnTrade openness and LnBroad money were not statistically significant. For the pre-WAMZ era, this means that we reject the null hypothesis for the variables LnTrade openness and LnExternal public debt and conclude that they have random effects while we fail to reject the null hypothesis for the variables LnBroadmoney, LnrealGDP per capita and LnGross fixed capita formation and conclude that they do not have random effect. Also, for the during the WAMZ era, this means that we reject the null hypothesis for the variables Lnreal GDP percapita, LnGross fixed capita formation, and LnExternal public debt and conclude that they have random effect while we fail to reject the null hypothesis for the variables LnTrade Openness and LnBroadmoney and conclude that they do not have random effect.

In the pre-WAMZ era, the Rho results show that the Idiosyncratic random is more significant than the cross section random. The Idiosyncratic random contributes 100 percent to the error term while the cross section contributes zero percent. In the during the WAMZ era, Idiosyncratic random is also more significant than the cross section random and contributes same 100 percent to the error term while the cross section random contributes zero percent to the error term.

The random effects are generally efficient but sometimes are correlated with independent variables and error term because the random variations across individuals are related to other observations of the individuals.

Fixed Effect Regression

The fixed effect regression is used for multiple observation and the estimates effects are only for those variables that change across different observations. Fixed effect regression allows the intercept of the model to vary freely across individuals and groups for panel data to enable us control for specific variables that do not vary across time. The fixed effect regression was done to enable us to estimate the effect of intrinsic characteristics of individual variables in the panel data set.

$Y_{it} = X^{1}_{it}\beta + \mu_{it} + \alpha_i$

H_0 : There is no fixed effect

H_1: There is fixed effect.

The fixed effect regression captures the three periods of pre-WAMZ, during WAMZ and the entire period.

Pre-WAMZ

Fixed Effect

Variable	Coefficient (Standard Error)	P-value
Dependent variable: LnInflation		
LnGross fixed capital formation	-0.105826 (0.061357)	0.0859
LnExternal Public debt	-0.157810 (0.048744)	0.0014
LnBroadmoney	0.052232 (0.020755)	0.0125
LnRealGDP per capita	-0.036993 (0.369631)	0.9204
LnTrade Openness	-0.004089 (0.072561)	0.9551
Constant	3.001698	
R-squared	0.357898	
Adjusted R-squared	0.329735	

During WAMZ

Fixed Effect

Variable	Coefficient (Standard Error)	P-value
Dependent variable: LnInflation		
LnReal GDP per capita	-0.803310 (0.371224)	0.0324
LnTrade Openness	0.006055 (0.079324)	0.9393
LnGross fixed capital formation	-0.243180 (0.100804)	0.0173
LnExternal Public Debt	0.167989 (0.060411)	0.0063
LnBroadmoney	0.128683 (0.004196)	0.0472
Constant	2.447924	0.0116
R-squared	0.408017	
Adjusted R-squared	0.359093	

Entire Period

Fixed Effect

Variable	Coefficient (Standard Error)	P-value
Dependent variable: LnInflation		
LnReal GDP per capita	-0.287710 (0.209426)	0.1704
LnTrade Openness	-0.024696 (0.052622)	0.6391
LnGross fixed capital formation	-0.119164 (0.041729)	0.0045
LnExternal Public Debt	-0.092154 (0.036963)	0.0131
LnBroad money	0.020953 (0.011434)	0.0677
Constant	3.528617	
R-squared	0.332485	
Adjusted R-squared	0.313943	

Among the variables used for the different periods, the during the WAMZ era had more fixed effects than the other two periods. In the pre-WAMZ period, three variables namely LnExternal public debt, LnGross fixed capita formation and Lnbroad money

were statistically significant while variables of LnrealGDP per capita and LnTrade openness were not significant. Hence, we reject the null hypothesis for the variables LnGross fixed capita formation, LnExternal debt and Lnbroad money and conclude that they have fixed effect; while we fail to reject the null hypothesis for the variables LnrealGDP per capita and LnTrade openness and conclude that they do not have fixed effects.

In the during the WAMZ period, four variables were statistically significant while one variable was not significant. The variables LnrealGDP per capita, LnGross fixed capita formation, LnExternal public debt and LnBroadmoney were statistically significant while the LnTrade openness was not significant. Hence, we reject the null hypothesis for the variables LnrealGDP percapita, LnGross fixed capital formation, LnExternal public debt and LnBroadmoney and conclude that they have fixed effect. Given that the variable LnTrade openness is not statistically, we fail to reject the null hypothesis and conclude that LnTrade openness does not have fixed effect.

In the entire period, three of the variables namely LnGross fixed capita formation, LnExternal public debt and Lnbraod money were statistically significant while the variables LnrealGDP per capita and LnTrade openness were not significant. Therefore, we reject the null hypothesis and conclude that variables LnGross fixed capital formation, LnExternal public debt and LnBroad money have fixed effect. For variables LnrealGDP per capita and LnTrade openness, we fail to reject the null hypothesis and conclude that they do not have fixed effect.

In the pre WAMZ era, during the WAMZ period and the entire period, all the variables that have fixed effect means that they are constant across individuals and do

not change at a constant rate overtime and any change they cause to an individual remains the same while the variables that do not have fixed effects changes all the time which affect policy formulation.

How has the creation of West African Monetary Zone influenced Inflation? At the creation of WAMZ in 2000, there were set primary and secondary criteria for member countries. One of the primary criteria and conditions for convergence was attaining single digit inflation. In the first 15years of WAMZ, there was good and effective communication, coordination, leadership and positive effect in society and countries. Some of the countries achieved single digit inflation even though it was ephemeral. Nigeria and Ghana had single digit inflation in 2011 and some other countries had for some time as well. However, with the changes in the Governors of Central Banks of member countries, the weakness of the Governors in recent years, the leadership of WAMZ now appears weak and not effective in co-ordination. Additionally, in recent years, member countries have witnessed a steady rise in inflation, which is driven by increasing debt, dollarization of the economy, recessions, macroeconomic instability, reduced production etc. Hence, the rising debt has been a trigger for inflation because these countries do not have well developed financial markets and the effects of initial debt are already high.

Even though the influence of WAMZ in achieving single digit inflation and macroeconomic stability has waned in recent years compared to earlier years, there is hope if the leadership is improved and the countries get better Central Bank Governors.

How has the creation of WAMZ influenced the Debt level?

The creation of WAMZ has had an influence on the debt level of member countries, but not a strong effect. They have helped secure loans for member countries and other countries at a cheaper interest rate, provided financial assistance and donations to member countries in time of need. The huge debt is normally incurred by the Central government and the politicians. The West African Monetary Institute (WAMI) and the Central Banks do advice the government against persistent borrowing, but in most cases the advice is not applied or ineffective largely because of practical non-independence of the Central banks, excessive powers of the Government, corrupt and ineffective leaders, culture of waste in government, lack of strong leadership and accountability from the Central bank and political leaders. The effect of WAMZ appears weak now, but it was not so a decade ago. The advisory roles of WAMZ to governments, especially in Monetary and Fiscal policy have not been strong in recent years especially is curtailing excessive borrowings and debt.

5.0: **CONCLUSION**

External debt has become a huge source of financing for countries in Sub-Saharan Africa, especially WAMZ countries to enable them boost growth and economic development. Lack of well-developed financial market has exacerbated the effect of external public debt on Inflation. The increasing level of external debt in recent years has led to high budget deficit, inflationary pressure and plunged the countries into a vicious circle of debt financing. The study investigates the nature of the link between external public debt and inflation in West African Monetary Zone (WAMZ) countries namely Guinea, The Gambia, Nigeria, Sierra Leone, Ghana, and Liberia using annual

data from 1960 to 2022. Among the six countries, the relationship between external public debt and inflation differs. Ghana, The Gambia and SierraLeone show a negative relationship between Inflation and external public debt while Guinea, Liberia and Nigeria show a positive relationship between external public debt and Inflation.

Further, we used three periods of study. The first period is the pre-WAMZ period (1960 to 2000), the second period is during WAMZ (2001 to 2022) and the third period is the entire period (1960 to 2022). WAMZ showed different outcomes in the region and have different relationship and macroeconomic outcomes among the variables. The creation of WAMZ and the period during WAMZ changed some of the macroeconomic outcomes of the variables. The outcome for some of the variables in the tests and regression differ in the three periods for the same variable. Also, the study uses NARDL approach to examine increasing and decreasing impact of external public debt on inflation. The NARDL approach to cointegration examined whether external public debt has symmetric or asymmetric link with Inflation in WAMZ countries. This study uses Unit root test, Vector Autoregressive (VAR) and Granger Causality to ascertain the relationship among the variables and use WALD test to examine whether there is a long run or short run, symmetry or asymmetry relationship between external public debt and Inflation.

The Wald test showed long and short run asymmetric relationship exist while the NARDL showed a stable long run cointegration among the variables for the entire period, some cointegration and no cointegration in the during the WAMZ period and no cointegration among the variables in the pre-WAMZ period. The panel data regression for all the three periods shows that inflation is a positive function and has positive

relationship with external public debt. Positive shocks in total public debt are statistically significant in the short run and in the long run, and this suggests that the inflationary effect of positive variation in external public debt in the WAMZ countries. This finding lends credence to the Fiscal theory of price level especially the aspect that asserts that the government debt adds to household wealth and the demand for goods and services increases price pressures.

Despite the germane contributions of this study to existing literature, the lack of disaggregated data on the external public debt (domestic and total debt) limits the current study's analysis of external public debt. Accordingly, the study was unable to distinguish the impact of external and domestic public debt on inflation. Further research might use disaggregated data on public debt and other variables such as oil price and exchange rate, which have caused significant changes in inflation rate in the WAMZ countries to further investigate the non-linear relationship among external public debt, domestic public debt, and inflation in WAMZ countries to see whether the results would be different.

Based on the conclusion, this study recommends the following:

1) The WAMZ countries should initiate strategies of reducing external debt stocks. There should be increased accountability in the use of borrowed funds and debt refinancing. Hence, this will lead to a reduction in inflation and lower taxes.
2) Need for fiscal and monetary policy coordination between the Central banks and Ministry of Finance to enable the fiscal deficit to be brought to an acceptable level, achieve price stability, and monitor budget deficits.

3) Governments of these WAMZ countries and Sub-Saharan Africa should strengthen their institutions especially political, governance and financial institutions and make more efforts to reduce the level of public debt and Corruption. Borrowed funds should be used for production and investment and not for consumption.

4) Need for restructuring of government budget and spending from corruption prone investments to areas where they are properly managed, monitored, and accountable.

5) Efforts needed by the Central bank and central governments to manage inflation especially addressing the drivers of Inflation. The Central banks and commercial banks should support more small and medium enterprises to stimulate production, agricultural production, and manufacturing etc. With increases in these activities, the countries will generate more revenue, reduce inflation, and have more funds for government activities without borrowing.

CHAPTER 3

THE IMPACT OF REMITTANCES ON THE EXCHANGE RATES IN WEST AFRICAN MONETARY ZONE (WAMZ)

ABSTRACT

The study investigates the impact of remittances on the real exchange rate of West African Monetary Zone (WAMZ) member countries by using annual data from six countries from 1960 to 2022. The WAMZ member countries are Ghana, The Gambia, Nigeria, Guinea, Liberia, and Sierra Leone. Remittances are important sources of foreign capital for developing countries including WAMZ. It smooths consumption and propels investment and welfare among recipient countries and their families. The study is unique because it examines three periods namely: Pre-WAMZ (1960 -2000), During WAMZ (2001 -2022) and the entire period (1960 – 2022); captures and compares how the increase in the receipt of migrant remittances have affected the real exchange rate for the different periods given the huge increase in remittances in the last two decades; uses updated data for a longer period; and shows how the different explanatory variables changes in the three periods examined. Moreover, in this study, we empirically examine the short and long run impact of migrant remittances on real exchange rate for WAMZ using Panel data from World Development Indicators (WDI), OECD and West African Monetary Institute data base. The results show that the pre-WAMZ remittances have a systematic effect on the exchange rate, in During WAMZ period, there was no systematic effect of the relationship on the exchange rate. Some of the variables were significant in the different periods while others were not. Correlation and Multicollinearity tests were done, and the results reveal no multicollinearity among the variables; some variables have positive or negative relationship with the real exchange rate and many of

the variables had negligible correlation. Cointegration results reveal long run equilibrium relationship among the variables in the entire period, unit root tests show that variables became significant after first differencing. Granger causality test, VAR, Fixed and Random effects show that some of the variables are significant. Results obtained in this study reveal that remittances lead to real exchange rate appreciation for the WAMZ countries. The study recommends that governments should create investment like diaspora bonds to promote more contributions from remittances and need to understand the economic importance of remittances.

Keywords: Remittance, real exchange rate, panel data, West African Monetary Zone.

1.0: INTRODUCTION

Remittances from migrants pose an important source of income for households in many developing countries. The value is rising and its role in promoting better living conditions and economic performance are very important and visible. Acosta et al (2006) posit that migrant remittances are driven by increased international migration, technological advancement and financial competitiveness and these result in the fall in the cost of transmitting funds from one part of the world to another part. Migrant remittance is ranked second most important source of external funding for developing countries after foreign direct investment (World Bank, 2014; Mallick and Mahallick, 2005; Zouhaier, 2019).

Capital inflows have shown to be very important in the economies of developing countries, especially in the form of private capital inflow which is composed of foreign direct investment, employee remittance, and portfolio investment. The countries have witnessed a massive rise in these flows in the recent decades and the composition and

magnitude have witnessed a significant change. Remittances remain one of the major components of capital flows. The continents of North Africa, South Asia and Middle East have witnessed a constant increase in the level of remittances in recent years. According to the World Bank, Nigeria accounted for the highest remittances flow into Sub-Saharan Africa in 2022. Remittance flow into the Sub-Saharan Africa was $53billion, with Nigeria having 38percent ($20.1 billion), next is Ghana and Kenya with $4.7 and $4.1billion respectively (World Bank, 2023). Growth in remittances to Middle East and North Africa declined by 3.8 percent to $64 billion in 2022 despite strong growth of 12.2 percent in 2021. The World Bank report asserts that the overall rise in remittances to the Sub-Saharan African region have helped several struggling African countries that are grappling with drought, flood, and debt servicing issues.

Further, governments of many developing countries including WAMZ have since realized the important role that migrant remittance plays as a source of external finance. Remittances emanate from migrants when they send money back home to their families; this serves as an important lifeline for the countries and comprise a share of the gross domestic product (GDP) for the recipient developing countries. On the contrary, remittances can make it difficult to understand the influence of global finance on national policy choices that exist in the developing world. Remittance is considered a form of capital inflow not requited and do not result in claims on assets, debt service obligations or other contractual obligations that may arise (Brown 2006; Kapur, 2005). Conversely, remittances cannot be withdrawn from a country’s export and cannot be merged with other capital flows that cause household insecurity such as FDI, portfolio flows etc. (Ahlquist, 2006; Garrett, 1998; Scheve and Slaughter, 2004).

Studies reveal that migrants increase their remittances to their families and home countries when they experience economic difficulties. Hence, remittance serves as inflow of income for families and protect policy makers from inconsistencies and any negative effect from the global economy. The financial transfers from the migrants serve as a form of insurance and buffer for developing countries against some exogeneous shocks (Kapur, 2005; Lopez-Cordova and Olmedo, 2006). “Over the years, there has been a continuous increase in migrants to advanced regions of the world from virtually all the countries of West African Monetary Zone (WAMZ). For example, the Migration and Remittance fact book (2011) revealed that there were about 4.6 million new migrants annually compared with about 2 million per annum between 1990 and 2000; and 3.6 million per annum between 2010 and 2013. A cursory look at this and other similar reports show that countries of WAMZ contribute significantly to the upward trend within the West African sub region. This, no doubt has resulted in the continuous increase in remittances inflows to these countries” (Iseghohi, 2020). For WAMZ countries, official figures from World Banks’ World Development Indicators (2015) posit that remittances inflow exceed FDI and Official ODA, inflows (Official development Statistics).

Similarly, Migration and Remittances factbook (2011) assert that Nigeria was one of the highest remittance recipient countries in 2007, 2008, 2009 and 2010 among Sub-Saharan African countries. For Ghana, Quartey (2006) suggests that remittances are becoming potential sources of foreign exchange and its magnitude exceed the amount of ODA to Ghana. Total remittances flow to Ghana stood at $1.9billion as at 2008 (Bank of Ghana, 2009). Increasing trend in remittances inflow had been reported in other

WAMZ countries in recent time as well such as Liberia, The Gambia, Sierra Leone, and Guinea. From the increasing trend, studies show that net remittances flow to WAMZ countries between 2004 and 2015 recorded positive flows (World Bank, 2016). Cooper (1999) considers exchange rate policy as arguably the most important macroeconomic policy domain for governments in developing countries. Given that exchange rate affects the price of all other goods and services because it is considered the most important price in an open economy, exchange rate policy contains important trade-offs (Bernhard and Leblang 1999; Broz 2002; Cohen 1993; Frieden 1991; Leblang 1999; Walter 2008). Fixed rates are chosen by policy makers to promote international trade and investment and serve as anchor for monetary policy, but the fixed rates have limitation and unable to adjust monetary policy when faced with changing domestic circumstances. However, floating exchange is better preferred by policy makers because it can adjust interest rate in reaction when there is economic downturn or exogeneous shocks. Singer (2010) suggests that remittances are an essential influence on exchange rate policy making in developing countries, their political institutions, interest groups and political economy considerations. Remittance help mitigate the political cost of failed monetary policy autonomy because of their countercyclical effect on economic downturns and ability to insulate policy makers from existing economic volatility and downturn, and then serve as a substitute for domestic monetary policy autonomy for developing countries. The remittance inflows have a positive relationship with the implementation of a fixed exchange rate, and this can be buttressed by applying conventional macroeconomic models. Models of Robert Mundell (1961) optimum currency area framework provide a basis to argue that migrant remittance

serves a similar role as cross-border government transfers in the way they allow domestic economy to adjust to fixed exchange rate.

Research Problem

In recent decades, developing countries have received a lot of cross-border remittance flows. The WAMZ member countries have benefitted from remittances inflow in the form of transfers to embassies, churches, non-governmental organization which have received billions of dollars. Although remittances have contributed to the WAMZ member countries' economies, these suppositions have not been backed by funding from any rigorous macro-econometric study (Adenutsi and Ahortor, 2008). The Central banks have not shown leadership by providing adequate monetary policy formulation to attract maximum remittances to these countries.

Further, remittances appear to be a challenge in the understanding of the influence of global finance on national policy choices in the developing countries. Remittance is a form of capital inflow and has some unusual characteristics such as they are 'unrequited' and hence do not result in claims on assets, debt services obligation or contractual obligations (Brown 2006; Kapur, 2005).

On the other hand, since purchases of financial or productive assets can be liquidated, remittances cannot be withdrawn from a country expose and not lumped together with other capital flows that cause household insecurity or income volatility e.g FDI and portfolio flows (Ahlquist, 2006; Garrett 1998; Scheve and Slaughter, 2004). Migrants tend to increase remittances they send to their countries when their home countries experience wars, famine or any economic difficulties as these remittances help smooth the income of families and protect them from the uncertainty and

inconsistencies of the global economy. Financial transfers and inflows from migrants can serve as a form of insurance for developing countries against exogeneous shocks (Kapur, 2005; Lopez-Cordova and Olmedo, 2006; Lucas and Stark, 1985). Remittances are faced with endogeneity. This is evident when there is appreciation of exchange rate after a substantial inflow of resources from one sector to another and the remittances are endogenous to exchange rates which then tend to lead to reverse causality and measurement error; hence considered as sources of endogeneity.

Motivation for the Study

Remittances inflow into the countries of WAMZ have been significant and can no longer be ignored. Remittances flow into the WAMZ countries in dollars, pounds, Euro and other foreign currencies. Remittances come from citizens of WAMZ who live abroad, immigrants who work abroad and send money to their families, loved one and home government. Remittance received by people and countries differ largely because they have more of their citizens abroad who care for them. The population of the citizens in their home countries and in diaspora differs. E.g. in Nigeria, citizens from Southern part of Nigeria travel a lot more and constitute a huge part of Nigerians abroad while the citizens of the Northern part travel abroad less. Therefore, Southern Nigerians get more remittances than Northern Nigerians. The remittance per capita gives us a perspective of the amount of remittance received by the individual or families or country since the population is factored in.

Moreover, remittance from citizens living abroad is now a component of the Government revenue and GDP in WAMZ countries. Countries receive billions of dollars annually from remittances inflows. The exchange rate is the currency of the WAMZ

country vs the US dollars. The remittances exert positive and significant impact through increase in consumption, trade openness, increase in domestic investment and economic growth which increases or appreciates the real exchange rate. Nigeria and Ghana have very many citizens living abroad and there has been huge migration from these WAMZ countries in recent decades. Given the high and increasing youth population, the failure of government to meet employment and other needs have propelled a surge in emigration to Western hemisphere in search of better life and opportunities.

Remittance flows are a component of capital inflows, and it is stable even when private capital flows tend to decrease, the remittance remains stable. The countries of WAMZ receive remittances from their citizens who are highly skilled emigrating workers whose departure created labor sabotages. If the remittances are large, the recipient WAMZ countries face appreciation of real exchange which can make their economies less competitive internationally.

Remittances in WAMZ countries have improved the welfare of the recipients, increased domestic demand, affected the domestic interest rate, relative prices of non-tradeable goods and the monetary policy of the Central Bank. Hence, the interaction of remittances with theoretical determinants have caused variations (appreciation and depreciation) in Exchange rate.

The main Objective of this study is to determine the impact of Remittances on the exchange rates of WAMZ member countries.

There is widespread general belief that remittances have contributed to the economy of WAMZ member countries, but this assertion has not been backed by many

macro-econometric studies. The role played by the Central bank in monetary policy formulation to attract maximum cross-border remittances to member countries still lacks some perspectives. Remittances have assisted receiving countries in poverty and inequality reduction, enhancement of human capital and financial development, reduction of labor supply, appreciation of real exchange rate and weaken the tradeable sector of receiving countries.

The research question of this study is to assess the impact of remittances on the currencies and exchange rate of the WAMZ countries.

Remittances flows are largely influenced by migrants who depart their home countries and community in search of greener pastures in advanced countries. The continuous increase in migrants to advanced regions also comes from WAMZ member countries which have contributed significantly to the upward trend within Sub-Saharan Africa and to continuous increase in remittances inflows to these countries.

WAMZ is a monetary union. The presence of WAMZ has influenced the flow of remittances has on the exchange rate. The pre WAMZ period (1960 to 2000), the during the WAMZ period (2000 to 2022) and the entire period (1960 to 2022) shows how WAMZ has exhibited different effects of remittances on the exchange rate.

Theories such as altruism, self-interest portfolio management e.t.c have motivated remittances flow and driven by need to cater for the welfare of relatives back in their home countries and communities. Johnson and Whitelaw (1974) state that altruism is a major consideration for the flow of remittances to any country. This position was buttressed by Lucas and Stark (1985) who assert that the motive for remitting is pure altruism and care of those left behind in their home countries.

Several theories of exchange rates, especially the ones that relate to remittance have explained the motive for remittances. One of such theories is Pareto theory which opines that improving exchanges between the migrant and the household based on the services the household members perform on behalf of the migrant. The agents (household) determine the outcome and division of gains based on their relative bargaining powers and their external options which is found somewhere between the market price for such services and the opportunity cost of the recipient (Rapoport and Docquier, 2006). Based on this theory, non-negatively constraint is binding, and the last unit of remittances sent by migrant to the household (recipient) is not equivalent to the agent marginal utilities of consumption, but it compensates for the services performed by the household.

Policymakers and Economic development experts have asserted that remittances have emerged as an essential source of development finance in developing countries since the 1980s especially when these countries experience dwindling official development, development assistance and inadequate private capital. Remittances complement scarce domestic resources (Adenutsi and Ahortor, 2008). Remittances play a significant role in raising the level of technological development especially through financing income-generating value-added projects, help to boost consumer sovereignty, promote exports, thus improve the benefitting country's Balance of Payment (BOP) and international reserves.

Furthermore, Africa and other developing countries have experienced flows of remittances especially given the unending difficulties in accumulating adequate international reserves which stems from the over dependency on imports of high-value

manufactured products and other essential commodities given the prevailing narrow weak export base of low-value primary commodities. “The implication is that the understanding of the underlying factors of remittance inflows is crucial to reserve sustainability and management. Since the significant role of remittances in propelling the development agenda of Africa can no longer be ignored in any contemporary development model, there is need to offer incentives to attract these transfers into developing countries. It is also imperative to examine the exchange rate and monetary policy implications of remittance inflows to developing countries like Ghana, as increasing inflows could lead to growth in money supply, exchange rate appreciation and reduction in interest rate and foreign debt among others”. (Adenusi and Ahortor, 2008). Siddique (2010) and Obadan (2012) assert that remittances is crucial in bridging the foreign exchange gap in the economy, hence help facilitate international trade especially importation of capital and intermediate goods that are required to boost domestic production capacities.

Remittances play a role in mitigating economic volatility (Frankel, 2009). Studies conducted by the IMF (2005) discovered that remittances significantly reduce the volatility of output, consumption, and investment. Despite having periods of stable economic growth, remittances are seen to be far less volatile than other capital flows, with foreign and showing more volatility than remittances from 1980 to 2003 (IMF, 2005). There is a need for a scholar to emphasize the insurance function of remittance for the developing world (Kapur, 2005; Kapur and McHale, 2005; Yang and Choi, 2007). Also, copious scholars believe that countries require some form of insulation from shocks from the global financial market e.g. welfare state spending, a larger

government, or some form of redistribution etc. (Garrett, 1998; Katzenstein, 1985). Political economy models are expected to pay careful attention to the unique influences of remittances on policy making whereby remittances can serve as a form of insulation rather than be source of insecurity or volatility.

However, many studies have not done enough research about the fundamental macroeconomic factors influencing remittance flows, and the impact of remittances pose on the economy of WAMZ member countries. For this study, we shall perform some tests and regressions for the three periods (pre-WAMZ period, during WAMZ period and entire period) to ascertain if the WAMZ formation has fundamentally altered the link between remittances and exchange rate.

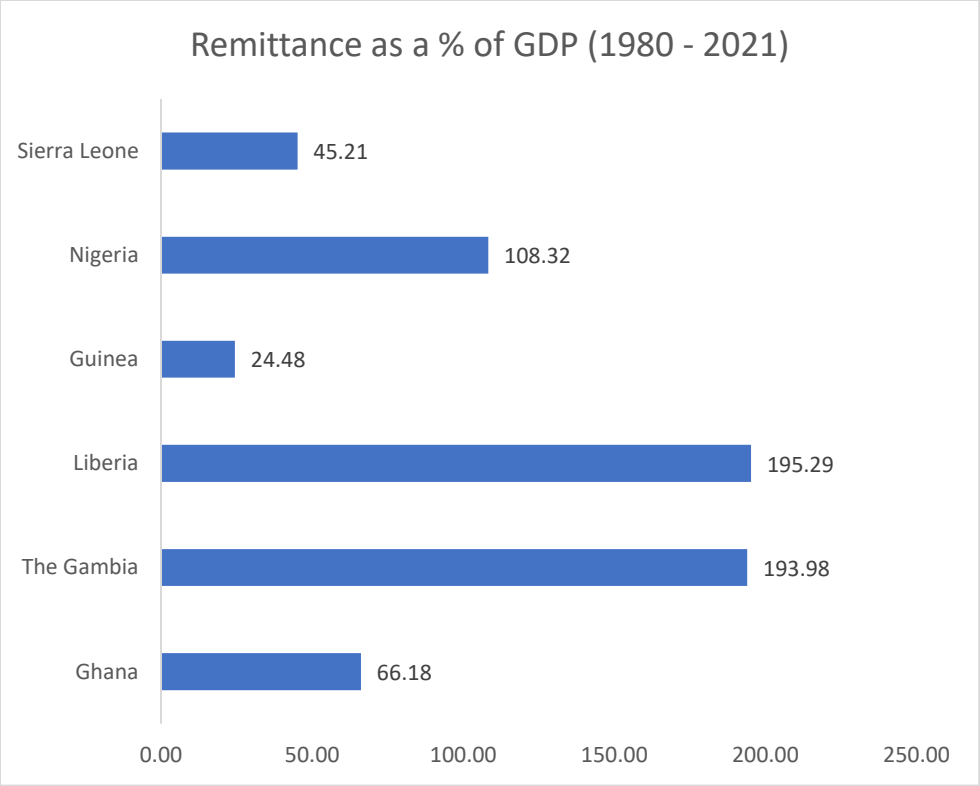
Contributions of the Study

The formation of WAMZ in 2000 has shown some significant effects in the exchange rate policies of member countries of the WAMZ. Studies reveal that prior to WAMZ formation, member countries had divergent real exchange rates. After WAMZ formation, a growing convergence in real exchange rate was observed among four countries namely: Nigeria; Sierra Leone; The Gambia; and Liberia (Nketiah et al, 2019). The WAMZ member countries have three exchange rate policy regimes namely fixed exchange rate regime; the intermediate; and the flexible or free-floating regime. The appropriate exchange rate regime is a key factor in achieving the proposed single currency (ECO). Given that WAMZ has the intention of deepening economic integration in the Economic Community of West African States (ECOWAS), the economic cost include the associated nominal exchange rate flexibility which serves as a policy instrument and buffer for adjusting asymmetric shocks.

Exchange rate is considered the most important price in an open economy and arguably the most important macroeconomic policy domain for governments in developing countries (Cooper, 1999). Remittances are important in influencing exchange rate policy making in WAMZ member countries; they also influence political institutions, interest groups and other aspects of the political economy. Remittances alleviate the political costs of lost monetary policy autonomy especially as they react in a countercyclical way to economic downturn and then insulate policy makers from economic uncertainty and volatility.

Remittances contribute in a positive way to the implementation of fixed exchange rates and have the capacity to act as a surrogate for domestic monetary policy autonomy in the WAMZ and other developing countries. Using Robert Mundell's (1961) optimum currency area framework, Singer (2010) posits that migrant remittances have a similar function as cross-border government transfers in the way they allow domestic economy to adjust to fixed exchange rate.

From a micro-level perspective, foreign remittances can elevate the financial status of individual households, improve family financial stability, and conspicuously improve their quality of life and their ease of access to social benefits. Also, remittances can stimulate economic productivity, boost entrepreneurship, and drive technological advancement (Azizi, 2021).



Source: World Development Indicator

Remittance contributes significantly to the GDP of many WAMZ countries. Data from World Development Indicator (WDI) show that Liberia received remittances and it contributes the highest to its' GDP compared to other WAMZ member countries. This shows the huge efforts and altruism of their immigrants towards giving back to their families back home and their country. The study contributes to existing literature and knowledge on how remittances inflows can be controlled or promoted because it makes significant contribution to productivity and the economy of WAMZ. Trade is promoted and economic activities are sustained with remittance inflows.

Hypothesis

Null Hypothesis: H_0: Remittances have no significant impact on the Exchange rate in WAMZ.

Alternative Hypothesis: H_A: Remittances have significant impact on the Exchange rate in WAMZ.

2.0: LITERATURE REVIEW

Theoretical Review

Several studies capture the effect of remittances on the exchange rate. Hassan and Holmes (2013), Lartey et al (2012) and Maklouhf and Mughal (2013) assert that persistent inflows of remittances exercise upward pressure on the long run real exchange rate, which then results in Dutch disease effects related to a decline in the competitiveness of receipts' countries tradeable sectors. Given the interests in Fiscal Policy, Abdih et al (2012a) place emphasis on the impact of remittances on government revenues, then estimate for several recipient countries, the fiscal implications of the cut back in worldwide remittances in 2009 emanating from the global financial crisis. Abdih et al (2012b) investigate the adverse impact that remittances have on the quality of institutions through two main channels namely: the expansion in the revenue base distorts government incentive which lowers the cost of appropriating resources for its own purpose; and the supplemental income available to households increases their ability to purchase goods and substitutes for government services.

Clemens and Mckenzie (2014) examine the failure to detect a generalized positive contribution of remittances to growth in literature and blame it on three main factors: measurement error; lack of power of conventional panel regression; and the offsetting effect of outward migration. They link increase in remittances to migration outflow, which tend to exert negative growth effect. On the other hand, Benmamoun and Lehnert (2013) utilize a panel GMM methodology for a sample of low-income countries

during 1990 -2006 and discover that remittances contribute positively to the growth in these countries more than FDI or ODA flows. Ramirez (2013) utilizes a fully modified OLS technique on some Latin American and Caribbean countries between 1990 -2007 and discover a positive impact of remittances, and it was greater for the lower -income countries in the region.

Ramirez (2013) extends to interacting remittances with institutional and financial sector variables and discovers that a stronger growth impact in countries with higher quality institutions and low levels of financial development. These results are in consonance with the finding of Guiliano and Ruiz-Arranz (2009) using a wider country sample. Both studies imply that remittances received in financially underdeveloped countries serve to relax financing constraints. Mandelman (2013) builds and estimates a general equilibrium model for a small open economy with volatile remittance inflows and acknowledges the properties and welfare implications of divergent monetary and exchange rate regimes. However, these studies assume that there exists a well-functioning financial system and achievable transmission mechanism that links changes in the policy rate to the lending behaviour by financial intermediaries.

Furthermore, Amuedo-Dorantes and Pozo (2004) examine the impact of workers' remittances on real exchange rate using a panel of 13 Latin America and Caribbean countries. Using instrumenting for remittances leads to a conclusion that remittances appreciate real exchange rate in remittance-receiving countries. Hence, remittances have the potential to enforce economic costs on the export sector of receiving countries by reducing their ability to compete internationally. They utilize a set of variables that are related to remittance -receiving countries as instruments for remittances. Ball et al,

(2013) utilize a panel consisting of 21 countries and show theoretically and empirically that remittances appreciate real exchange rate under both flexible exchange rate regime and fixed exchange rate. Lartey et al (2012) use a panel data set that comprises 109 developing and transition countries from 1990 to 2003 and discover that rising level of remittances have spending effect that leads to real exchange rate appreciation and the effects of resource movements that benefit the non-tradeable sector at the expense of tradeable goods production.

Acosta et al (2009a) examine the effect of remittances on the real effective exchange rate based on the condition of the level of financial sector maturity present in developing countries. Similarly, they discover that remittances can increase the exchange rate (appreciation). Hassan and Holmes (2013) investigate the long run relationship between remittances and real exchange rate for some less developed countries. They discover a small inelastic, but significant and long run relationship which confirms the presence of Dutch disease effect. Investigating the short run relationship between remittances and exchange rate using panel vector error correction model, Hassan and Holmes (2013) confirm that remittances appreciate exchange rate. Studies by Barajas et al (2011) reveal regional differences in the impact of remittance on real exchange rates. The Middle East North African countries tend to experience the typical upward effect of increasing remittance inflow on the real exchange rate and Asian countries and Asian countries experience less effect. Beja Jr (2011) reveals that Dutch disease caused by international remittances besets the middle-income countries, but not the upper income and low-income countries. Alonso Gonzalez and Sovilla (2014) discover that remittances cause the Dutch disease, and they proffer demand

policies combined with Central bank purchases of foreign currency in the FOREX market with the aim to neutralize the negative impact of remittances on exchange rates. Mandelman (2013) use data for the Philippines to estimate a general equilibrium model for a small open economy and infers that remittances have a steady increase and there is equilibrium level of real exchange rate appreciation. Sapkota (2013) examines impact of remittances on Nepal's economy and conclude that remittances have reduced poverty and inequality and contributed to Dutch disease effect and real exchange rate appreciation.

Acostal et al (2009b) use Bayesian method and Salvadorian data to build and estimate a general equilibrium model for a small open economy and assert that increase in remittances cause Dutch disease effects. Bourdet and Falck (2006) reveal that inflow of remittances to Cape Verde exerts an appreciating effect on the real exchange rate and contributes to the deteriorated competitiveness. Makhlouf and Mughal (2013) examine Pakistan and conclude that aggregate remittances and remittances from Persian Gulf contribute to the Dutch disease in Pakistan, but those from North America and Europe do not contribute.

Additionally, copious papers in literature have made known the endogeneity concern in examining the impact of remittances on exchange rate. Remittances tend to be endogenous to real exchange rates in the remittance-receiving countries. The endogenous relationship present between workers' remittances and real exchange rates can be demonstrated by reverse causality.

Azizi (2021) asserts that there exists a reverse causality between real exchange rate and remittances. Remittances impact the real exchange rate and vice versa. E.g

Faini (1994) asserts that real exchange rates play an important role in affecting the remittance behaviour of migrants in a sample of five Mediterranean countries. Yang (2008) reveals that appreciation of migrants' currency against the Philippine peso leads to a rise in household remittances from overseas.

Empirical Review

Edwards (1989) attempts to explain exchange rate volatility by using a theoretical model to capture the long run and short run fluctuations that exist in the exchange rate of developing countries. He displayed a dynamic small open economy model to explain the effect of nominal and real variables on the real exchange rate. The theoretical model posited that equilibrium real exchange rate is determined by real variables which can affect the long run equilibrium real exchange rate and the model was tested using 12 developing countries with data from 1962 to 1985. The results reveal that nominal variables affect the real exchange rate only in the short run while in the long run, the real exchange rate is affected by only real variables. Ahmed (2009) affirmed the Dutch disease hypothesis for Pakistan by estimating a linear regression model using variables namely Terms of trade, government spending, degree of openness, workers remittances, Foreign direct Investment (FDI) and real exchange rate. Workers' remittance was considered as a separate explanatory variable because of its importance for the Pakistani economy. The results reveal that there were increases in all the various forms of capital inflows which led to real exchange rate appreciation. Further, studies by Lopez et al (2007) explain the impact of remittances on real exchange rate using selected Latin American countries. The results suggest that high flows of remittances to these countries lead to a significant appreciation of the real

exchange rate. Another study by Amuedo-Dorantes and Pozo (2004) for Latin American countries obtained results that were similar to Lopez et al (2007) and concluded that the appreciation of the real exchange rate of these countries due to increased level of remittances led to a reduction in their competitiveness and a reallocation of resources to the non-tradeable sector. However, not all studies support the assertion that large capital flows lead to exchange rate appreciation. Acosta et al (2009) and Holzner (2006) discovered strong evidence that supports Dutch disease in their empirical studies. Barajas (2010) and Fayad (2010) reveal that remittances tend to appreciate the real exchange rate only under certain economic circumstances that are specific to each country. The circumstance is that such countries will have more open capital accounts and a low level of trade to experience real exchange rate appreciation that is caused by increased levels of remittances.

Moreover, Okolie (2023) argues that the role of diaspora remittance as an economic development tool show concern that continued currency appreciation because of high inflows could lead to Dutch disease phenomenon. Several factors influence the decisions of immigrants to remit money home from abroad.

Englama (2007) posits that some countries make deliberate efforts to attract remittance as a source of external financing given the impact of foreign exchange rates on the foreign reserve. Studies by El Sakka and McNabb (1999), Russell (1986) discovered the determinants of diaspora remittances which include level of economic activity in the host and home countries, wage rate, exchange rate, inflation, interest rate and the efficiency of the banking system as a contributory factor to remittance flows in countries.

Faini (1994) discovered evidence that the real exchange rate is a significant determinant of diaspora remittance. Swamy (1981), Straubhaur (1986), Elbadawi and Rocha (1992) assert that real earnings of workers and total number of migrants in the host countries have a significant and positive effect on the flow of diaspora remittance.

Remittances and Exchange Rate Regime Choice

Capital mobility plays an important role and influence in the political economy of exchange rate regimes. Some studies consider capital mobility as sensitive to capital flows and domestic rates of return (Goodman and Pauly, 1993). The exchange rate regime is an indicator of financial policy openness based on the IMF surveys conducted on capital controls, and it is considered as a measure of a country's relationship with international financial markets (Quinn, 1997). Financial openness makes a fixed exchange rate less attractive and unlikely to be adopted.

Further, for developing countries, the inclusion of remittance into the political economy model of exchange rates does not signify the abandonment of the Mundell-Fleming condition. Mobile capital is a reliable response to different rates of return including countries that are highly dependent on remittances. Considering the impact of increase in remittances during periods of uncertainty such as recession in the receiving country, studies show that household utilize the funds from remittances to boost their consumption of food and other necessities and it helps to maintain their small businesses, investment, and necessities.

Remittance is important and different from capital flows because they do not aggravate the trade off between fixed exchange rates and domestic monetary policy autonomy. "Remittances are not a panacea for economic instability and are unlikely to

prevent recessions or to respond with enough force to allow a country to sustain a fixed rate in the face of a massive speculative attack" Singer (2010). Therefore, the inflows from remittances make it less expensive for countries to adopt fixed rates.

Additionally, Robert Mundell's (1960, 1961) analyses of optimum currency areas (OCAs) avails a useful perspective on the relevance of remittances in the determination of exchange rate policy. The OCA framework amplified by Mckinnon (1963) posits that countries that choose to share a common currency should respond in a similar way to economic shocks like sudden changes in prices of different commodities. This implies a single monetary policy for a single currency. In a similar vein, for countries with fixed exchange rate to US dollar, the countries essentially import US monetary policies. A single monetary policy is grossly inadequate in stabilizing the economy of different countries if their economic conditions vary substantially across different regions of the currency area. Given the presence of asymmetric shocks, even in economically homogeneous currency unions, countries tend to adjust their own domestic economy to enable it to conform to the prevailing monetary policy. The optimum currency area (OCA) literature emphasizes two adjustment mechanisms:

1) Labour mobility in the union should be high to enable workers in adversely affected regions to relocate to more favorable employment environments.
2) The currency union should have a system of public transfers from supra-regional authority (risk sharing) to enable it respond to local shocks just as the Federal government of the US sends emergency funds to states in times of crisis (Singer, 2010).

With respect to risk sharing, many developing countries including WAMZ member countries depend on remittances to offset the effects of economic downturns. Although remittances are not fiscal transfers per se and no central government can direct them to send to their countries, remittances enable countries to give up some of the risks associated with forgone monetary policy autonomy to migrants, who then remit funds to their families in a countercyclical way.

3.0: METHODOLOGY

Theoretical Model

Mundell (1963) and Fleming (1962) provide a framework for how macroeconomic policies are conducted in the presence of capital flows. The Mundell-Fleming model is an extension of the IS-LM model in an open economy setting with the hallmark assumption of sticky prices (Mark, 2001). Traditionally, the Mundell – Fleming models generally deal with fiscal and monetary policy effectiveness in the presence of global capital mobility that exist within the regimes of flexible or fixed exchange rates. These models could predict the impact of domestic and external shocks and the co-movement of macroeconomic variables at home and abroad.

Even though these Mundell- Fleming models have short comings such as being static and do not consider dynamic effects of capital and asset accumulation and ignoring inter-temporal links and restrictions, the traditional Mundell-Fleming model has been modified to overcome some of the deficiencies. To overcome the static model, expectations were incorporated to make it dynamic. The modification and incorporation have produced two types of models namely:

1) Deterministic Dynamic Mundell-Fleming models
2) Stochastic Dynamic Mundell-Fleming models. (Adenutsi and Ahortor, 2008).

Dornbusch Overshooting Model is an example of deterministic dynamic Mundell - Fleming model and this model exploits the slow adjustment present in the goods markets and the instantaneous adjustment in the asset markets to justify why the exchange rate may be more volatile that its underlying fundamentals in a deterministic and perfect foresight environment (Mark, 2001).

Obstfeld Stochastic Model is an example of the stochastic dynamic Mundell-Fleming models, and this model explains how nominal and real shocks can generate a modified form of exchange rate overshooting. This model predicts that when demand shock is positive, the exchange rate rises above its shadow value. And when there is supply shock, the exchange rate falls below its shadow value.

Empirical Model

To examine the impact of remittance inflows on exchange rate, a model takes cognizance of various theories and outcome of previous empirical research such as Gapen & Montiel (2008) Quartey (2006) Vargas -Lundius (2004) Rapport & Docquier (2006) were specified. The empirical model takes insights from the theoretical model in the choice of variables for the model and shows the relevance of the variables in explaining the theoretical framework and relationship. The justification for the variables is backed by economic theory on how the variables individually influence the personal remittances and it expresses the functional relationship between the dependent variable and these independent variables.

In the light of the above and drawing insights from Nketiah et al (2019), Loto and Alao (2016) and McMahon (1998) models, this model posits that real exchange rate is a

function of per capital remittances received, per capita income, trade openness, ratio of government expenditure to GDP and capita flow.

ERR = f (PCR, PCI, TOP, GEX, CI)

Method of Analysis

The nature of the study entails the use of panel data for the period 1960 – 2022. Panel data is apt because it can identify parameters in the occurrence of measurement error and have robustness to omitted variables and the capture the efficiency of parameter estimates. The panel robust least squares (Panel RLS) estimator would be used to estimate the model for impact of remittance on exchange rate in WAMZ. The choice of this estimator is because it accounts for biasness introduced in the regression model by outliers which makes the results from the panel ordinary least squares estimator not reliable. The variables would be tested for unit root and cointegration test would be performed to determine if there is a long-run relationship among variables of the model or not.

The study captures three periods to enable us to explain the effect of WAMZ. The three periods are:

Pre-WAMZ period (1960 to 2000)

During WAMZ period (2000 to 2022)

Entire Period (1960 to 2022)

Data description: The data type is secondary data, and it uses a panel data set for the six countries of WAMZ. The countries comprise Nigeria; The Gambia; Guinea; Sierra Leone; Ghana and Liberia. WAMZ is our focus because it is an important monetary union that is instrumental in the promotion of regional integration and development of

sub-Saharan Africa and provides an institutional framework for policy discussion and implementation. The period of study is 1960 -2022 based on availability of data.

Research Question

How does remittance impact the exchange rate and currencies of the WAMZ countries?

Remittances can propel the growth of new small-scale businesses and then foster entrepreneurship by relaxing credit constraint for receiving countries. Remittances can mitigate the exchange rate volatility derived from the outflow and export by providing an indirect stabilizing effect of exchange rate volatility in times when other kinds of capital flows experience fluctuations and then offer regular source of foreign currency into the receiving country economy.

Data from six WAMZ countries from 1960 to 2022 would be used to investigate the impact of remittances on real exchange rates and net exports.

Net exports will require the instruments to address endogeneity of workers' remittances and the instrumental variables are weighted average per capita GNI, unemployment rate and real interest rate of remittance sending countries.

Model:

We use a panel of six countries in WAMZ to analyze how workers' remittances affect real exchange rate and net exports. We estimate the relationship and can be written as

$$E_{it} = \beta_0 + \beta_1 R_{it} + \beta_2 I_{it} + \beta_3 OP_{it} + \beta_4 X_{it} + \beta_5 CF_{it} + \alpha_i + \delta_t + \varepsilon_t$$

Where

E_{it} = real exchange rate

R_{it} = per capita remittances received by country I at year t

I_{it} = Per capita income

TOP_{it} = Trade Openness = (import + export/GDP)

X_{it} = ratio of government expenditure to GDP

CF_{it} = Capital flow (FDI + foreign aid)

δ_t= time fixed effect

α_i = country fixed effect

$\mathcal{E}_{it}$ = Error term

ε = Error term

Based on apriori expectations, we expect that: $\beta_1 > 0$, $\beta_2 > 0$, $\beta_3 > 0$, β_4 </> 0, $\beta_5 > 0$

The real exchange rate for the country I at time t is defined as

$E_{it} = e_{it} \times P_{us}/P_{it}$

e_{it}=nominal exchange rate

P_{it} = price index

P_{us} = US price

Price index can be the GDP deflator or CPI.

We check for autocorrelation and heteroskedasticity and overcome that using Newey-West heteroskedasticity and Autocorrelation consistent (HAC) Standard errors. Endogeneity problems from remittances will be addressed using instrumental variables namely per capita GNI in remittance-sending countries, unemployment rate in remittance sending countries and real interest rate in remittance sending countries.

Variables used in the Model.

Real Exchange rate: After conversion to a foreign currency, the real exchange rate informs us of how many times goods and services can be purchased abroad than

purchased in the domestic market for a specified amount. Changes in real exchange rates are important because they tell us how much of the goods and services in the domestic country can be exchanged for goods and services in a foreign country. Citizens of WAMZ countries receive remittances in foreign currencies and they convert it to their local currency which is utilized in their domestic markets for the purchase of goods and services.

Per capita remittance received: The per capita income is an important indicator of the growth and development of a country especially as it provides the perspective of how well the economy is doing for its citizens. The number of people who receive remittances (population) has been increasing in recent years as given by the amount of remittances per population. Citizens that receive high remittances tend to have higher per capita income and enjoy better consumption and wealth distribution especially in a small economy and WAMZ. Studies show that workers' remittances received have negative correlation with the real GDP per capita in the home country. This underscores the microeconomic underpinnings of remittances especially in the person-to-person transfers. In the model, the per capita income captures the well-being of the people of WAMZ after receiving remittances.

Per capita income: This is the measure of economic growth and well-being which captures the amount of money earned per person in a country in a period. This reflects how well the economic well-being of the people is. Aggregate price levels across WAMZ are positively related to the per capita income. Data on sectorial productivity levels for each country show how real exchange rates rely on cross country differences in sectorial technology to explain the relationship between real exchange rate and GDP

per capita. The real exchange rate depends on differences in capital shares, differences in intermediate input shares across sectors and differences in aggregate productivity present across country. In this model, the per capita income is important in explaining the aggregate productivity and difference in input shares across WAMZ which shape the real exchange rate.

Trade Openness: Trade openness drives economic growth and investment, and it shows how free or how restricted a country's trade relations are with the global community. The relationship with the real exchange rate shows that the appreciation of the real exchange rate makes the domestic product more expensive for the rest of the world, hence decreasing its demand. Increase in trade openness makes the currency market absorb more of the impact from real shocks and then appear to be more affected by the nominal shocks. With trade openness for more countries, this leads to better economic growth and better working conditions for the people.

Ratio of government expenditure to GDP: Increase in government spending stimulates aggregate demand and then leads to real GDP growth. The growth can lead to job creation, more income, more consumer spending, and an increase in aggregate demand. Increase in government purchases leads to appreciation of real exchange rate and increase consumption in developing countries including WAMZ. An increase in government expenditure increases spending, output, and employment. The appreciation of real exchange rate deteriorates current account in all countries because it puts pressure on the domestic currency to appreciate, hence there is depreciation of domestic currency trade balance deficit caused by increase in government expenditure.

Data for the General government final consumption expenditure is the proxy for this variable.

Capital Flow: Capital flow leads to a loss of competitiveness which can be caused by appreciation of the real exchange rate. The significant appreciation of the real exchange rate can cause a sudden decrease in capital flows which widens the current account deficit and causes a sudden reduction in the current account. These create problems for investment and macroeconomic management in the countries. The rise in remittances and foreign direct investment observed in some countries of WAMZ leads to a surge in external financing and this shows the impact of capital flows on the domestic economy which can be captured largely through the real exchange rate. The aggregate capital inflows which comprise public and private flows are very associated with real exchange rate appreciation; hence this justifies the presence of the variable in the model. Data on Foreign Direct Investment (FDI) inflow is used as a proxy for capital inflow.

Estimation Techniques

The OLS regression technique will be used to analyze the data. Stationary tests, cointegration, Augmented Dickey-Fuller and unit root tests will be applied. Additionally, Fixed effect, random effect and stability tests will be applied. Descriptive statistics and diagnostic testing such as the Multicollinearity and Pearson correlation test will be implemented in this study.

4.0: ANALYSIS, INTERPRETATION AND DISCUSSION OF RESULTS.

Real Exchange Rate Descriptive Statistics

	Sierra Leone	Nigeria	Liberia	Guinea	Ghana	The Gambia
Mean	169.028	147.313	360.364	265.962	358.871	170.887
Median	142.626	133.162	356.978	268.789	141.745	201.211
Maximum	561.187	536.910	414.894	301.678	3053.589	269.888

Minimum	91.352	49.776	304.784	213.897	68.182	72.758
Standard Deviation	92.860	94.801	40.060	33.392	474.284	57.618
Skewness	2.532	2.328	0.273	-0.504	3.631	-0.359
Kurtosis	9.589	8.644	1.693	1.680	19.264	1.838
Jarque-Bera	181.287	140.520	5.267	7.233	832.860	4.889
Probability	0.000	0.000000	0.072	0.027	0.000000	0.087
Sum	10648.760	9280.723	22702.91	16755.58	22608.92	10765.86
Sum Sq Dev	534630.401	557216.3	99502.11	69135.29	13946619	205835.6
Observations	63	63	63	63	63	63

Source: Researcher's computation from WDI data

The average real exchange rate of Liberia is the highest among the six countries of WAMZ for the 63-year period while Nigeria recorded the lowest average real exchange rate among the WAMZ countries for the same period. This implies that Nigeria has the highest trade competitiveness while Liberia has the least trade competitiveness and likely to worsen the balance of trade.

Ghana recorded the highest maximum value for the real exchange rate while Nigeria recorded the least minimum value for the real exchange rate. The kurtosis and skewness statistics measure the departure from symmetry and peaked ness of the distribution respectively. The data collected show that the positive skewness is quantitatively high, and this justifies the high level of the peak value. Additionally, the high real exchange rate for Liberia implies that Liberia is losing its competitive edge more and the exports are more expensive while the imports are less expensive. The Increase in productivity tend to lead to lower production costs and lead to a rise in the real exchange rate. On the other hand, Nigeria with the lowest real exchange rate implies that it gains some competitive edge, the exports are cheaper while the imports are more expensive. Nketiah et al (2019) posit that increase in capital flows is a function of stock of assets and liabilities in the economy and increase in net foreign assets leads

to changes in the real equilibrium exchange rate. Remittance affects the real exchange rate through their impact on growth. Even though the impact on growth is uncertain from our results, Lopez et al (2007) assert that remittances lead to a significant appreciation in real exchange rate.

Panel Data Regression

The panel data regression involves five explanatory variables and the dependent variable of real exchange rate. Regression was done for three periods to enable us to compare the impact on the variable during the various changing times. The first period is the pre-WAMZ period (1960 – 2000), the second period is during the WAMZ (2001 – 2022) and the third period is the entire period of study (1960 – 2022).

$$RER_{it} = \alpha + \beta_1 PCI_{it} + \beta_2 PCR_{it} + \beta_3 GFCE_{it} + \beta_4 CF_{it} + \beta_5 TOP_{it} + \delta_t + \alpha_i + \mu_t$$

Pre-WAMZ period

Variable	Coefficient (Standard Error)	P-value
Dependent Variable: Real Exchange rate		
Per capita Income	0.070543 (0.077099)	0.3611
Per capita Remittance received	9.659054 (3.644316)	0.0086
Government Consumption Expenditure	-0.823915 (2.516104)	0.7436
Capital Inflow	-2.25E-07	0.0011

	(6.80E-08)	
Trade Openness	-0.466055 (0.292587)	0.1125
Constant	302.1122	
R-squared	0.064075	
Adjusted R-squared	0.044577	

$$RER_{it} = 302.1122 + \beta_1 0.070543 + \beta_2 9.659054 + \beta_3 -0.823915 + \beta_4 -2.25E\text{-}07 + \beta_5 -0.466055 + \delta_t + \alpha_i + \mu_t$$

In the pre- WAMZ era, the variables per capita remittance and capital inflow were statistically significant while the variables per capita income, Gross final consumption expenditure and trade openness were not significant. This implies that we reject the null hypothesis and conclude that Remittances have significant impact on real exchange rate for the variables per capita remittance and capital flow while we fail to reject the null hypothesis and conclude that remittances have no effect on exchange rate for the variables Per capita income, Gross final consumption expenditure and Trade. Also, for per capita remittance, one unit increase will result in an increase in the real exchange rate by 9.65905 while holding other variables constant. From the result, the positive relationship between per capita remittance and real exchange rate is in consonance with Economic theory. An increase in remittance causes an appreciation of the exchange rate, increase in the capital account and external imbalance. Giving the increasing population to explain the per capita remittance, the remittances received will lead to appreciation of the real exchange rate. For the capital inflow, the negative

relationship in the result is not in consonance with economic theory. This means that if the capital inflow increases by one unit, then the real exchange rate decreases by 2.25E -07 while holding other variables constant. An increase in capital inflow leads to currency appreciation, but a decrease in net exports and aggregate demand. Capital inflow produces high demand for both tradeable and non-tradeable goods which leads to higher relative prices of non- tradeable goods and appreciation of the real exchange rate.

During WAMZ

Variables	Coefficient (Standard Error)	P-value
Dependent Variable: Real Exchange rate		
Per capita Income	-0.017728 (0.016211)	0.2762
Per capita remittances received	0.035792 (0.167035)	0.8307
Government Consumption Expenditure	13.00792 (1.696217)	0.0000
Capital Inflow	-2.35E-09 (5.27E -09)	0.6563
Trade Openness	0.010748 (0.107344)	0.9204
Constant	43.94366	

R-squared	0.421618	
Adjusted R-squared	0.398666	

$$RER_{it} = 43.94366 + \beta_1 -0.017728 + \beta_2 0.035792 + \beta_3 13.00792 + \beta_4 -2.35E-09 + \beta_5 0.010748 + \delta_t + \alpha_i + \mu_t$$

The five explanatory variables are per capita income, per capita remittance, Government final consumption expenditure, capital inflow and trade openness. Among these, only the Government final consumption expenditure is statistically significant while the remaining four variables are not significant. The Government final consumption expenditure is highly statistically significant; hence we reject the null hypothesis and conclude that the variable has a significant impact on the real exchange rate. Since the variables per capita income, per capita remittance, capital inflow and trade openness are not significant, we conclude that they do not have impact on the real exchange rate during WAMZ. If the Government consumption expenditure increases by one unit, we expect the real exchange rate to increase by 13.00792 while holding other variables constant. While Government purchases and expenditure cause the real exchange rate to appreciate, increase in consumption in developing countries especially WAMZ leads to depreciation of the real exchange rate.

Entire period

Variable	Coefficient (Standard Error)	P-value
Dependent variable: Real Exchange rate		
Per Capita Income	-0.025783 (0.037833)	0.4960
Per capita remittance received	-0.454901 (0.434583)	0.2959
Government consumption Expenditure	1.476916 (1.866428)	0.4293
Capital Flow	-1.71E -08 (1.42E-08)	0.2285
Trade Openness	0.143473 (0.150347)	0.3406
Constant	248.7431	
R-Squared	0.057581	
Adjusted R-squared	0.044914	

$$RER_{it} = 43.94366 + \beta_1\text{-}0.036001 + \beta_2\text{-}0.621258 + \beta_3 0.372466 + \beta_4\text{-}1.46E\text{-}08 + \beta_5\text{-}0.131158 + \delta_t + \alpha_i + \mu_t$$

The five independent variables witnessed changes in the three periods of study. For the per capita income, the coefficient was negative in the entire period, positive in the pre-WAMZ period and negative in the during the WAMZ period. For the per capita remittance, the coefficient was negative for the entire period, positive for the pre-WAMZ period and positive for the during the WAMZ period. For the Government consumption expenditure, the coefficient is positive during the entire period, negative during the pre-WAMZ period and positive during the WAMZ period. For the Capital flow, the coefficient was negative for the entire period, pre-WAMZ and during WAMZ period, but statistically significant for only the pre-WAMZ period. For the Trade openness, the coefficient was positive in the entire period, negative in the pre-WAMZ period and positive in the during the WAMZ period.

Further, from the regression result for the entire period, none of the five explanatory variables were statistically significant, hence we fail to reject the null hypothesis and conclude that all of them do not have significant impact on the real exchange rate. For the per capita income, if it increases by one unit of the dollar, this leads to a decrease in the real exchange rate by 0.0225783 while holding other variables constant. Per capita income is a measure of economic growth, and a high real exchange rate stimulates economic growth. For the per capita remittance, a one unit increase in the per capita remittance received leads to a decrease in the real exchange rate by 0.454901 while holding other variables constant. Economic theory posits that an increase in per capita remittances lead appreciation of the real exchange rate, increase in capital account and external imbalance. For the Gross final consumption expenditure, an increase of one unit is expected to increase the real exchange rate by 1.476916

while holding other variables constant. Increase in government spending stimulates the aggregate demand and causes some real GDP growth and real exchange rate appreciation. The Government expenditure can influence the real exchange rate potentially through the resource withdrawal channel and the consumption tilting channel.

The capital flow has a negative relationship with the real exchange rate for the entire period. If the capital inflow increases by one unit, then the real exchange rate decreases by 1.71E-08 while holding other variables constant. An increase in capital inflow leads to real exchange rate appreciation and a reduction in net exports and aggregate demand. Capital inflow produces a higher demand for both tradeable and non-tradeable goods and then higher relative price for non-tradeable goods. Capital inflow increases the domestic resources needed to produce non-tradeable goods needed to meet the increase in demand. Also, the trade openness has a positive relationship with the real exchange rate and a one unit increase in the trade openness is expected to increase the real exchange rate by 0.143473 while holding other variables constant. An increase in the trade openness leads to absorption of more real shocks by the currency market which affects nominal shocks. In an open economy, fluctuations in the exchange rate leads to expectations of a depreciation on the national currency.

Fixed Effect Regression result

Fixed effect regression allows the intercept of the model to vary freely across individuals and groups for panel data to enable us control for specific variables that do not vary across time. The fixed effect regression was done to enable us to estimate the effect of intrinsic characteristics of individual variables in the panel data set.

$RER_{it} = c + \beta_1 X_{1it} + \beta_2 X_{2it} + \beta_3 X_{3it} + \beta_4 X_{4it} + \beta_5 X_{5it} + \mu_{it} + \delta_t + \alpha_i$

$Y_{it} = X^1_{it}\beta + \mu_{it} + \alpha_i$

H_0 : There is no fixed effect

H_1: There is fixed effect.

Pre-WAMZ period

Variable	Coefficient (Standard Error)	P -value
Dependent variable: Real Exchange rate		
Per capita Income	0.057792 (0.076784)	0.4524
Per capita remittance	0.633686 (7.262377)	0.9305
Government Final consumption expenditure	-4.805716 (3.957401)	0.2258
Capital Inflow	-1.34E-07 (7.41E-08)	0.0715
Trade openness	-0.237129 (0.279865)	0.3977
Constant	358.9402	
R-squared	0.238930	
Adjusted R-squared	0.206544	
Prob (F-statistic)	0.00000	

During WAMZ period

Variable	Coefficient (Standard Error)	P -value
Dependent variable: Real Exchange rate		
Per capita Income	0.004300 (0.005431)	0.4301
Per capita remittance	-0.123197 (0.057794)	0.0351
Government final consumption expenditure	-1.354567 (0.635403)	0.0350
Capital Inflow	3.76E-10 (1.60E-09)	0.8141
Trade openness	0.017541 (0.029282)	0.5503
Constant	177.3192	
R-squared	0.960972	
Adjusted R-squared	0.957747	
Prob(F-statistic)	0.000000	

Entire period

Variable	Coefficient (Standard Error)	P-value
Dependent variable: Real Exchange rate		
Per Capita Income	-0.036001 (0.036451)	0.3240
Per capita remittance	-0.621258 (0.449916)	0.1682
Government Consumption Expenditure	0.372466 (2.355429)	0.8744
Capital Inflow	-1.46E-08 (1.43E -08)	0.3076
Trade Openness	-0.131158 (0.154134)	0.3954
Constant	291.2044	
R-squared	0.217451	
Adjusted R-squared	0.196128	
Prob (F-statistic)	0.00000	

The fixed effect regression is used to correct for endogeneity concerns among the variables. Each of the variables showed different responses to the fixed effect regression at the three different periods. In the pre-WAMZ period, one the variables -

Capital inflow- was statistically significant, in the during the WAMZ period, the per capita remittance and Government consumption expenditure were statistically significant while in the entire period, none of the variables was significant. For the pre-WAMZ era, we conclude that only the variable, Capital inflow, has fixed effect while the other variables do not have fixed effect. In during the WAMZ era, the variables per capita remittance and Government final consumption expenditure have fixed effect while the other three variables do not have fixed effect. In the entire period regression result, none of the variables have fixed effect. The three variables with fixed effect are useful in controlling for any individual specific attributes that do not vary across time and it is important in cases where variables are difficult to observe. Overall, the F-statistic of the three periods regression is significant which implies that they have fixed effect. The country and time fixed effect is important because it uses only data on individuals having multiple observations and the estimate affects only those variables that change across these observations.

Random Effect.

The random effect regression model enables us to estimate the effect of individual specific characteristics e.g grit that are not measurable and present in panel data studies. They have exogeneity and random effect has factor which contributes to the outcome, but their levels are not fully sampled or understood.

$RER_{it} = c + \beta_1 X_{1it} + \beta_2 X_{2it} + \beta_3 X_{3it} + \beta_4 X_{4it} + \beta_5 X_{5it} + \mu_{it} + \alpha_i$

The random effect is written as:

$Y_{it} = X^1_{it}\beta + \mu_{it} + \alpha_i$

The null hypothesis H_0: There is no random effect.

The Alternative hypothesis H_1: There is random effect.

Pre-WAMZ period

Variable	Coefficient (Standard Error)	P -value
Dependent variable: Real Exchange rate		
Per Capita Income	0.070543 (0.070260)	0.3164
Per Capita remittance	9.659054 (3.321081)	0.0040
Government Final consumption expenditure	-0.823915 (2.292937)	0.7197
Capital Inflow	-2.25E-07 (6.20E -08)	0.0003
Trade Openness	-0.466055 (0.266636)	0.0818
Constant	302.1122	
	S.D	Rho
Cross -section random	4.30E -05	0.0000
Idiosyncratic random	226.7815	1.0000
R-squared	0.064075	
Adjusted R-squared	0.044577	

Prob(F-statistic)	0.006869	

During WAMZ

Variable	Coefficient (Standard Error)	P-value
Dependent variable: Real Exchange rate		
Per capita Income	-0.017728 (0.004297)	0.0001
Per capita remittance received	0.035792 (0.044277)	0.4204
Government final consumption Expenditure	13.00792 (0.449628)	0.0000
Capital Inflow	-2.35E-09 (1.40E-09)	0.0949
Trade Openness	0.010748 (0.028454)	0.7063
Constant	43.94366	
	S.D	Rho
Cross section random	3.84E-05	0.0000
Idiosyncratic random	19.16810	1.0000
R-Squared	0.421618	

Adjusted R-squared	0.398666	

Entire period

Variable	Coefficient (Standard Error)	P-value
Dependent variable: Real Exchange rate		
Per Capita Income	-0.036001 (0.036451)	0.3240
Per capita remittance	-0.621258 (0.449916)	0.1682
Government Consumption Expenditure	0.372466 (2.355429)	0.8744
Capital Inflow	-1.46E-08 (1.43E -08)	0.3076
Trade Openness	-0.131158 (0.154134)	0.3954
Constant	291.2044	
R-squared	0.217451	
Adjusted R-squared	0.196128	
Prob (F-statistic)	0.00000	

The random effect test is important because it examines if the variance for each random intercept or slope and their covariances are significantly different from zero. The random effect tells us the variability and differences between different entities or subjects within a larger group. The regression result for the three periods shows different results and relationships of the variables. In the pre-WAMZ era, three variables namely per capita remittances, capital inflow and trade openness were statistically significant hence we conclude that the variables have random effect while the other two variables do not have random effect because they are not statistically significant. In the during the WAMZ period, per capita income, Government consumption expenditure and capital inflow are statistically significant, hence we conclude that they have random effect. In the result for the entire period, none of the variables were statistically significant. Therefore, we conclude that none of the variables have random effect. In each of the three periods regression results, the Idiosyncratic random is 1.000 while the cross-section random is 0.000. This means that the Idiosyncratic random is more significant and contributes 100 percent to the error term.

Unit root

The presence of unit root causes a spike in output which leads to higher levels of output being higher than the past trend. Unit root measurement tells us how much stationarity a time series model has.

ADF test – Augmented Dickey Fuller test

$$\Delta Y_t = \alpha + \gamma Y_{t-1} + \delta_1 \Delta Y_{t-1} + \ldots\ldots\ldots\ldots + \delta_p \Delta Y_{t-p} + \varepsilon_t$$

H_0 : The residuals have unit root

H_1: There is no unit root in the residuals.

Panel data Unit root

Level Test

Method	Statistic	Observation	P-value
Null Hypothesis : Unit root			
Levin, Lin & Chu t*	-0.34832	360	0.3638
Lm, Pesaran and Shin W-stat	-1.26311	360	0.1033
ADF Fisher Chi-Square	19.0775	360	0.0867
PP – Fisher Chi-square	18.6436	372	0.0975

First Differencing Test

Method	Statistic	Observation	P-value
Null Hypothesis: Unit root			
Levin, Lin & Chu t*	-7.96189	295	0.0000
Lm, Pesaran and Shin W-stat	-8.33142	295	0.0000

ADF -Fisher Chi-square	85.1491	295	0.0000
PP – Fisher Chi-square	169.520	305	0.0000

The unit root test was done twice – level and first differencing- in a bid to arrive at a statistically significant p-values for all the variables in the model. The first differencing test ensures that the variables no longer have unit root, and we reject the null hypothesis. Given that the presence of unit root can lead to spurious regression whereby the relationship between variables appears meaningless, the difference enables us to eliminate the unit root. Also, the implication of this unit root test and hypothesis shows that random shocks display permanent effect on the long run level of the macroeconomy and that the fluctuations on the real exchange rates are not transitory.

Cointegration

Cointegration tests are useful in testing the presence of correlation between two or more non-stationary time series in the long run for a specified period, long run parameters and relationship for two or more variables are identified.

$$\Sigma Y_i Y_{it} = \mu_t$$

The presence of cointegration signifies the existence of long run equilibrium relationship between the variables highlighted.

Pre-WAMZ period

Method	Statistic	P-value	Statistic	P-value
Panel v-Statistic	3.157969	0.0008	-0.682976	0.7527
Panel rho-Statistic	-1.948415	0.0257	1.675858	0.9531
Panel PP-Statistic	-8.780964	0.0000	0.198872	0.5788
Panel ADF-Statistic	-5.515991	0.0000	0.794500	0.7865

During WAMZ

Method	Statistic	P-value	Weighted Statistic	P-value
Panel v-Statistic	-0.712971	0.7621	-0.200050	0.5793
Panel rho-Statistic	1.868247	0.9691	1.100485	0.8644
Panel PP-Statistic	0.069455	0.5277	-1.817990	0.0345*
Panel ADF-Statistic	2.041999	0.9794	1.498836	0.9330

Entire period

Method	Statistic	P -value
Panel v-Statistic	-2.228456	0.9871
Panel rho-Statistic	-3.906036	0.0000***
Panel PP-Statistic	-5.393766	0.0000***
Panel ADF – Statistic	-3.097145	0.0010***

Cointegration involves modelling the variables to I(0) and it is a linear combination of those variables that have lower order of integration.

H_0: There is NO co-integration.

H_1: There is co-integration.

From the Johansen cointegration test results, the variables are statistically significant, p-values <0.05 hence, we reject the null hypothesis. Therefore, we conclude that the variables do not have cointegration. They are stationary.

The cointegration level or long run relationship among the variables differs in pre-WAMZ period, during WAMZ and entire period. In this pre-WAMZ period, all the variables were not significant, hence there was no cointegration in the pre-WAMZ period. This means that there was no equilibrium long run relationship among the variables in the period. There is no evidence of cointegration between the variables and the Ɵ1 would be insignificant. The residuals contain a unit root. It implies that the time series will not connect through an error correction model.

Also, during the WAMZ period, one of the variables is statistically significant while the other variables are not significant. Therefore, is some cointegration and more no

cointegration. There is some evidence of cointegration between the variables and the Θ1 would not be significant. Some of the variables are stationary, that is why they cannot be co-integrated. Long run equilibrium relationship exists among some of the variables but not all the variables in the during the WAMZ era. Time series can connect to a variable through an error correction model.

In the entire period, most of the variables were statistically significant, which means that there was more cointegration. The economic notion is that there is a long run relationship between economic variables in the model for those variables. There is evidence of a long run linear relationship between three or more time series variables and the Θ1 would be significant. The residuals do not have a unit root. This implies that time series will connect through an error correction model. More of the variables were non-stationary and the coefficient estimates Y_{t-1} is now super consistent and then converges to zero. The stationary variables have asymptotic distribution of the F-statistic and will remain the same.

Granger Causality

The entire 63- year period Granger causality test explains causations and the relationship between the two variables show that past values of one variable gives predictive information about the future values of another variable, more than the information contained in its own past values. The Granger causality tests whether a variable is useful in forecasting the behavior of another variable in the model. This Granger causality test is important for deciding if a single equation model of Y and X variables has a right- hand side variable and will be necessary for forecasting purposes.

The Granger causality test shows how to ascertain the usefulness of one variable to forecast another variable.

$H_0 : \Theta = 0$ No Granger Causality

The coefficient of past values in the regression is equal to zero.

$H_1 : \Theta \neq 0$ There is Granger Causality

The coefficient of past values is not equal to zero.

Variable	Observation	P-value
Per Capita income does not Granger cause Real Exchange rate. Inference: We fail to reject the null hypothesis and conclude that there is no Granger causality	366	0.4724
Per Capita remittance does not Granger cause Real Exchange rate. Inference: We fail to reject the null hypothesis and conclude that there is no Granger causality	366	0.5851
Government final consumption expenditure does not Granger cause Real Exchange rate. Inference: We fail to reject the null hypothesis and conclude that there is no Granger causality	366	0.4180

Capital Inflow does not Granger cause Real exchange rate. Inference: We fail to reject the null hypothesis and conclude that there is no Granger causality	366	0.4487
Trade Openness does not Granger cause Real exchange rate Inference: We fail to reject the null hypothesis and conclude that there is no Granger causality	366	0.6112
Per capita remittance does not Granger cause Per capita Income Inference: We reject the null hypothesis and conclude that there is Granger causality	366	0.0011
Government Final Consumption Expenditure does not Granger cause Per capita Income. Inference: We fail to reject the null hypothesis and conclude that there is no Granger causality	366	0.8459
Capital inflow does not Granger cause Per capita Income Inference: We reject the null hypothesis and conclude that there is Granger causality	366	1.E-08

Per capita Income does not Granger cause Capital Inflow Inference: We reject the null hypothesis and conclude that there is Granger causality	366	0.0002
Trade Openness does not Granger cause Per capita income. Inference: We fail to reject the null hypothesis and conclude that there is no Granger causality	366	0.5304
Government final consumption expenditure does not Granger cause per capita remittance. Inference: We fail to reject the null hypothesis and conclude that there is no Granger causality	366	0.2634
Capital Inflow does not Granger Cause Per capita remittance. Inference: We fail to reject the null hypothesis and conclude that there is no Granger causality	366	0.4024
Per capita remittance does not Granger cause Capital inflow Inference: We reject the null hypothesis and conclude that there is Granger causality	366	0.0236
Trade Openness does not Granger cause Per capita remittance. Inference : We fail to reject the null hypothesis and conclude that there is no Granger causality	366	0.7964
Capital Inflow does not Granger cause Government Consumption Expenditure. Inference: We fail to reject the null hypothesis and conclude that there is no Granger causality	366	0.9141
Government final consumption expenditure does not Granger cause Capita inflow.	366	0.0283

Inference: We reject the null hypothesis and conclude that there is Granger causality		
Trade Openness does not Granger cause Government final Consumption Expenditure Inference: We fail to reject the null hypothesis and conclude that there is no Granger causality	366	0.4492
Trade Openness does not Granger cause Capital Inflow Inference: We fail to reject the null hypothesis and conclude that there is no Granger causality.	366	0.8585

Among the many joint variables, five of the joint variables were statistically significant and had Granger causality while the other joint variables were not significant and did not have Granger causality. Per capita remittance Granger causes per capita income, capital inflow Granger causes per capita income, Per capita income Granger causes capital inflow, Per capita remittance Granger causes capital inflow and Government final consumption expenditure Granger causes Capital inflow. Consequently, this implies that the past values of one of the joint variables that Granger causes each other provides predictive information about the future values of another variable that is way beyond the information contained in its past values. Since the variables Granger cause each other, they are not exogenous to each other. But the many other joint variables that are not significant and hence does not Granger cause each other, they are strictly exogenous to each other.

Vector Autoregressive (VAR)

$$Y_t = \phi + \phi Y_{t-1} + \varepsilon_t$$

Vector Autoregression models are used for multivariate time series, and it captures the relationship that exist between multiple quantities as they change over

time. Vector autoregressive (VAR) is preferred because it captures intertwined dynamics of time series data, and the model provides individuals with improved forecasting performance. VAR explains causal relationship among variables overtime and forecast future observation.

H_0: There is no relationship between the variable population parameter, its past values, and past values of other variables.

$$\phi = 0$$

H_1: There is a relationship between the variable, its past values, and past values of other variables.

$$\phi \neq 0$$

Vector Autoregressive (VAR) Estimates

Variable	Coefficient
Real Exchange Rate (-1)	0.681493 (0.05271) [12.9289]
Real Exchange Rate (-2)	0.066510 (0.05277) [1.26029]
Constant	56.57487 (23.3656) [2.42129]
Capital Inflow	-5.66E -09

	(9.8E – 09) [-0.57482]
Government Final Consumption Expenditure	0.466463 (1.31192) [0.35556]
Per Capita remittance	-0.135178 (0.30080) [-0.44940]
Per Capita Income	0.000404 (0.02631) [0.01536]
Trade Openness	0.039772 (0.10786) [0.36875]
R -squared	0.561791
Adjusted R- squared	0.553223

From the VAR result, only one variable Real Exchange rate (-1) is statistically significant, and we reject the null hypothesis while the other variables namely Real Exchange rate (-2), Capital inflow, Government final consumption expenditure, Per capita remittance, Per capita income and Trade openness are not statistically significant. Therefore, we conclude that for the Real Exchange rate (-1), there is a

relationship between the variable, its past values, and past values of other variables. For the other variables, we fail to reject the null hypothesis and conclude that there is no relationship among the variables, their past values, and past values of other variables. VAR models the relationship present between variables overtime. The structural VAR result shows the causal relationships that can be used to model and forecast impacts of individual shocks and policy decisions.

Correlations

The Pearson correlation test is important because it measures the strength and direction of linear relationship between two variables. It is used to evaluate the strength of association between data and variables. The variables have positive and negative association present among the six variables including real exchange rate.

		Real Exchange rate	Per capita remittance	Per capita Income	Trade Openness	Government final consumption expenditure	Capital Inflow
Real Exchange rate	Pearson Correlation	1	-.183	-.215	.081	.104*	-.210**
	Sig (2-tailed)		<.001	<.001	.115	.044	<.001

Per capita remittance	Pearson Correlation	-.183**	1	.707*	.108*	-.090	.621**
	Sig (2 - tailed)	<.001		<.001	.036	.082	<.001
Per capita Income	Pearson Correlation	-.215**	.707**	1	-.158**	-.252**	.775*
	Sig (2- tailed)	<.001	<.001		.002	<.001	<.001
Trade Openness	Pearson Correlation	.081	.108*	-.158*	1	.345**	-.114*
	Sig (2- tailed)	.115	.036	.002		<.001	.026
Government final consumption expenditure	Pearson Correlation	.104*	-.090	-.252**	.345**	1	-.189**

	Sig (2-tailed)	.044	.082	<.001	<.001		<.001
Capital Inflow	Pearson Correlation	-.210**	.621**	.775**	-.114*	-.189**	1
	Sig (2-tailed)	<.001	<.001	<.001	.026	<.001	
	N	378	378	378	378	378	378

Real exchange rate has relationship with all the variables. Real exchange rate has perfect positive relationship with itself, the relationship with per capita remittance is considered as negligible correlation, negative and there is insufficient statistical evidence that the correlation between two variables is significant. Given that there exists a negative correlation between real exchange rate and per capita remittance, it implies that both variables move in opposite direction and do not move in tandem. When the real exchange rate increases, the per capita remittances decreases and vice versa. Similarly, the real exchange rate has a negative relationship with the per capita income, shows negligible correlation and there is insufficient statistical evidence that the correlation between two variables is significant. The negative relationship implies that when the real exchange rate increases, then the per capita income decreases and vice versa.

Additionally, the trade openness has a positive relationship with the real exchange rate. It has negligible correlation and there is insufficient statistical evidence

that correlation between two variables is significant. The positive relationship implies that the real exchange rate and trade openness move in tandem; if the real exchange rate increases, then the trade openness also increases and if it decreases, the trade openness also decreases. The real exchange rate has a positive relationship with the Government final consumption expenditure. The correlation is negligible and there is insufficient statistical evidence that the correlation between the two variables is significant. The positive relationship between the real exchange rate and Government final consumption expenditure implies that both variables move in tandem with each other and as one variable decreases, the other variable also decreases.

For the capital flow, it has a negative correlation with the real exchange rate. The correlation is negligible and there is insufficient statistical evidence that the correlation between the two variables is significant. The negative correlation implies a negative relation between the capital flow and the real exchange rate, and they do not move in tandem. If the capital flow increases, then the real exchange rate decreases and if the real exchange rate increases, then the capital flow decreases.

Overall, the variables have 36 points of correlation with one another, and the correlations are either positive or negative. Apart from the perfect correlations present, the highest is the correlation between capital inflow and per capita income. The correlation coefficient is 0.775 and it suggests that there is a high positive correlation between the capital inflow and per capital income for the 63-year period in WAMZ. Both variables move in tandem and have a high positive association. In the entire correlation result, there is no multicollinearity. This is because the correlation coefficients are less than 0.8.

The independent variables are not highly correlated with each other. Given the absence of multicollinearity, it is easy to interpret the regression coefficients and there is no inflation of standard errors and the unique impact of each variable on the dependent variable can be clearly observed. The results have reliable probabilities in terms of the effect of independent variables in the model.

Model Summary

Model	R	R Square	Adjusted R Square	Std Error of the Estimate
1	.240	.058	.045	215.94319096

From the model, it shows that the model does not have good fitness for the entire period. The low R square of 0.058 means that only 5.8 percent of the variations in the real exchange rate is explained by per capita income, per capita remittance, Government final consumption expenditure, capital inflow and trade openness while the remaining 94.2 percent of the variation is unaccounted for. The standard error of 215.943 is high. The standard error is intuitively the standard deviation of a sampling distribution, and it depicts how much disparity there is likely to be between the point of estimates obtained from a sample relative to the true population of the mean. From the high value, it is obvious that that the disparity is quite large.

ANOVA

Model		Sum Squares	Df	Mean Square	F	Sig
1	Regression	1059873.262	5	211974.652	4.546	<.001
	Residual	17346903.760	372	46631.462		
	Total	18406777.022	377			

1. Dependent Variable: Real Exchange rate
2. Predictors: (Constant), Trade openness, per capita remittance, Government final consumption expenditure, capital inflow, Per capita income

The regression shows that there exists a relationship between real exchange rate and per capital remittance, real exchange rate and per capita income, real exchange rate and Government final consumption expenditure, real exchange rate and capital inflow, and real exchange rate and trade openness. The ANOVA result is important because it informs us that there are significant differences between the means of three or more groups. Also, the test result is statistically significant, and it implies that at least one group's mean differs from others. The 'between' variance is much larger than the 'within' variance and the factor level impacts the mean of the distribution of the variables. The test shows that F-test and adjusted R-squared in the model specification provided evidence that the explanatory variables are jointly not equal to zero, but not a good fit of the model.

Coefficients

Model	Unstandardized B	Coefficients Std Error	Standardized Coefficient Beta	T	Sig	Statistics VIF
Constant	248.743	29.980		8.297	<.001	
Per capita remittance	-.455	.435	-.080	-1.047	.296	2.286
Government consumption expenditure	1.477	1.866	.043	.791	.429	1.190
[]polmwtwt;.,Capital Inflow	-1.714E-8	.000	-.097	-1.206	.229	2.573
Per capita Income	-.026	.038	-.064	-.681	.496	3.431c.dmmc.ax
Trade Openness	.143	.150	.054	.954	.341	1.250m

Dependent Variable: Real Exchange rate

The coefficients and their values tell us the relationship each value has with the dependent variable, the real exchange rate. There is a negative relationship between

the real exchange rate and per capita remittance, capital inflow and per capita income. There is a positive relationship between real exchange rate and the Government final consumption expenditure and trade openness. From the result, none of the variables is statistically significant. This means that none of the variables is a useful predictor of the real exchange rate. Also, the VIF statistics is an indicator to inform us of the presence of multicollinearity or not. Since (Variance Inflation Factor) VIF of 5 – 10 signifies multicollinearity, there is NO multicollinearity in the results. This is because all the VIF statistics are less than 5.

The no multicollinearity in the results means that the independent variables are not highly correlated with each other. This means that each predictor makes some important contributions in explaining the outcome. A significant amount of information present in one predictor is not contained in other predictors. The statistical significance of independent variables is NOT undermined.

How has the remittances impacted the exchange rate and economy of WAMZ?

From the results, the correlation coefficient between the predictors and the Variance Inflation Factor (VIF) is considered the most used method by statisticians to test multicollinearity. Since the values range between 1.19 and 3.43, this leads to the conclusion where we fail to reject the null hypothesis of no multicollinearity. There is no multicollinearity, hence the statistical inferences are reliable, and the independent variables interact and affect each other. The Pearson correlation test did show that there exist relationships between real exchange rate and all five independent variables chosen in the model. The relationship was either positive or negative. Per capita remittance variable is proxy for the remittance, and it shows a negative relationship with

the real exchange rate. There is negligible correlation, and both variables move in opposite direction. An increase in per capita remittance leads to a decrease in the real exchange rate.

Since the creation of WAMZ in 2000, exchange rate stability has been one of the major goals of the monetary union. Many WAMZ and Sub-Saharan African countries have exchange rate stability as one of their monetary policy objectives. The creation of WAMZ has led to better coordination and more inflow of FDI and remittances from migrants who are citizens but live abroad. The remittances and capital inflow has led to the appreciation of the real exchange rate in the member countries. Hence, there has been a huge increase in remittance to member countries which have served as sources of livelihood for many families and an important component of the GDP of these countries. Remittances' impact on the real exchange rate of the member countries has been one of the contagious issues that the various governments of WAMZ have been facing since independence. The increase in remittances has been driven by having many WAMZ citizens abroad, increased interest/request by home governments, altruism from migrants who live and work abroad etc. The increase in remittance, which is a component of inflows into the economy has increased consumption in the economy, led to the appreciation of the real exchange, increased the domestic economy, but have not achieved exchange rate stability.

5.0: CONCLUSION

International migrants are assiduous in their host countries and save a portion of their income in savings which they remit a part of their savings to their families back home for either support or investment. Remittances are expected to help improve the

economy of remittance-receiving countries, but it is not always true. Remittances have the potential of appreciating the real exchange rate of the remittance-receiving countries, hence weakening the competitiveness of their economy, and reducing their exports. We discover that for all the WAMZ countries, an average of 10 percent increase in per capita remittance will lead to 4.54 percent reduction (appreciation) in the real exchange rate. The total per capita remittance received by WAMZ countries rose from 115million dollars in 1960 to 26.5 billion dollars in 2022.

Also, an increase in remittance leads to appreciation of the real exchange rate which reduces economic competitiveness and export of the remittance receiving countries. This causes Dutch disease and move resources from tradeable to non-tradeable sectors. The impact of remittances can be mitigated by government efforts at directing remittances towards investment rather than consumption. However, the remittances have been for altruistic purposes and have been spent on consumption which causes an appreciation of the exchange rate.

Moreover, the study examined the impact of remittances on the exchange rate of the WAMZ countries. To analyze the impact of remittances, the ordinary least square method was chosen. The study used time series data and panel data regression for the five explanatory variables that influenced the exchange rate over the 63-year period. Correlation, Multicollinearity and ANOVA tests were done, and we found that many of the variables possessed negligible correlation. Among the explanatory variables, some have a positive relationship with the real exchange rate while others have a negative relationship. The correlation result shows that many were negligible correlations except for per capita income/capital flow, per-capita remittance/per capita income which

recorded a high positive correlation, and few others have moderate and low correlation. The F test and adjusted R squared in the model specification show evidence that the explanatory variables are jointly not equal to zero and do not have goodness of fit for the entire period.

Further, the study analyzed the impact using three periods namely: Pre-WAMZ era (1960 – 2000), during WAMZ era (2001 -2022) and the entire period (1960 – 2022). The regression results of the variables in the three periods differ. In the pre-WAMZ period, the per capita remittance and capital inflow had a significant impact on the real exchange rate. In the during the WAMZ era, the Government final consumption expenditure was statistically significant and had an impact on the real exchange rate. In the entire period, none of the variables were significant. The analysis shows that a long run relationship (co-integration) exists among the variables in the entire period. The pre-WAMZ period does not show long run relationship while the during the WAMZ period shows long run relationship for some of the variables.

The research further reveals that in the entire period, the per capita income, per capita remittance, and capital inflow result in the appreciation of the real exchange rate in WAMZ. The negative relationship with the real exchange rate shows that the variables move in the opposite direction with the real exchange rate and such leads to appreciation. In the pre-WAMZ period, the government consumption expenditure and capital inflow are the variables that propelled the real exchange rate appreciation while in the during the WAMZ period, the per capita income and capital inflow caused the appreciation of the real exchange rate. The Granger causality tests, the Vector

Autoregressive (VAR) and the Unit root tests reveal that some variables were significant in their impact on the real exchange rate.

Recommendations

The analysis reveal important issues and we recommend the following:

1). Need for more understanding and emphasis on the economic importance of remittances in the WAMZ member countries' economies.

2). Need to study the consequences of remittance on the export sector because of real exchange rate appreciation that emanates from increasing flows of remittances.

3). The increasing level of remittances has attracted a lot of consideration in WAMZ especially in the last two decades, therefore this calls for new opportunities. More opportunities for investment expenditure in capital goods which will boost income, stimulate production and increase exports.

4) Need for governments of WAMZ member countries to create investment vehicles such as diaspora bond to encourage the citizens of WAMZ member countries who are immigrants working abroad to contribute towards national development.

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APPENDIX

Map of West Africa

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Exploring the relationship between servant leadership behaviors', the type of higher education institutions and demographic profiles in the USA using Structural Equation Model. Organizational learning, Innovation and Development Journal. Vol. 9 No. 2. December 2023. (With Ahmed Al-Asfour and Yvonne Hunter-Johnson).

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