

## Real Interest Rate, Investment and Economic Growth: Panel Evidence from West African Monetary Zone

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### ABSTRACT

**Purpose:** This paper investigated the effect of interest rate on investment and growth on countries under the West African Monetary Zone (Gambia, Sierra Leone, Nigeria, Ghana, Guinea and Liberia) with the use of Panel data analysis from 2000 to 2021.

**Approach/Methodology/Design:** The study uses the Levin and Lin test to confirm the unit root of the selected variables. The stationarity shows that real interest rate, exchange rate, inflation and term of trade are integrated at levels and real gross domestic product, investment, and savings are integrated at order one. Also with the use of Kao Panel Co-integration test, it was confirm that there exists a long run relationship among the variables.

**Findings:** The study revealed that real interest rate shows a non-significant relationship to both investment and growth in the countries under the West African Monetary Zone (WAMZ). According to the study, these countries need to reduce their real interest rates in order to increase investment in WAMZ, particularly Ghana, Gambia, and Liberia, as a result of the findings. It is imperative that policy makers in West African Monetary Zone (WAMZ) countries implement policies that will contribute to the achievement of the threshold inflation rate consistent with higher economic growth.

**Originality/Value:** In this study, Panel data analysis has been estimated and after the test of hausman test the random effect method was used to carry out the estimation to know the impact of real interest rate on investment and economic growth with evidence for West African Monetary Zone for the period 2000 to 2015.

## INTRODUCTION

The debate over the exact influence of interest rate on investment and economic growth remains an unfinished business in that interest rate policy is an effective tool in monetary policy that mobilizes financial personnel to promote economic growth. Investment, inflation, money demand, and unemployment are all influenced by the interest rate targets of monetary

policy. It is common for central banks to minimize interest rates whenever they choose to increase investment, money demand, and consumption in an economy. Creating economic bubbles is a risky outcome of a macroeconomic policy such as low-interest rates, where substantial investments flow into the mortgage and stock markets. It's worth noting that interest rates have a significant impact on the economy, and only the Central Bank has the power to manipulate them being that it affects stocks and other investments (Itsede, 2002). Thus, to maintain and improve economic stability, the Federal Government adopts monetary policy when the economy is in a recession. When the economy is booming, the Federal Government lowers interest rates to promote spending and raises interest rates to maintain inflation in the economy (Imoagwu, Umunna, Kalu & Okaforocha, 2022).

West African countries formed the Economic Community of West African States (ECOWAS) on the 28th of May 1975 to promote economic integration. ECOWAS is one of the five regional pillars of the African Economic Community (AEC). A mutual currency was established in this sub-region in 1987 through the Economic Community of West African States Monitoring Cooperation Program (EMCP). ECOWAS is mainly populated by Francophone and Anglophone countries. In 1948, a monetary union was established among Francophone countries in 1948. Nigeria and Ghana led the new initiative launched by ECOWAS monetary integration in 1999. West African Economic and Monetary Union (UEMOA) and WAMZ will complement each other in due course and a second monetary zone is scheduled to be established by 2004 under this new initiative (Danladi, 2015).

According to Balogun (2019), monetary integration can be enhanced by potential trade creation within and above states by eliminating trade payment difficulties. In addition, monetary integration initiates the exchangeability of currencies. Too many currency differences have hampered the expansion of trade between the ECOWAS countries. The fact suggests that a single region currency would eliminate this impediment. The Economic Community of West African States (ECOWAS) came into existence in 1975. ECOWAS is working on monetary integration in West Africa. A monetary zone and a common currency were established through the ECOWAS Monetary Cooperation program in 1987. The Monetary zone is called the West African Monetary Zone (WAMZ), (Itsede, 2001).

The West African Monetary Zone (WAMZ) was created by Nigeria, Guinea, Sierra Leone, Ghana, Gambia, and Liberia in December 2000. In 2001, a West African Monetary Institute was established to prepare for the establishment of another monetary zone, and it began practicing to set the stage for the launch of the single currency by 2003 in Gambia, Sierra Leone, Nigeria, Ghana, Guinea and Liberia. WAMZ launched in 1994 as a complement to West African Economic and Monetary Union (UEMOA), which includes Benin, Burkina Faso, Cote d'Ivoire, Mali, Niger, Senegal, Togo, Guinea Bissau, and Togo. Tarawalie, Sissoho, Conte, and Ahotor (2013) describe the monetary zone as the second setup of West Africa and its member countries with primary and secondary convergence criteria. In order to establish a common currency over time, they aim at establishing a common currency over time.

Each WAMZ country has agreed on a set of criteria for setting up a common currency. Four are primary, while five are secondary. In addition, the country should have no domestic arrears in local currency, a fiscal revenue/GDP ratio of no less than 20%, a wage bill to total revenue ratio of almost 30%, and a stable real exchange rate. The following primary criteria must be satisfied: first, the reserve of gross foreign currency must exceed or equal three months' worth of imports at any given time; second, the benchmark for inflation must be below 10%; and third, the Central Bank must fund up to 10% of budget deficits. Except for inflation, all WAMZ member nations met the three primary criteria in 2006. WAMZ

countries experienced an inflation rate of 11%. However, this is the average value for individual nations, (WAMI, 2006).

**Table 1: West Monetary Zone Convergence Criteria**

| Primary Criteria  | Target         | Secondary Criteria   | Target         |
|---|----------------|--|----------------|
| Inflation   | Single-digit   | Non-accumulation of payment arrears                                | < 0            |
| Fiscal deficit to GDP ratio<br>Central Bank funding of fiscal deficit (as a % of previous year's tax revenue) | = - 4%<br>=10% | Tax revenue to GDP ratio<br>Salary mass to total tax revenue ratio | > 20%<br>< 35% |
| Gross external reserves to months of import cover   | = 3 months     | Public investment from domestic receipts<br>Real interest rate     | > 20%<br>> 0   |
|   |                | Exchange rate stability  | ± 15%          |

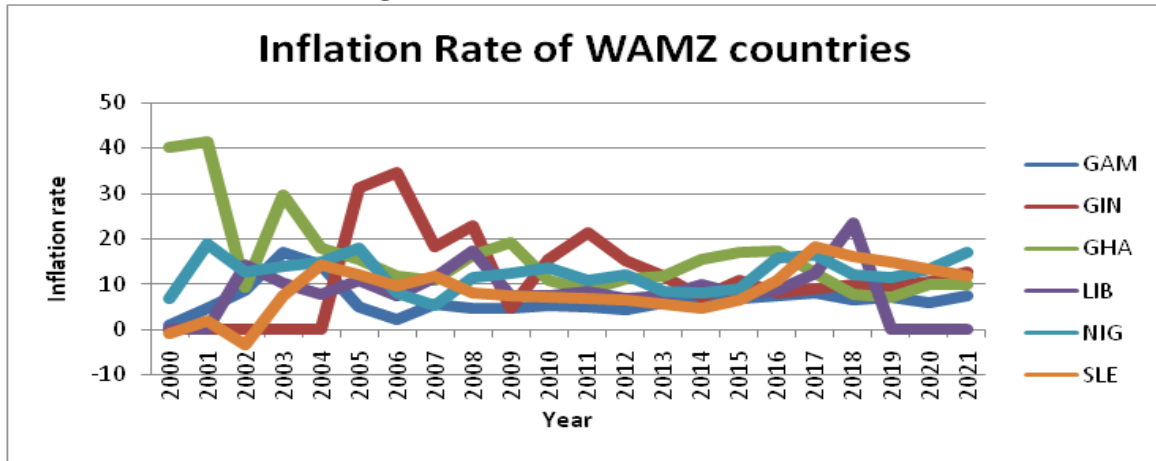
Source: Accra Declaration of Creation of Second Monetary Zone (2000)

The vision by members of WAMZ chief of state and government was coming collectively by the WAMZ countries to create a single monetary zone from the eight counties in the sub-region. by the year 2000. The main objectives of West Africa Monetary Zone are: To preside over foreign trade and financial operations. To elevate trade integration in the region. To harmonize legislation and statistics. To elaborate payment systems and motivate macroeconomic convergence.

There was a request that WAMZ members implement some measures in order to achieve the extreme objective of single currency, which included adopting a market-based exchange rate of not more than 10% by 1998 and not exceeding 5% in the future; ensuring that the budget deficit ratio to the GDP does not exceed 5% by 1998 and 3% by 2000.; Central Bank credit to national government not greater than 10% of initial year's tax and the actualization of sole digit inflation rate. By the year 2003, the purpose of this program was to establish a mutual central bank, use a common currency in these countries, and merge this currency with the Franc CFA by 2004 to form a single ECOWAS currency, the Ecoi. Oladimeji Alo (2004) asserts that the introduction of monetary integration will result in the establishment of a mutual regional market encompassing more than 210 million people.

The Nigerian economy remains a dominant economy in the WAMZ, with 76.5% of its population and approximately 86% of its GDP located there. With an oil-based economy, Nigeria provides about 20% of GDP, 80% of the total revenue, and 90% of the foreign exchange returns. Ghana is the next largest economy within the zone, with 9.2% of GDP. Gambia and Liberia have the lowest GDP per capita at 0.6 and 0.4 percent, respectively (African Development Fund, 2008). Growth in the zone has been buoyant in the past decade, averaging 7% between 2000 and 2011.

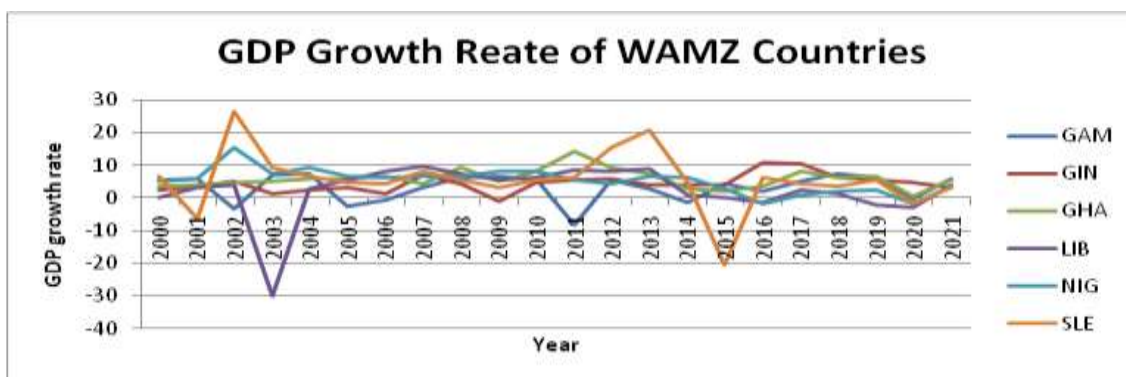
**Figure 1: Inflation Rate of WAMZ**



Source: Computation by Authors from World Bank Indicator (2021).

When WAMZ was formed in 2000, the target was sole-digit inflation; at the end of 2000, with the exception of Ghana, the performance of Gambia, Sierra Leone, and Nigeria was within the parameters set, and Guinea did not experience inflation. Ghana 10.9% and Guinea 31.3% failed to meet the single-digit inflation limit in 2006, while Nigeria had an inflation rate of 8.2%, Gambia had a rate of 2.0%, Sierra Leone had a rate of 9.5%. By 2010, the Nigerian, Ghanaian, and Sierra Leonean inflation rates failed to reach single-digits, while Gambia and Liberia had inflation rates of 5.04% and 7.29%, respectively. As of 2015, Gambia, Liberia, Nigeria and Sierra Leone are under the limit of single digits with 6.8%, 7.7%, 9.0%, and 6.7% respectively, while Guinea and Ghana are under the limit of double digits with 10.8% and 17.1%, respectively. The only two countries that meet the limit of single digits in 2020 and 2021 are Gambia and Ghana, which have 5.93% and 9.8% for Gambia respectively and 9.8% and 9.9% for Ghana respectively. Only Liberia meets the single digits during this period in WAMZ (WDI, 2021). Since the inflation rates of these member countries differ, the difference in real interest rates affects their investment and growth, making WAMZ difficult to function.

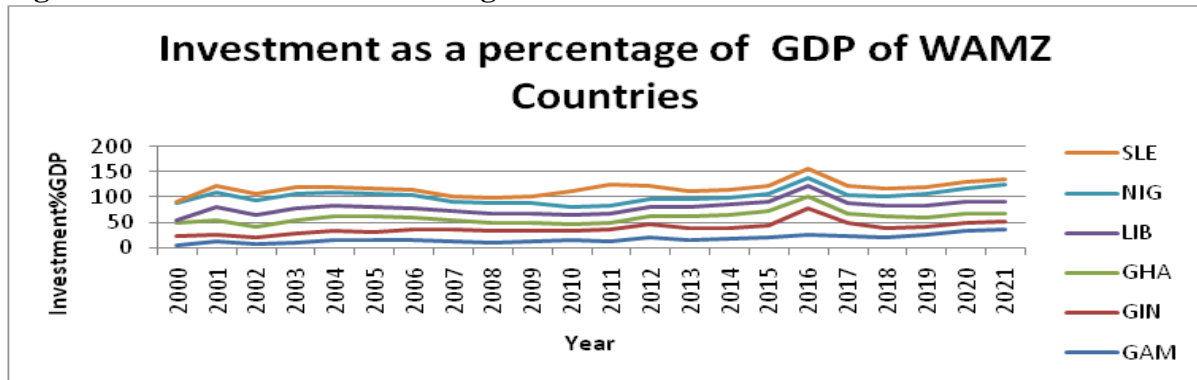
**Figure 2: GDP Growth Rate**



Source: Computation by Authors from World Bank Indicator (2021).

From figure 2 above, due to the fluctuations in inflation and interest rate among the members of WAMZ, the GDP growth rate of these countries also fluctuate which effect the growth of this countries and not achieving the objective of the West African Monetary Zone and employing a single currency.

**Figure 3: Investment as a Percentage of GDP**

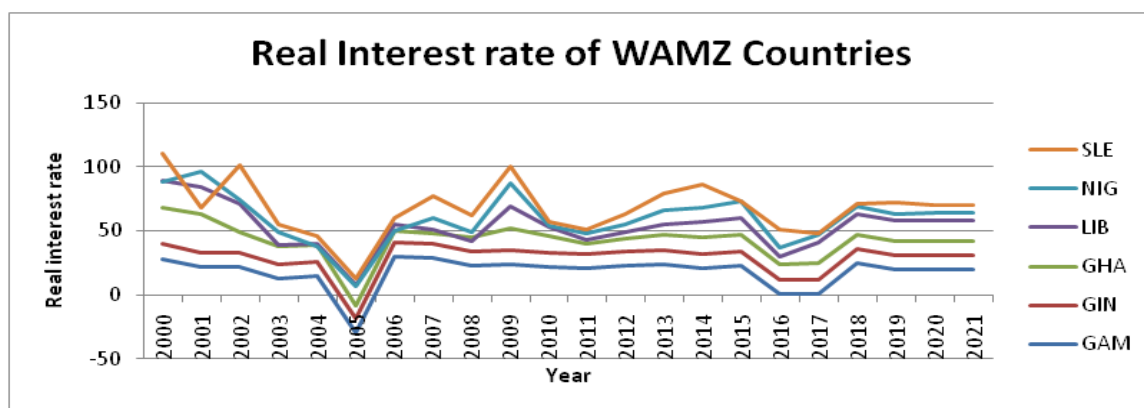


Source: Author's computation from World Bank Indicator (2021).

From figures 2 and 3 above, due to the fluctuations in inflation and interest rate among the members of WAMZ, the GDP growth rate and investment of these countries also fluctuated.

Compared to 2012, the West African region maintained its growth space at 5.6% in 2014. ECOWAS' sub-regional activities were buoyant in 2013 due to the satisfactory performance of member countries in terms of economic growth. Sierra Leone had 13.0% economic growth, Liberia had 8.1%, Ghana had 7.6%, Burkina Faso had 6.6%, and Nigeria had 5.4% (ECOWAS, 2015). The growth rates in Nigeria for 2020 and 2021 were -1.7% and 3.64%, respectively, while Sierra Leone's growth rate for 2021 was 3.05%, compared to -1.96% in 2020. A growth rate of 5.6% was recorded in the Gambia in 2021 as a result of expansion in the primary, secondary, and tertiary sectors following a decline of -0.20% in 2020. Ghana's real GDP growth rate was 5.3% in 2021 against 0.51% in 2011 due to a reduction in the tertiary and secondary sectors in the country. The actual GDP growth in Guinea in 2021 was 3.1% compared to 4.6% in 2020. Liberia's real GDP growth rate was 4.0% relative to -2.98% in 2020 (World Bank Indicator, 2021).

**Fig 4. Real Interest Rate of WAMZ**



Source: Author's computation from World Bank Indicator (2021).

Investments are necessary in developing countries where interest rates are vital for economic growth. A rise in nominal interest rates can discourage investors in this context since capital is too expensive. A high level of inflation in member countries can be seen in the figure above, resulting in a very low real interest rate. As indicated above, the real interest rate does not meet the second criteria of WAMZ, which affects investment and GDP growth if a common currency is used among the member countries. Studies have shown that since

WAMZ came into existence in 2000, it has been a challenge to maintain conditions that contain inflation and real interest rates. Beside the divergence in inflation between these countries, the prospects for their convergence are also weak, thereby obstructing the commencement process (Ofori & Asumadu, 2018).

West African Monetary Zone member countries differ in their trade patterns mainly based on their economies, natural resources, and domestic demand. Natural resources are allocated unevenly, and match is different. We anticipate that WAMZ's switch to Eco currency will enliven binding trade among member countries. The objective of bilateral trade enlargement is to reduce transaction costs that inhibit foreign trade, and to determine to what extent these savings are offset by devaluations. Based on the difference between interest rates between two countries, the International Fisher Effect (IFE) predicts that an exchange rate will increase or decrease according to the exchange rate appreciation or depreciation of a country's currency.

There are a number of challenges facing the West African Monetary Zone (WAMZ), which have resulted in the extension of its year of achievement and the failure to achieve a single currency among the five countries. WAMZ member countries face a decision problem regarding the pace of convergence. As a result of the "one size fits all" policy, WAMZ countries are having difficulty bringing their interest rates into conformance with the decisions of the West African Central Bank. It is possible that an interest rate may be appropriate for a region as a whole but inappropriate for some of its members. When countries are experiencing high inflation and overheating economies, they will have low real interest rates right when they need high interest rates, however, economies that are experiencing high unemployment and low inflation will have high interest rates at the same time (Balogun, 2009). There is also the possibility that high inflation countries within the ECOWAS region may convey inflation to lower inflation countries. The member countries are aware that inflation rates vary from one another. Several countries will experience fluctuations in inflation, whereas others will experience under-slung or moderate inflation. By entering the union, these countries with mediocre inflation rates could be simulated by those with lofty inflation rates. In the West African Monetary Zone (WAMZ), fear of domination may pose a problem in achieving monetary union, as there will always be rich and poor countries based on natural resources and economics.

Another problem experienced by the West African Monetary Institute (WAMI) is a lack of independence among Central Banks, which may undermine the credibility and effectiveness of monetary policy. Based on Laurens and Segalotto's (2009) index of the Central Bank for West African countries, the following results are found: 0.69 for Bank of West African State (BCEAO); 0.3 for Guinea; 0.50 for Ghana; 0.44 for Nigeria, compared to an average of 0.47 for African countries. Assembling a monetary union among the West African Monetary Zone (WAMZ) members is predicated upon single-digit inflation requirements. As the years have passed, however, actualizing this objective has become almost impossible (WAMZ, 2015). During 2014, the Ebola epidemic outbreak in Gambia, Liberia and Sierra Leone significantly deteriorated the budget deficit excluding grants, which resulted in significant declines in revenues and an increase in government expenditure as a result of the disease's impact on economic activities (UNECA, 2015). Because of the context in which these WAMZ countries find themselves, the purpose of this study is to examine the impact of real interest rates on investment and economic growth of these countries.

Several researchers have done so many works that concern the West African Monetary Zone (WAMZ). Works like examination of the adverse results of inflationary afflictions on

corporate investment in West Africa Monetary Zone (WAMZ), testing the agents influencing currency convertibility in West Africa, determined FDI in the West Africa Monetary Zone (WAMZ), and also discovered the cause-effect relationship connecting FDI and economic growth using the simultaneous equation model on a panel of WAMZ countries, examination on determinants of inflation differential in a panel of West African Monetary Zone (WAMZ) states, estimation of the entrance levels of inflation and also identifying the determinants of growth in WAMZ countries. From the above review, none of the researchers has investigated the effect of real interest rate on investment and economic growth evidence in the West African Monetary Zone with recent data from 2000 to 2021. However, contrary to this background, this study intends to fill a gap by examining the effect of real interest rates on investment and economic growth in the six countries comprising the West African Monetary Zone (WAMZ), including Gambia, Guinea, Ghana, Liberia, Nigeria, and Sierra Leone.

## REVIEW OF LITERATURE

### Theoretical Literature

Robert Mundell developed the theory of an optimum currency area in 1961. Several other economists contributed to the development of this theory, including Abba Lerner, Kenen (1969), and Mickinnon (1963). The term optimum currency area (OCA) also refers to as optimum currency region (OCR) which refers to the structural division that maximizes the economic effectiveness of allotting a single currency to the entire region. As well as depicting the ideal attribute for the invention of a reformed currency, this theory is designed primarily to demonstrate whether or not a certain region is willing to become a currency union. Optimal currency areas (OCA) theory states that a country wishing to join a currency union must either slacken its national monetary policy or try to balance the two.

A single currency not only results in a loss of economic sustainability, but also increases monetary efficiency, which can lead to an increase in exports, a rise in aggregate demand, and a decrease in aggregate prices. In the event that a member of the monetary union proposes, for accounting reasons, that one of their currencies act as the source currency or if a new accounting currency is adopted to serve this purpose, each member will agree that the exchange rate will remain constant with respect to the reference currency. It is the responsibility of the central bank governors to decide whether to change the equality of the reference currency during monetary integration. If the decision about the changes occurs, then all the other currencies must change with it.

Interest rate determination is based on Keynes' liquidity preference theory in 1936. According to the General Theory of Employment, Interest, and Money, demand and supply for money determine interest rates. In the theory of money as an asset, interest is left for not obtaining bonds. Money remains the most liquid asset, according to Keynes. The liquidity of a company remains an asset. An asset's liquidity increases as it is converted into money more rapidly. In Keynes' theory of liquidity preference of interest rate underneath money demand, a significant deviation occurred between money demand and individual demand for goods. Aside from not being consumed, money demand serves as a means of securing an asset. Traditionally, the crossroads of demand and supply of capital have been considered as a determining factor of interest rates based on the theory of general equilibrium. When capital supply equals capital demand, the equilibrium interest rate is reached. The entrepreneur group makes investment choices that demand capital. Demand for capital led to investment judgment while supply encouraged savings among residents. The savings timeline illustrates

the supply of capital. This illustrates that interest rate is determined by savings and investment.

### **Empirical Literature**

The influence of interest rate on economic growth has in recent years been extensively examined, although the attention devoted to the experience of developing countries in this regard has thus far been limited. Njie & Badjie (2021), examined the impact of interest rate on economic growth in the Gambia. The VECM was used to check both the long-run and short-run relationships between variables and results shown that Gambian economic growth is not associated with interest rate growth in the short run, but it is in the long run. Between 2005 and 2013, Saba & Danish (2016) examined how interest rates affected Islamic and non-Islamic economies. The study used the random effect and system generalized method of moment (GMM). Compared to non-Islamic countries, interest rates, per capita income, and inflation have significant positive effects in Islamic countries. By using the Vector Error Correction Model (VECM), Wuhan & Adnan (2015) examined the effect of interest rates on investment in Jiagsu Province, China, from 2003 to 2012. Results indicated that the variables have a long-term relationship.

Mayo and LeRoux (2018) adopted ARDL bound test to determine the effect of interest rate on economic growth through savings and investment, they discovered that interest rate has a positive influence on economic growth through savings and investment. Obamuyi (2009), Maiga (2017) and Etale and Ayunku (2016) used the Error correction model and co-integration model to investigate interest rate on growth in Nigeria, which shows that co-integration exists between the two variables and real interest rate has a significant impact on economic growth. Bablola, Danladi, Akomolefe, and Ajibiye (2015) used OLS to examine the effect of inflation and interest rate on economic growth in Nigeria, the result shows that inflation and interest rate have a negative influence on economic growth. Najarzadeh, Ashena, and Jezdani (2012) with the use of time series and panel data examined the granger causality relationship connecting interest rate and GDP growth in some selected Islamic nations, the panel causality result shows no significant causal relationship connecting interest rate and economic growth. Ajayi, Oladipo, Ajayi, and Nwanji (2017) assessed the effect of interest rate on economic growth in Nigeria and employed the Error Correction Model (ECM) to examine the short and long-run relationship between real interest rate, inflation, and savings deposit and the result shows negative.

In ECOWAS countries, Waziri, Jelilov & Isik (2017) analyzed the interest rate and economic growth using a panel method. As a result of their analysis, they found a negative relationship between interest rate and economic growth. According to Ofori & Asumadu (2018), interest rates and investment determination play an undesirable, highly significant role in short and long-run interest rate differences in WAMZ countries. Co-integrated panels were employed to examine factors affecting currency convertibility in West Africa. Based on the study, the chosen countries are sufficiently similar to form a monetary union, and the convergence test indicates conditional convergence in interest rates and exchange rates.

A study by Onyemaechi & Raji (2014) used the Error Correction Mechanism (ECM) to investigate the adverse effects of inflationary afflictions on corporate investment in the West African Monetary Zone (WAMZ) in order to explain how inflation affects corporate investments both in the short and long run. According to the study, WAMZ's financial development is not transparent with regard to its effect on corporate investment. With panel least squares techniques, Saka, Onafowokan & Adebayo (2015) examined the convergence criteria between 2000 and 2008. Based on their findings, practically every controlled variable



has an indirect impact on income growth rates, as well as the possibility of convergence over time. Ndoricimpa, Osoro & Kidane (2016) examined the inflation threshold and its influence on the inflation-growth nexus in selected African countries by using dynamic panel threshold modeling. This study reveals that regional economic communities have distinct threshold models. A study conducted by Abdul and Marwan (2013) examined the impact of interest rate, inflation, and GDP on the real economy in Jordan. This study employed the Johansen test to determine whether inflation or interest rate have a negative impact on economic growth.

## METHODOLOGY AND PROCEDURES

A study based on the popular theory of optimal currency areas, this study will be conducted. Economic and monetary integration are forecast to be discussed in the Optimal Currency Area (OCA). According to this theory, regional integration has become a matter of discussion after examining the pros and cons of monetary union within the European Monetary Union (EMU). Based on the OCA theory, countries should strive to create a monetary union that is desirable in order to make sure that the benefits outweigh its costs. It tends to be used most frequently to evaluate countries' participation in monetary unions or their exit from them.

The following production function of Solow Neoclassical model will be employed to measure the different sources of economic growth.

$$Y = AF(K, L) \dots \dots \dots (1)$$

where Y = total national output

- K= the quantity of physical capital
- L = the quantity of labour used
- A = the state of technology.

Since this study is on cross country basis, the study will adopt the use of panel method. The choice of panel data methods is due to its numerous benefits over single cross sections.

### The Model

The panel data set is formulated by a sample that N (countries) that are observed at various time periods. Consider a simple model with one explanatory variable.

$$Y_{it} = a_i + \beta X_{it} + \mu_{it} \dots \dots \dots (2)$$

where the variable Y and X have both i and t subscripts for I = 1, 2, ... N sections and t = 1, 2, ... N. Coefficients  $\beta$  has subscript as a result differ for each country and do not have any subscript because they will be the same for all units and for all years.

The essential procedure obtained in panel econometrics is known as Fixed Effects (FE). The model permits for various constants for each group and is comparable to that of equation (2). The fixed effects estimator can also be seen as the least-squares dummy variables (LSDV) estimator because for it to permit for various constants for every group, it includes a dummy variable for every group. For clearer view, observe the following model.

$$Y_{it} = a_i + \beta_1 X_{1it} + \beta_2 X_{2it} + \dots + \beta_k X_{kit} + \mu_{it} \dots \dots \dots (3)$$

## Model Specification

### Model One for Objective One

$$INV_{it} = \alpha_i + \beta_1 RIR_{it} + \beta_2 SAV_{it} + \beta_3 INF_{it} + \beta_4 EXR_{it} + \beta_5 GDP_{it} + \mu_{it} \dots \dots \dots (4)$$

Where INV = Investment

- RIR = Real Interest Rate
- SAV = Savings
- EXR = Exchange Rate
- INF = Inflation
- GDP = Gross Domestic Product

### Model two for objective two

$$GDP_{it} = \alpha_i + \beta_1 RIR_{it} + \beta_2 INF_{it} + \beta_3 INV_{it} + \beta_4 EXR_{it} + \beta_5 TOT_{it} + \mu_{it} \dots \dots \dots (5)$$

Where GDP = Gross Domestic Product

- RIR = Real Interest Rate
- INF = Inflation
- INV = Investment
- EXR = Exchange Rate
- TOT = Terms of Trade

## Pre-Test

### The Levin and Lin (LL) test.

This panel unit root test was created by Levin and Lin (1992). Levin and Lin adopted a test that can literally be viewed as an extension of the DF test. The model form is as follows.

$$\Delta Y_{i,t} = a_i + \rho Y_{i,t-1} + \sum_{k=1}^n \phi_k \Delta Y_{i,t-k} + \delta_i + \theta_i + \mu_{it} \dots \dots \dots (6)$$

The model permits for two way fixed effects, one from the  $\delta_i$  and the other from the  $\theta_i$ , which makes both unit-specific fixed effects and unit specific time trends. The Unit specific fixed effects are very crucial component due to the permit for heterogeneity because the coefficient of the lagged  $Y_i$  is deprived to be homogeneous over all units of the panel. The LL test also assumes that the individual processes are independent in cross sectional data.

The null hypothesis of this test states that

$$H_0: \rho = 0 \quad H_0: \rho = 0$$

### The Kao Test

The Kao (1999) revealed DF and ADF-type tests for co-integration in panel data. According to Kao, the residual based co-integration test can be adopted.

$$\mu_{it} = e u_{it-1} + v_{it} \dots \dots \dots (7)$$

Kao (1999) also proposes an ADF test, where one can run the following regression

$$\mu_{i,t} = \rho \mu_{i,t-1} + \sum_{j=1}^n \phi_j \Delta \mu_{i,t-j} + v_{it} \dots \dots \dots (8)$$

## Hausman Test

Essentially, the Hausman test allows you to choose between fixed effects and random effects. For the panel data, the suitable choice connecting the fixed effects and the random effects methods examines if the regressors have a correlation with the individual (unobserved in most cases) effect. In accordance with Ahn and Moon (2001), the Hausman statistical test could be viewed as a distance test between H0, i.e., that random effects are consistent and efficient, and H1, i.e., that random effects are inconsistent (fixed effects will be consistent). Hausman adopts the following test statistics

$$H = (\hat{\beta}^{FE} - \hat{\beta}^{RE})' [Var(\hat{\beta}^{FE}) - Var(\hat{\beta}^{RE})]^{-1} (\hat{\beta}^{FE} - \hat{\beta}^{RE}) \sim \chi^2(\kappa) \dots \dots \dots (9)$$

## Post Test

### Fixed Effect Method

An example of a fixed effects model is a statistical model in which the model parameters are fixed or non-random, which differs from a random effects model and a mixed model in which all or some of the parameters are random. By using the fixed effect estimator, it is possible to correct some endogenous effects resulting from the regression coefficients correlating with individual specific effects, although, the regressors are still assumed not to be correlating with the idiosyncratic error  $\mu_{it}$ .

$$Y_{it} = \alpha_i + \beta_1 X_{it} + \beta_2 X_{2it} + \dots + \beta_k X_{kit} + \varepsilon_{it} \dots \dots \dots (10)$$

### Random Effect Method

Assuming that the fixed effects are uncorrelated with the explanatory variables, random effects are created, which results in strict limitations in the treatment of panel data. Random effects models assume that countries diverge in their error terms, and they also include a non-measurable stochastic variable that distinguishes individuals.

$$Y_{it} = \alpha_i + \beta_1 X_{it} + \beta_2 X_{2it} + \dots + \beta_k X_{kit} + \mu_i + \varepsilon_{it} \dots \dots \dots (11)$$

## RESULTS AND DISCUSSION

### Panel Unit Root/ Stationarity Test

The Levin, Lin and Chu, 2002 will be use to conduct the unit root test in order to know the stationarity of each variable. In each test, if H0:  $\rho = 0$  will accept the null hypothesis say that the variable has a unit root or is not stationary and if H0:  $\rho < 0$  will reject the null hypothesis thereby accepting the alternative, saying that there is no presence of unit root or the variable is stationary.

**Table 4.1**

| Var         | Levin, Lin and Chu, 2002 Test |                     |             |                      |
|-------------|-------------------------------|---------------------|-------------|----------------------|
|             | Level Diff                    | First Diff          | Second Diff | Order of Integration |
| <b>RIR</b>  | -3.52019 (0.0002)**           |                     |             | I(0)                 |
| <b>RGDP</b> | 7.03980 (1.0000)*             | -3.21832 (0.0006)** |             | I(1)                 |
| <b>INV</b>  | -1.21056 (0.1130)*            | -5.64518 (0.0000)** |             | I(1)                 |
| <b>INF</b>  | -4.07869 (0.0000)**           |                     |             | I(0)                 |
| <b>EXR</b>  | -2.52573 (0.0058)**           |                     |             | I(0)                 |
| <b>SAV</b>  | -1.62755 (0.0518)*            | -1.87961 (0.0301)** |             | I(1)                 |
| <b>TOT</b>  | -2.24069 (0.0125)**           |                     |             | I(0)                 |

The null hypothesis (H<sub>0</sub>) is that there is present of unit root meaning that the variables are not stationary while the alternative hypothesis (H<sub>a</sub>) is that there is no unit root, meaning that variables are stationary. Specification level are noted as \* unit root present and \*\* no unit root presence. From the above table using the Levin, Lin & Chu (LLC) to test for unit root, real interest rate (RIR), inflation (INF), exchange rate (EXR), and terms of trade (TOT) are integrated of order zero I(0) while real gross domestic product (RGDP), investment (INV) and savings (SAV) are integrated of order one I(1). As a result of these we can proceed to test for co-integration of the variables.

### The Co-integration Test Using the Kao Panel Co-integration Test

The null hypothesis there is that (H<sub>0</sub>) meaning no co-integration while alternative hypothesis (H<sub>a</sub>) is that there is co-integration among the variables, meaning that the variables possess a long-run relationship. To determine whether to reject or accept the null, the probability level must be less than 5% to reject the null hypotheses otherwise accept.

**Table 4.2**

| ADF               | t-Statistics | Prob   |
|-------------------|--------------|--------|
| Residual Variance | -3.456318    | 0.0003 |
| HAC Variance      | 60.45920     |        |

From the above we can see that probability is ADF test is less than 0.05 (5%) we are going to reject the null hypothesis and accept the alternative hypothesis. We conclude that there exists a long run relationship among the variables. We can go ahead to determine the long-run and short run relationship in the regression.

### The Hausman Test

**Table 4.3**

Correlation Random Effects- Hausman Test

| Test Summary  | Chi-Sq. Statistic | Chi-sq. d.f | Prob   |
|---------------|-------------------|-------------|--------|
| Period random | 0.743541          | 5           | 0.9805 |

From the above hausman test, since the probability is 0.9805 and it is more than 5% (0.05), it means that we accept the null by using the random effect for analysis i.e., the random effect is consistence and effective.

### Estimate the Impact of Real Interest Rate on Investment in WAMZ Countries.

**Table 4.4**

**Dependent Variable: INV**

**Method: Panel EGLS (Cross-section random effects)**

| Variable            | Co-efficient | Std.Error | t-Statistic | Prob   |
|---------------------|--------------|-----------|-------------|--------|
| <b>C</b>            | 1250.589     | 180.3077  | 6.935862    | 0.0000 |
| <b>RIR</b>          | -14.25221    | 14.19224  | -1.004226   | 0.3182 |
| <b>S(SAV)</b>       | 0.028319     | 0.011211  | 2.526112    | 0.0134 |
| <b>EXR</b>          | -0.107898    | 0.056937  | -1.895026   | 0.0616 |
| <b>INF</b>          | 1.161287     | 6.256818  | 0.185026    | 0.8532 |
| <b>D(RGDP)</b>      | 0.111953     | 0.050410  | 2.220827    | 0.0291 |
| <b>RESID(-1)</b>    | 0.792431     | 0.211129  | 3.753302    | 0.0003 |
| Weighted Statistics |              |           |             |        |
| R-square            |              |           | 0.605756    |        |
| Durbin-Watson stat  |              |           | 2.019360    |        |

From the above panel regression table in 4.4, savings (SAV) and real gross domestic product (RGDP) are positive and statistically significant to investment in West African Monetary Zone countries. While real interest rate (RIR), exchange rate (EXR) and inflation (INF) are statistically insignificant to investment (INV) in West Africa Monetary Zone countries. That is say one percent change in savings will bring about 2% increases in investment and a percentage change in real gross domestic product was as a result of 11% increases in investment in West African Monetary Zone countries. The Error Correction model is also significant and positive showing that the error in the regression has been corrected. The R-square shows a 61% goodness of fit and the Durbin-Watson statistic shows 2.02 which shows that there is no serial or auto-correlation in the regression. The result reveals that real interest rate does not impact on investment in the West African Monetary Zone countries. This result conforms to the findings of authors like Onyemachi, & Raji (2014) and Wuhan, & Adnan (2015).

#### Estimate the Impact of Real Interest Rate on Economic Growth in WAMZ Countries.

**Table 4.5**

| Variable                   | Co-efficient | Std.Error | t-Statistic | Prob   |
|----------------------------|--------------|-----------|-------------|--------|
| C                          | 1403.066     | 256.1682  | 5.477129    | 0.0000 |
| RIR                        | 5.450087     | 5.122479  | 1.063955    | 0.2904 |
| INF                        | 4.151239     | 7.513933  | 0.552472    | 0.5821 |
| D(INV)                     | 0.222364     | 0.056288  | 3.950471    | 0.0002 |
| EXR                        | 0.300432     | 0.104807  | 2.866525    | 0.0053 |
| TOT                        | 0.002734     | 0.002501  | 1.093029    | 0.2775 |
| RESID(-1)                  | 0.708255     | 0.074122  | 9.555204    | 0.0000 |
| <b>Weighted Statistics</b> |              |           |             |        |
| R-square                   |              |           | 0.562935    |        |
| Durbin-Watson stat         |              |           | 1.327674    |        |

From the above panel regression table 4.7.1., both investment (INV) and exchange rate (EXR) are positive statically significant to real gross domestic product (RGDP) while real interest rate (RIR), inflation (INF) and term of trade (TOT) are statistically insignificant to real domestic product to West African Monetary Zone countries. That is to say one percentage change in investment brings about 22% increases in real gross domestic product and one percentage change in exchange rate brings about 30% increases in real gross domestic product in WAMZ countries. The Error Correction model is also significant and positive showing that the error in the regression has been corrected. The R-square shows a 56% goodness of fit and the Durbin-Watson statistic shows 1.52 which shows that there is no serial or auto-correlation in the regression. The result reveals that real interest rate does not impact on gross domestic product in the West African Monetary Zone countries. This result conform to the findings of authors like Saka, Onafowokan, & Adebayo (2015), Waziri, Jelilor, & Isik (2017), Babalola, Danlandi, Omolefe, & Ajibiye (2015), Najarzadeh, Ashena, & Jazdani (2012) and Njie, & Bidjie (2021).

### CONCLUSION AND SUGGESTION

In this study, Panel data analysis has been estimated and after the test of hausman test the random effect method was used to carry out the estimation to know the impact of real interest rate on investment and economic growth with evidence for West African Monetary Zone for the period 2000 to 2015. In the first objective, the result reveals that real interest rate does not impact on investment in the West African Monetary Zone countries. That is to say real interest rate has no significant impact on investment. Therefore real interest rate has nothing

to do with the investment of the countries in the West African Monetary Zone. And in the second objective, the result reveals that real interest rate has no significant impact on gross domestic product in the West African Monetary Zone countries. Therefore real interest rate has nothing to do with the gross domestic product in the countries that made up the West African Monetary Zone.

Base on the findings, the study recommends that: The study also recommends that these countries should reduce their real interest rate to increase investment in WAMZ especial in Ghana, Gambia and Liberia. Policy markers of countries that made up the West African Monetary Zone (WAMZ) should implement policies aimed at achieving the threshold inflation rate that is consistent with higher economic growth. The study recommends that countries like Gambia, Ghana, Liberia and Sierra Leon should bring down their rate of interest so that investment will increase and leads to economic growth. Finally, the study recommends countries like Guinea and Sierra Leon to try to appreciate their currency.

## CONFLICT OF INTEREST

None.

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