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Exchange Rate Volatility and Economic Growth Nexus in the West African Monetary Zone (WAMZ)

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Abstract:- This study assessed the relationship between exchange rate volatility and economic growthin the west African monetaryzone (WAMZ). The study employed annualized panel dataset that spans from 1989 to 2019, using analytical technique ofthe fixed-effect panel dynamic threshold model.The GARCH technique was employed to ascertain the exchange rate volatility of the selected WAMZ Member States including, Nigeria, Ghana, and The Gambia, while Guinea, Sierra Leone and Liberia were dropped from the observation owning to non-availability of data. The results show thatthe first lag of real GDP(Rgdp), has a significant and positive relationship with the dependent variable. While exchange rate volatility has a negative but insignificant relationship with economic growth. The study also indicate that inflation is negatively and significantly related to economic growth within the countries, whereas interest rate is positively and insignificantly related to economic growth. Given the importance of exchange rate on economic growth through facilitating international trade and investment in the WAMZ region, these countries' monetary authorities, government and other relevant agencies should adopt measures that will discourage imports and encourage exports and adapt an exchange rate policy that principally seeks to stabilize exchange rates with the zone.

Keywords:- *Exchange rate volatility, GARCH (1,1) model.*

I. INTRODUCTION

Exchange rate remains a very important economic and financial variable in macroeconomic management due mainly to the increased financial globalization and world trade integration.The choice of an appropriate exchange rate regime is one of the most critical decisions in the formation of a monetary union. While various countries migrate from individual currencies to a common currency, the union trades with non-member countries and the type of exchange rate regime used by the union have different macroeconomic implications, given the structure of the countries in the union. As part of the roadmap activities of the proposed ECOWAS monetary union, the harmonisation of exchange rate regimes is critical at proposing an ideal exchange rate regime for the ECOWAS region which currently has two major blocs.

On one hand, the West African Monetary Zone (WAMZ), which came into existence in the year 2000 was formed by Nigeria, The Gambia, Guinea, Ghana, and Sierra Leone, while in 2010, Liberia joined the zone (but due to data availability this paper will only involve three countries -Nigeria, The Gambia, and Ghana). In 2003, the zone was expected to commence a full-blown monetary union which never materialised. By 2015, the zoneproposed the introduction of a common currency, the "eco", in order to reduce the exchange rate volatility and uncertainty arising from differences in official exchange rate inthe zone.Thus,paving a way that could make stable inflation rate, and enhanced efficiency in allocation of capital accompanied by intra-regional trade (Yuen, 2000).

The WAMZ countries over the years have employed different exchange rate regimes ranging from fixed to peg, and from managed float to independent float. The adoption of floating exchange rate regime in the WAMZ dates to the 1980s (Sekkat & Varoudakis, 1998). Nigeria, before 1986, operated fixed exchange rate system. Prior to the introduction of Naira, Nigeria pound was at one time, or another pegged at par to the British pound or the US dollar. The subsequent devaluation of the US dollar affected the value of the naira in 1973, and Nigeriadecided to discontinue any direct relationship between her currency with either the British pound sterling or the US dollar.

The dwindling oil prices in the early 1980s and attendant economic problems, led the economy into crisis, hence, the International Monetary Fund (IMF) in 1986 recommended the Structural Adjustment Programme (SAP).During this period, thefloating of exchange rate was one of the policies put in place.This led to the introduction of the second-tier foreign exchange market (SFEM) in September 1986, which was later transformed into foreign exchange rate market (FEM) in 1987. Floating exchange rate regime was maintained from 1986-1993, until a temporary suspension in 1994, when the official exchange rate was pegged to the US dollar. There was the reversal of policy in 1995 with the "guided deregulation" of the foreign exchange market, through exchange rate liberalization and the adoption of a dual exchange rate mechanism (Fapetu&Oloyede, 2014).

The Nigeria exchange rate reforms of 1995 heralded the establishment of autonomous foreign exchange rate market (AFEM). This was followed by the introduction of the inter-bank foreign exchange rate market (IFEM) in 1999.

Subsequently, the retail Dutch Auction System (rDAS) was reintroduced on July 22, 2002, to conserve the external reserves, reduce to minimum, the spread between the official rate, parallel market and BDC rates, amongst other reasons. The wholesale Dutch Auction System (wDAS) replaced the rDAS on February 20, 2006.

The re-emerging crisis in the European Union countries and the declining growth rate of the Chinese economy,and the seeming insecurity challenges in the country resulted in all forms of market speculations and sentiments. This affected capital inflows with undue pressure on demand for foreign exchange, leading theCentral Bank of Nigeria (CBN)to re-introduce the rDAS as an alternative to the wDASin October 2013. However, the Bank closed the rDAS window on February 18, 2015, and migrated its operations to interventions in the inter-bank foreign exchange market (IFEM). This supported the elimination of the widening margin between the exchange rates in the inter-bank and RDAS window, which engendered undesirable practices including round-tripping that fueled speculative demand, rent-seeking, and inefficient use of the foreign exchange resources (CBN, 2015).

The CBN suspended the sale of foreign exchange to Bureau-de-change (BDCs) and disallowed BDC participation in the inter-bank foreign exchange market. Subsequently, exchange rate management was further liberalized following the issuance of the “Revised Guidelines for the Operation of the Nigerian inter-bank Foreign Exchange Market on June 15, 2016, and came into operation on June 20, 2016, till date. The advent of this policy guideline heralded another era in the flexible foreign exchange rate regime in Nigeria.

Ghana, on the other hand practiced fixed or pegged exchange rate till 1986. The country however, introduced the managed flexible exchange rate system between 1987 to 1992, whenit implemented the free-floating exchange system. This system however, caused about 1500% depreciation of the Cedi against the US dollar over a decade period (John & Tawiah 2015).Previous studies (see Tarawalie, Sissoho, Conte, &Ahortor 2013; Alagidede& Ibrahim) show that over the years, Ghana has encountered high exchange rate volatility mainly during the flexible exchange regime.

In The Gambia, the floating exchange rate system came into effect in 1986, as part of the economic restructuring program of the IMF. The central bank of The Gambia intervenes to maintain reserves level and to smoothen out volatility of the exchange rate(Sambujang, et al. 2014).

Unlike countries under fixed exchange rate regimes, countries under floating exchange rate regimes are likely to experience volatility. This is even more so for WAMZ countries that not only practice floating exchange rates but are also import dependent (both raw materials and finished goods). Also, due to globalization and financial liberalization, these countries have significant debt exposure, both private and public, from the international markets. These amplify the risk of exchange-rate-volatility-induced instability for these countries. The unexpected movement in exchange rate is termed exchange rate volatility (Ozturk, 2006). Exchange rate volatility takes the mode of swings or fluctuations in the exchange rate over a periodor deviations from equilibrium exchange rate (Ogundipe&Ogundipe, 2014). Amongst its several causes, is the issue of multiplicity of foreign exchange markets parallel with the official exchange rate which could lead to fluctuations in currency values.

Volatility of the exchange rate generates uncertainty about expected future path of exchange rate which could negatively or positively affect other fundamental macroeconomic variables including growth, inflation, investment and output.Exchange rate volatility increases uncertainty and risk in economic decision-making, including investment, import and export. Volatile exchange rates are related to unplanned fluctuations of relative prices in an economy. More so, exchange rate regimes are considered as the main mechanism in the analysis of economic efficiency since the era of Friedman (1953), Humphrey (1974) and (Umaru, Niyi& Davies; 2018). Therefore, attaining exchange rate stability could likely lead to macroeconomic stability and promote economic growth. Attempts to manage exchange rate volatility and its overshooting tendencies started after the failure of the Bretton Woods System in 1971 (Stockman, 1978).

The exchange rate breakdown exposed many currencies to exchange rate volatility or fluctuations amidst other issues, and since then, there has been increasing and continuous interest in attempts at ascertaining the effects of exchange rate volatility on growth in different climes.

The potential behaviour of monetary policy indicators such as interest rate, inflation rate and exchange rate can affect the growth channels. Thus, the general price level (in nominal terms) may rise in the WAMZ and this may be transmitted either from imported inflation or through exchange rate channel, which may affect the competitiveness of the economy. Monetary policy must therefore consider the effects and respond appropriately, particularly given the structure the of two major blocs of the ECOWAS nations.

The above scenario has inspired several studies on the effects of exchange rate volatility on macroeconomic stability and economic growth with varying results. A few of such studies have established that exchange rate volatility has positive impact on economic growth through the adjustment process to shocks (Barguellil et al, 2018; Edwards & Levy-Yeyati, 2005; Levy-Yeyati & Sturzenegger, 2003). Some studies on the contrary, established the negative effects of exchange rate volatility on some macroeconomic indicators that may affect economic growth, employment, investment, international trade and inflation (Belke& Setzer, 2003).

Despite the existence of such literatures, limited number of studies have been conducted in that regard for countries under WAMZ. It is therefore, the intention of this study to not only add to the existing literature on the impact of exchange rate volatility on economic growth in the WAMZ, but to also help in settling the argument about the nature of the relationship between economic growth and exchange rate volatility.Tocover the existing gap, this study seeks to answer some pertinent questions such as: what is the nature of exchange rate volatility in the WAMZ? And what is the nature of causality of this relationship in the WAMZ economy.

The study intends to employ the Generalized Autoregressive Conditional Heteroscedasticity (GARCH) to ascertain the exchange rate volatility, while the fixed-effect panel dynamic threshold modelwill be employed to establish the nature and extent of the relationship between exchange rate volatility and economic growth, within the WAMZ in both the short and long runs using annual data covering 1989-2019 period. The rest of the paper is organized as follows. Section 2 presents the theoretical and empirical literature and establishes the research gap to be filled by this study. Sections 3 and 4 dwell on the methodological procedures and results presentations while Section 5 concludes the paper with policy recommendations.

II. EMPIRICAL REVIEW

Few studies exist on the relationship between exchange rate volatility and economic growth within the West African Monetary Zone (WAMZ). However, the literature is replete with studies that focus on exploring the relationship between exchange rate volatility and specific macro variables such as imports, exports and trade in specific countries.

Empirical results from the literature are mixed, with regards to the nature of the relationship between exchange rate volatility and economic growth. While some studies found a negative relationship between the two; others found a positive relationship; and some even an insignificant relationship between the two.

Holland et al (2011) explored the relationship between growth and exchange rate volatility using panel data analysis involving a set of 82 advanced and developing economies including Ghana, Gambia, Nigeria, Senegal and Sierra Leone. Using a two-step system GMM panel growth model on a dataset spanning 1970-2009, the paper established a negative and significant relationship between exchange rate volatility and economic growth.

Barguellil et al (2018) studied the relationship between exchange rate volatility and economic growth using a set of 45 developing and emerging economies including Ghana, Gambia, Nigeria, Senegal and Sierra Leone over 1985-2015 period. Using GARCH to generate exchange rate volatility and employing both Difference GMM and System GMM models for estimation, the study found a negative and significant relationship between economic growth and both nominal exchange rate volatility and real exchange rate volatility from both models.

Uba (2015) studied the relationship between exchange rate volatility and economic growth in Nigeria using annual data spanning 1980-2012 period. Adopting the GARCH technique, the study found a negative and insignificant relationship between economic growth and exchange rate volatility in Nigeria in both the short and long runs.

Danladi & Uba (2015) studied the impact of exchange rate volatility on economic performance in the West African Monetary Zone (WAMZ) with focus on Nigeria and Ghana. The study utilized annual data between 1980-2013 and adopted the GARCH approach. The empirical results indicate a negative and insignificant relationship between exchange rate volatility and economic growth in Nigeria, and a positive but insignificant relationship between exchange rate volatility and economic growth in Ghana.

Alagidede& Ibrahim (2016) studied the causes and effects of exchange rate volatility on economic growth in Ghana using annual data between 1980-2013. Adopting GARCH and Generalized Method of Moments, the study found a negative and significant relationship between exchange rate volatility and economic growth in Ghana.

Umaru et al (2018) studied the effects of exchange rate volatility on economic growth of West African English speaking countries including Gambia, Ghana, Nigeria, and Sierra Leone between 1980-2017. Using panel data regression analysis, the study found a negative and significant relationship between real exchange rate and economic growth in Ghana and Nigeria, and an insignificant relationship between real exchange rate and economic growth in Gambia and Sierra Leone.

Tule et la (2020) studied the effect of exchange rate volatility on economic growth in Nigeria monthly data between 2003-2017. Using GARCH approach to generate exchange rate volatility and Vector Error Correction Model (VECM), the study found a negative relationship between economic growth and exchange rate volatility.

Katusiime et al (2016) studied the nexus between exchange rate volatility and economic growth in Uganda using annual timeseries spanning the period1960-2011. Adopting GARCH model to generate exchange rate volatility and Autoregressive Distributed Lag ARDL estimation approach, the study found a positive relationship between exchange rate volatility and economic growth in both the short run and long run, which is significant only in the long run. However, when the model is augmented with an exchange rate volatility-political instability interaction term, the interaction variable yielded negative and significant coefficients in both the short run and long run, indicating that exchange rate volatility has a negative relationship with economic growth only in the face of political instability.

Phiri (2018) studied the non-linear relationship between exchange rate volatility and economic growth in South Africa using annual data between 1970-2015. He used GARCH approach to generate exchange rate volatility. Adopting the Smooth Transition Regression (STR) model, the study found government spending as the transition variable and further estimated the threshold of the transition variable which determines the regime switching behaviour. The study found that below this threshold, exchange rate volatility has a positive and significant relationship with economic growth. However, above the threshold, the relationship becomes negative but insignificant.

Raji (2013), studied the impact of real exchange rate misalignment on economic performance in the WAMZ economies using quarterly data between 2000-2010. Adopting the Generalized Method of Moments of Dynamic Panel Estimation Method supported with Cross Country Correlation Approach, the study discovered that the Zone experiences asymmetrical correlations between real exchange rate misalignment and economic performance, while the inclusion of equilibrium real exchange rate revealed a symmetrical relationship with economic performance.

From our literature review it was discovered that there exists a relationship between exchange rate volatility and economic growth, some countries have high volatile exchange rate in the region while some have the least volatile exchange rate. Most studies employed the GARCH Approach in their analysis while others employed GMM, pooled OLS, ARDL bound test and cross-country correlation approach. These studies failed to conduct causality tests to determine the direction of the causality between variables, more so the years covered are not up to date, so results could be outdated. This study is therefore set to bridge this gap by employing GARCH test, while expanding the years of coverage to 2019.Our study also employed panel VAR technique to dissect this relationship.

III. METHODOLOGY AND DATA

This study is quantitative research that attempts to assess the relationship between exchange rate volatility and economic growth nexus in the WAMZ.

This study employed annual time series data analysis to examine the exchange rate volatility in the WAMZ. The analytical technique ofthe fixed-effect panel dynamic threshold model, of the selected macroeconomic variables were explored, and inferences drawn based on the panel analysis for the WAMZ, while the GARCH technique was employed to ascertain the exchange rate volatility of their currencies, respectively. This study design is chosen because the time series data lends itself to the application of quantitative research, while the panel analysis seem to be a superior and acceptable technique for assessing the variables and the series.

The study employed annualized panel dataset that spans from 1989 to 2019. This data range was chosen because of the timing of the research and the need to minimise missing observations in the baseline model (data availability). The selected WAMZ Member States are Nigeria, Ghana, andThe Gambia, while Guinea,Sierra Leone and Liberia were dropped from the observation owning to non-availability of data.

The chosen dependent variable for this study is economic growth, which we defined as the growth rate or real growth of each of the selected countries gross domestic product. The major explanatory variable is the exchange rate volatility. We estimate exchange rate volatility using the GARCH technique. The exchange rate volatilitywas generated using GARCH (1,1) model, because of its parsimony and ability to capture volatilityin most time series (see Tarawlie et al., 2013).

To make our results comparable with previous studies, some theoretically important control macroeconomic variables that are important determinants of economic growth were introduced to the baseline model. The variables are inflation rate,external reserve, interest rate, amongst others. The data were sourced from the World Development Indicator (WDI) databank.

IV. THEORETICAL FRAMEWORK

The absolute purchasing power parity (PPP), which states that exchange rate are relative price levels, seems to be an essential, but not a sufficient bedrock for the flexible price monetary model (FPMM).

Monetary theory proposes that exchange rate is the relative price of two or more currencies. The flexible price monetary model is however, built on two main assumptions. Firstly, all prices are perfectly flexible yielding continuous Purchasing Power Parity. Secondly, money markets are always in equilibrium with respect to the Keynesian money demand function, which sees real money balances as a function of real income and interest rate, hence we can state that:

$$M/P = L\,(Y, i) \qquad \ldots (1)$$

where M represents the nominal money supply, P is the price level, Y is the real income and i stands for the interest rate. In the Keynesian money demand function, (M/P), the demand for real money balances is negatively dependent on interest rate and positively dependent on real income. A rise in real income induces higher level of real money demand, while, an increase in interest rate is expected to decrease the demand for real money balances owing to the rise in cost of holding money. Accordingly, M represents the narrow definition of money supply, which is very sensitive to interest rate.

According to Cagan (1956), the functional form of the Keynesian money demand can be written as:

$$M_t/P_t = Y_t^k e^{-\lambda it} \qquad \cdots (2)$$

where k and λ stands for the income elasticity and the interest semi-elasticity of money demand.

If we take the natural logarithm of (2) we have as below:

$$M_t - P_t = ky_t - \lambda i_t \qquad \ldots (3)$$

If we solve equation (3) for P, then we obtain:

$$P_t = M_t - ky_t + \lambda i_t \qquad \ldots (4)$$

The above equation transformation could apply for a foreign country; hence we have the equation as below:

$$P_t^* = M_t^* - k^* y_t^* + þ\, \lambda^* i_t^* \qquad \ldots . (5)$$

where P_t* and M_t* represents foreign variables and coefficients. Therefore, intercountry difference can be stated as follows:

$$P_t - P_t^* = M_t - M_t^* - ky_t + k^*y_t^* + \lambda i_t - \lambda^* i_t^* \quad (6)$$

Equation 6 implies that intercountry relative prices are influenced by countries relative money supply, real income, and interest rate.

The law of one price, states that identical products must sell for the same price, and arbitrage eliminates the discrepancy in prices, this is the foundation of PPP. It incorporates price indices to the model and postulates that international trade removes arbitrage opportunities. Therefore, absolute PPP, the second building block of FPMM can be written as below:

$$E = P/P^* \quad \ldots (7)$$

Where E represents the nominal exchange rate, while P and P* respectively represents domestic and foreign price levels. If we take the natural logarithms of the above, we obtain:

$$E_t = p_t - p_t^* \quad (8)$$

If we combine equations 8 and 6, we obtain a FPMM as follows:

$$s_t = m_t - m_t^* - ky_t + k^*y_t^* + \lambda i_t - \lambda^* i_t^* \quad (9)$$

Given that the domestic demand for money has identical elasticities to those of the demand for foreign currency ($k = k^*$ and $\lambda = \lambda^*$) therefore, the following restricted equation applies:

$$E_t = (m_t - m_t^*) - k(y_t y_t^*) + \lambda(i_t - i_t^*) \quad (10)$$

Equation 10 suggests three hypotheses that are testable: the coefficient on the relative money supply is positive and unity; the coefficient on the relative real income term is negative and the coefficient on the relative interest rate is positive.

If we employ the forward-looking monetary policy to modify the FPMM we therefore, incorporate current expectations represented by S_t, into the model, hence, we introduce an uncovered interest rate parity that states as below:

$$S_t (E_t+1) - E_t = i_t - i_t^* \quad (11)$$

If interest rate differential in FPMM is replaced with the expected change in exchange rate we obtain:

$$E_t = (m_t - m_t^*) - k(y_t - y_t^*) + \lambda(S_t(E_t+1) - E_t) \quad (12)$$

Rearranging equation 12 we have as follows:

$$E_t = (1 + \lambda)^{-1} x_t + \delta(S_t(E_t+1)) \quad (13)$$

Given that $x_t = [(m_t - m_t^*) - k(y_t - y_t^*)]$ and $\delta = \lambda(1 + \lambda)^{-1}$.

The expected exchange rate in period t+1, in line with the rational expectations theory, can be written as follows:

$$S_t (E_{t+1}) = (1 + \lambda)^{-1} S_t(x_{t+1}) + \delta(S_t (E_{t+2})) \quad (14)$$

If we replace the expected exchange rate recursively for all future periods and impose the transversality condition ($\lim \delta^j S_t (E_{t+j}) = 0$), we can therefore, define the forward-looking monetary model (FLMM) as follows:

$$E_t = (1+\lambda)^{-1} \sum_{j=0}^{\infty} \delta^j S_t(X_{t+j}) \quad (15)$$

where δ represents a discount factor.

It therefore, presupposes that equation 15, sees exchange rate as the present value of all expected future values of xt (fundamentals), money supply and real income. Nevertheless, since the future values of the fundamentals are not easily observable, FLMM may not be practical in determining the exchange rate.

Hence, to establish the link between exchange rate and the fundamentals we deduct current value of the fundamentals from both sides of equation 15 to obtain the necessary arrangement for this condition to hold, therefore, we have the following:

$$E_t - x_t = \sum_{j=0}^{\infty} \delta^j S_t (\Delta x_t + j) \quad (16)$$

Given that the fundamentals are first-difference stationary, therefore, the right-hand side of Equation 16 must be stationary as well. Accordingly, the exchange rate is expected to be cointegrated with the fundamentals, given that it is also first-difference stationary time series (MacDonald and Taylor, 1992).

If we assume that there is no rational bubble, we can therefore, test the FLMM with the equation and constraints below, using a cointegration technique.

$$E_t = \beta_0 (m_t - m_t^*) + \beta_1(y_t - y_t^*) \ (\beta_0 = 1; \beta_1 < 0) \quad \ldots (17)$$

Furthermore, if we jettison the foreign variables $(m_t - m_t^*) + \beta_1(y_t - y_t^*)$ and introduce exchange rate as our dependent variable subject to other macroeconomic variables such as inflation, interest rate, external reserve, and government expenditure, in anticipation that they could impact on real growth rate, therefore, we candetermine economic growth relationship, by rewriting equation 17, as below:

$$RGDP_t = \beta_0 (RGDP_t) + \beta_1 (IN_t) ++\beta_2(IR_t) + \beta_3(EX_t) + \beta_4(GXP_t) \ (\beta_0 = 1; \beta_{1\ldots} \beta_5 < 0) \quad \ldots (18)$$

Where IN_t, IR_t, IR_t, EX_t, GXP_t represents inflation, interest rate, external reserve andgovernment expenditurerespectively. Equation 18 is therefore, the building block of this study, as it is theoretically supported by previous research and existing exchange rate and economic theories.

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V. DISCUSSION OF RESULTS

This section is organized into three subsections. We present and discuss some preliminary analysis with exploratory data analysis to explore the dynamic relationship between exchange rate volatility and economic growth in the WAMZ region in the first subsection. This is particularly important for understanding the modelling approach and inferential expectation of the research. In the second subsection, the models' estimations are presented and discussed while battery of diagnostic tests for evaluating the performance of the model are presented in the last subsection.

A. Some Preliminary and Exploratory Data Analysis

In this section, we report the summary statistics of the variables used in the analysis. For the sampled countries, the key variables are the exchange rate volatility, real GDP, M2, interest rate, inflation, and government expenditure. From the summary statistics presented in Table 1, we can infer evidence of unpredicted changes in the dynamics of real GDP, Inflation and exchange rates volatility. For example, the estimates of the standard deviation of the real GDP almost double the mean estimates. This may suggest that real GDPis characterized with extreme values observation (with excess kurtosis and large asymmetries). Equally, the standard deviation of the exchange rates volatility and Inflation are much higher than their mean values which further underscore the presence of uncertainty within the sampled countries.

Variable		Mean	Std. Dev.	Min	Max	Obs.
id	Overall	2	.8179	1	3	N= 300
	Between		1	1	3	n= 3
	Within		0	2	2	T= 100
exch	Overall	58.22472	78.23817	.1381503	322.0937	N= 300
	Between		76.40893	1.661399	145.1474	n= 3
	Within		47.07417	-76.92166	235.1711	T= 100
ge	Overall	4.46e+10	3.44e+10	1.38e+09	1.06e+11	N= 300
	Between		3.21e+10	7.80e+09	6.42e+10	n= 3
	Within		2.22e+10	1.68e+09	8.64e+10	T= 98.667
infl	Overall	13.18248	11.95069	.548387	94.167	N= 300
	Between		6.678006	5.787416	18.77224	n= 3
	Within		10.62963	1.160995	92.3617	T= 100
Ir	Overall	11.49141	8.553489	-2.781755	36.06755	N= 300
	Between		7.948395	2.500761	17.5846	n= 3
	Within		5.559076	2.427055	29.97436	T= 100
m2	Overall	10.33704	13.06683	-24.3918	53.77972	N= 300
	Between		6.426375	3.369013	16.03086	n= 3
	Within		11.96319	-25.666	52.50553	T= 100
rgdp	Overall	4.995198	3.323465	-5.000415	15.18909	N= 300
	Between		1.265616	3.570723	5.990165	n= 3

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Within		3.158163	-3.57594	14.75959	T= 100
year Overall	50.5	28.9143	1		N= 300
Between		0	50.5		n= 3
Within		28.9143	100		T= 100

Table 1: Summary statistics of the Key Variables in the Panels

Further scrutiny of table 1 produce evidence of highly nonlinear movement of the variables in the panels which may suggest that the models to be estimated can deal with nonlinearities. We can also conclude that large size of standard deviation relative to the size of mean may also suggest that the variables are highly unpredictable.

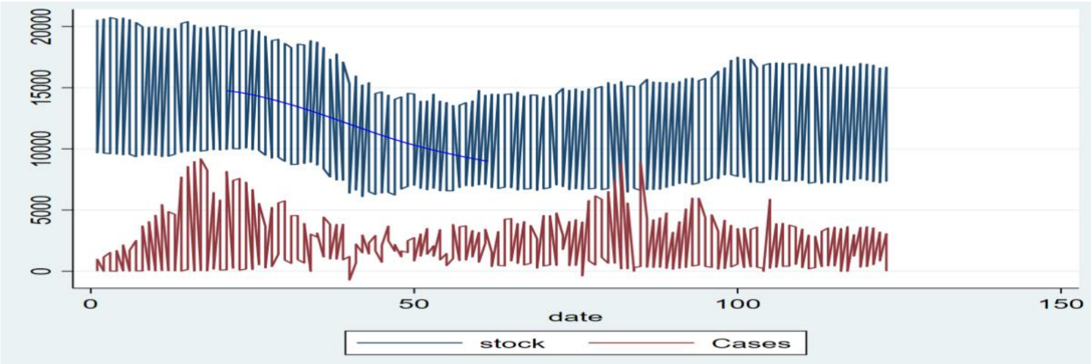

Fig. 1: Conditional Correlation between Real GDP and Exchange rates volatility (Nigeria)

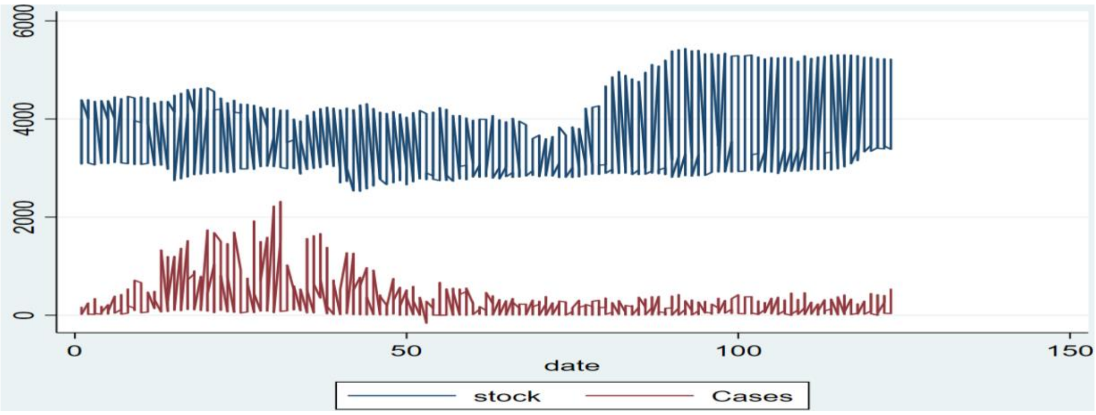

Fig. 2: Conditional Correlation between Real GDP and Exchange rates volatility (Ghana)

We visualize the dynamic conditional correlation between the real GDP and exchange rates volatility in figures 1-3. We can readily infer that, from figures, when the exchange rates volatility in the WAMZ spiked up to approximately 10000 (as standard deviation), real GDP is observed to fall significantly and vice versa. This may reflect the increased fear of the investors even with fall in the exchange rates volatility.

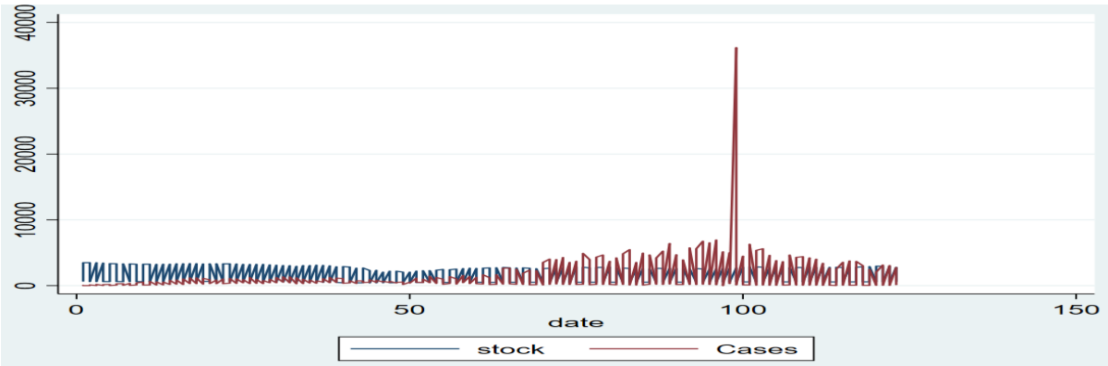

Fig. 3: Conditional Correlation between Real gdp and Exchange rates volatility (Gambia)

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These dynamics are also observed in Africa and North American countries. Generally, there is evidence that the correlation between the real GDP and exchange rates volatility is strong and that increases in the size of exchange rates volatility is observed to yield lower and reduced real GDP across these countries.

B. Models' Estimation Results

Our reference model, the Hansen 1999 fixed-effect panel dynamic threshold model, is estimated by setting the number of thresholds to be 1 (***thnum (1)***), the number grid point search as 400 (***grid (400)***) and the number of bootstrap replications is set to be 300 (***bs (300)***). The number of trimming proportions is set to 1 as it must be equal to the number of thresholds specified in the 'thnum' and the trimming proportion is set to 0.10 (***trim (0.10)***). The regime-dependent variables in the model is 'Exchange rates volatility', (***rx (govt. expenditure, Exchange rates volatility)***) while the threshold variable is assumed to be 'govt. expenditure', (***qx (govt. expenditure)***). We use lag of govt. expenditure price, (***lag.ge***), lag of exchange rate (***lagexr***) and the lag of rgdp return (***lagrgdp***) as the list of regressors for regime-independent variables while rgdp returns (***rgdp***) is used as the dependent variable.

Table 2: Threshold Estimates (level=95)

Model	***Threshold***	***Lower***	***Upper***
Th-1	32.2500	31.0200	32.7300

We report the estimates of the threshold in Table 2, which provides the value of the threshold parameter as 32.2500 while the lower and upper estimates of the confidence intervals are, respectively, 31.0200 and 32.7300. *Th-1* denotes the estimator in single-threshold models.

Table 3: Threshold Effect Test (bootstrap=300)

Threshold	***RSS***	***MSE***	***Fstat***	***Prob***	***Crit10***	***Crit5***	***Crit1***
Single	3.88e+07	1.38e+07	254.33	0.0467	174.2263	243.5818	353.5036

In table 3, we report the threshold effect test, which follows F-distribution with critical values at 10%, 5% and 1%, including the residual sum of square (*RSS*), mean sum of square (*MSE*). Estimates from table 3 suggest that the null of linear model is strongly rejected as the size of the *F-statistic* is large with the probability value less than 5%. Thus, it can be inferred that our data supports nonlinearity and that there are significant threshold effects. This suggests that government expenditure exhibits abrupt behaviour with the emergence of inflation.

Table 4: Fixed-Effects Regression of the Hansen 1999 Panel Dynamic Threshold Model

Rgdp	Coeff.	Std.Err.	t	P>|t|	Lower CI	Upper CI
lagrgdp	54.43241	21.76541	2.50	0.010	-23.9876	87.7654
lag.ge	-82.54727	31.09973	-2.65	0.008	-143.5271	-21.56743
lagexr	1.20746	.3980563	3.03	0.002	.4269574	1.987962
Inflation	.2135379	.4525249	0.47	0.637	-.6737653	1.100841
cat#c.ge						
0	156.9393	33.03517	4.75	0.000	92.16453	221.7142
1	177.3461	31.22538	5.68	0.000	116.1199	238.5723
cat#c.exchange rates volatility						
0	-.5718718	.0362985	-15.75	0.000	-.6430452	-.5006984
1	-.044387	.0204852	-2.17	0.030	-.0845541	-.0042199
cons	15611.9	446.901	34.93	0.000	14735.63	16488.18

Extracted from table 4, we can infer the statistical significance of the regime-independent variables (***lagrgdp, laggovt. expenditure, lager and Inflation***) and regime-dependent regressors (***govt. expenditure and exchange rates volatility***). Except ***Inflation*** that is not too different from zero to warrant the rejection of the null hypothesis of statistically insignificant, all other variables (regime-dependent and regime-independent) are found to be statistically significant with the lowest probability values. Parameters of interest are the regime-dependent regressors (***govt. expenditure and Exchange rates volatility***) which assume discrete and abrupt change with indicator function defined over the range of two values (0, 1).

We can observe that the regime-dependent variables are highly statistically significant across the two regimes, with estimated coefficients that are different across the two regimes. It is imperative to note that, in our research, we define first regime (regime_1) as the period in which global tension due to COVID-19 pandemic is in its peak while second regime (regime_2) is defined as the period with less global tension in the fear of COVID-19 pandemic. For government expenditure as one of the regime-dependent variables, the partial elasticity coefficient in the first regime is estimated to be approximately 156.93 and this partial elasticity coefficient has increased to 177.34 in the second regime. Interpreted differently, rgdp returns depressed by approximately 13 percent between the two regimes, implying that government expenditure changes have negatively affected the rgdp returns. The estimated coefficients of the thresholds are statistically significant with least probability value of making type 1 error. Equally, for exchange rates volatility, as the second regime-dependent variable, we observe that the more turbulent period has threshold effect which is estimated to be approximately -.5718718 (-57.18%) and this value has reduced to approximately -.044387 (-0.44%) in the calm period of the crisis. This implies that the value of the rgdp returns falls as high as 99.23% when the global economy transition from calm period of the crisis (regime_2) to the turbulent period of the crisis (regime_1). Therefore, we can infer that the threshold effects of ***exchange rates volatility*** on rgdp returns is statistically significant, and we can interpret it to be that for a unit increase in the number of exchange rates volatility, rgdp returns deteriorates by almost 57% during the turbulent period of the crisis while for a unit increase in the number of exchange rates volatility, rgdp returns deteriorates as low as 0.44% during the calm period of the crisis.

Table 5: Summary Statistics and Scalar Values from the Estimated Fixed-Effects of Hansen's Panel Dynamic Threshold Model

R-sq: Within	0.2890
Between	0.0398
Overall	0.0148
corr (u_i, xb)	-0.2736
F (7, 2897)	168.24
Prob>F	0.0000
sigma_u	28760.95
sigma_e	3660.6363
rho	.98405856
F test that all u_i=0: F (23, 2897)	6287.69

From diagnostic presented in table 5, we can say that the test statistics supporting our reference model provides overwhelming evidence that our data support the Hansen 1999 model. The within variation of the model (0.2890) is comparatively larger than between variation of the model (0.0398) as well as the overall variation of the model (0.0148). The joint influence of all the regressors is far from being irrelevant in accounting for the behaviour of the rgdp returns as the *F-statistics* produce evidence of 168.24 test statistic with zero probability value. The unobserved component of the model is also found to be significant with the *F-statistic* value as high as 6287.69.

With single-threshold model estimates presented in table 2-5, which clearly reject the linear model, it is natural to fit a double-threshold model. The model set up is described as the number of thresholds to be 2 (***thnum (2)***), the number grid point search increased to 10000 (***grid (10000)***) and the number of bootstrap replications is set to be 1000 each (***bs (1000 1000)***). The number of trimming proportions is set to 2 and the trimming proportion is set to 0.05 each (***trim (0.05 0.05)***).

Table 6: Threshold Estimates (level=95)

Model	Threshold	Lower	Upper
Th-1	32.2500	31.0200	32.7300
Th-21	32.2500	31.0200	32.7300
Th-22	52.5200	52.0500	53.3900

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Increasing the number of thresholds to 2, (***thnum (2)***), as reported in table 6, leaves the results somewhat similar to the estimates of single threshold. We observe that the single-threshold estimates, *Th-1*(or sometimes, *Th-21*) is 32.2500 while the double-threshold estimates, *Th-22* is 52.5200. However, to search for the evidence of whether our data support double-threshold model, we report the threshold effect tests in table 7.

Table 7: Threshold Effect Test (bootstrap=1000 1000)

Threshold	**RSS**	**MSE**	**Fstat**	**Prob**	**Crit10**	**Crit5**	**Crit1**
Single	3.88e+07	1.38e+07	254.33	0.0480	186.5031	248.5651	391.8205
Double	3.84e+10	1.37e+07	32.60	0.5310	109.3315	165.2290	255.2422

In the single-threshold model, the formal hypothesis test has in its null form (*Ho*) that linear model is more appropriate while the alternative hypothesis (*Ha*) says that single-threshold model is more appropriate. In the double-threshold model, the null hypothesis (*Ho*) supports the single-threshold model while the alternative hypothesis (*Ha*) assumes double-threshold model. Apparently, from table7, we can say that our data seems to provide overwhelming evidence in support of a single-threshold model as the size *F-statistics* is reasonably large (245.33) with probability value less than 5%. Thus, we can say that we reject the double-threshold model with high probability value.

It is also revealing, in terms of statistical model evaluation, to compare the fixed-effects regression with different number of settings by varying the number of grid point search (***grid***), the number of bootstrap replications (***bs***) and the number of trimming proportions (***trim***).

Table 8: Model Comparison: Variants of Hansen Panel Dynamic Threshold Model

	Model 1 **b/se**	**Model 2** **b/se**	**Model 3** **b/se**	**Model 4** **b/se**
Laggovt. expenditure	-82.547** (31.10)	-82.547** (31.10)	-82.547** (31.10)	-94.576** (31.03)
lagexr	1.207** (0.40)	1.207** (0.40)	1.207** (0.40)	1.186** (0.40)
Inflation	0.214 (0.45)	0.214 (0.45)	0.214 (0.45)	0.330 (0.47)
_cat=0 # govt. expenditure	156.939*** (33.04)	156.939*** (33.04)	156.939*** (33.04)	108.011** (33.03)
_cat=1 # govt. expenditure	177.346*** (31.23)	177.346*** (31.23)	177.346*** (31.23)	145.215*** (31.59)
_cat=0 # Exchange rates volatility	-0.572*** (0.04)	-0.572*** (0.04)	-0.572*** (0.04)	0.585*** (0.04)
_cat=1 # Exchange rates volatility	-0.044* (0.02)	-0.044* (0.02)	-0.044* (0.02)	-0.040* (0.02)
_cat=2 # govt. expenditure	168.655*** (31.13)			
_cat=2 # Exchange rates volatility	0.094 (0.09)			
constant	15611.905*** (446.90)	15611.905*** (446.90)	15611.905*** (446.90)	17049.667*** (514.71)
R-sqr	0.289	0.289	0.289	0.297
dfres	2897	2897	2897	2895
BIC	56392.8	56392.8	56392.8	56374.9

* p<0.05, ** p<0.01, *** p<0.001. Standard errors are in parenthesis

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There are four different model version of Hansen specification, which are differed by grid search points, number of bootstrap replication as well as the trimming proportion. This will help in assessing the performance of the model under different statistical setting. ***Model 1, Model 2 and Model 3*** are all estimated with single-threshold while ***Model 4*** is estimated with double-threshold. Quantitatively, the single-threshold models (*Model 1, Model 2 and Model 3*) are similar (although number of grid search point, number of bootstrap replication and trimming proportion are all different) and the statistical significance of the coefficients are qualitatively similar. Interestingly, comparing single-threshold with the double-threshold (*Model 1, Model 2 and Model 3 vs Model 4)*, we can readily infer that model 4 is not so different from the rest of the model in terms of sign as well as statistical significance of the estimated coefficients. In addition, in the case of the double-threshold model (*Model 4*), although the threshold-effect test for the double-threshold model is rejected, however, the government expenditure as one of the regime-dependent variables, is highly statistically significant.

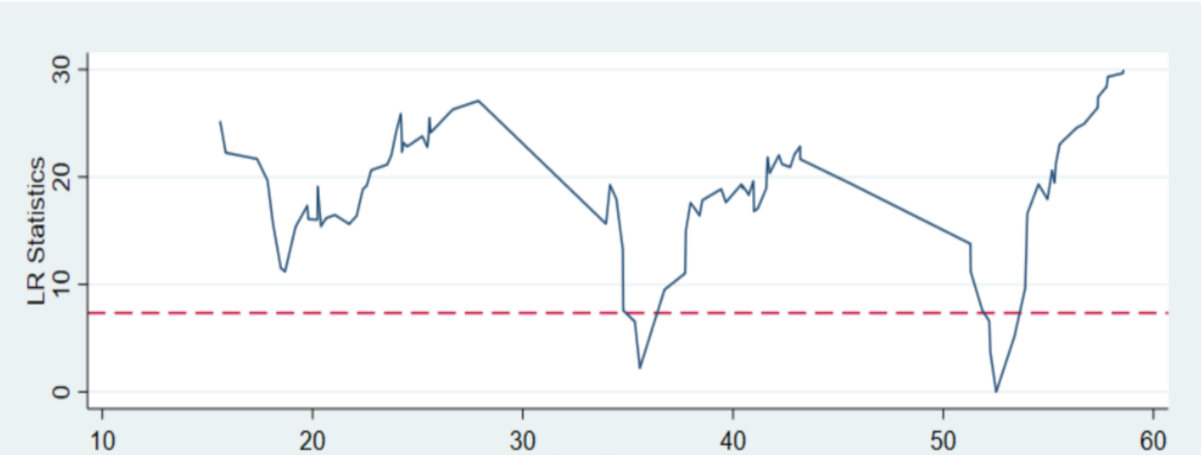

Fig. 4: LR Statistics of the First Threshold

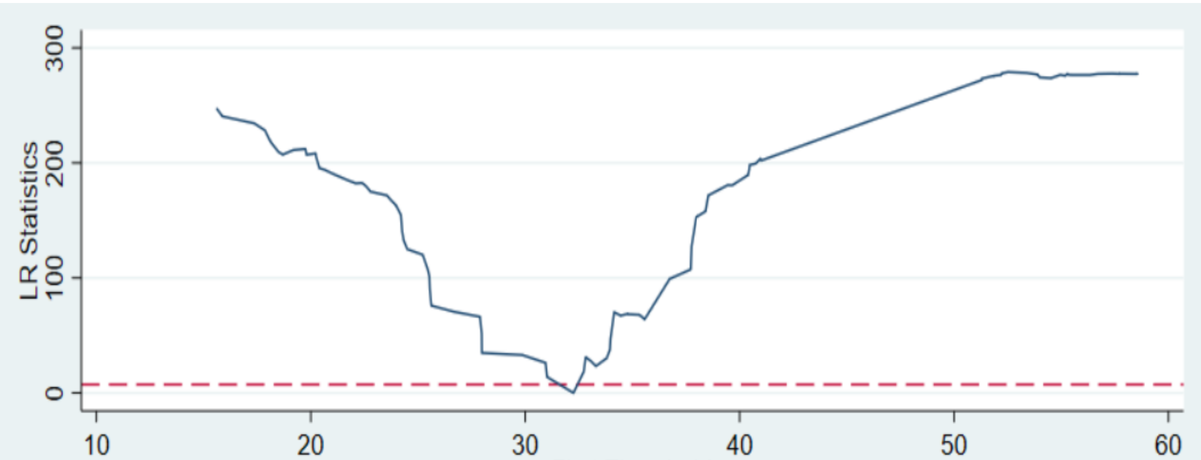

Fig. 5: LR Statistics of the Second Threshold

Based on the likelihood ratio statistics, we plot the confidence interval for the LR statistics in figure 4 and 5 in which the dynamic of the threshold variable is depicted. Clearly, from figure 4, the critical values fixed at 7.35 generated from the model, is found to be statistically significant at 95% confidence interval. In figure 5, we can see that there is hardly evidence of significant threshold parameter. This, however, has buttressed that the best model for this empirical exercise is the single-threshold model.

C. Diagnostics Tests

It is natural to check the robustness of the proposed models and evaluate how good our estimates are in relations to various forms of diagnostics available for testing the goodness of fit of the models. Therefore, we propose to test for the equality of slope coefficients among the regressors. This test is in line with panel threshold model(s) as the rejection of the hypothesis of slope homogeneity provides evidence of nonlinearities (and possible threshold) in the information sets used in the model's estimation.

Table 9: Slope Homogeneity Test of Pesaran and Yagamata (2008)

Statistics	P-Value
7.738	0.000
Adj. 7.974	0.000

From the estimates presented in Table 12, we can strongly reject the null of slope homogeneity and assume that we have strong statistical evidence that the coefficients of the variables used in the model's estimation are characterized with varying degrees of influence on the dependent variable. Based on the results in table 12, it must be emphasized that at least one of the variables in the model is highly nonlinear and, therefore, justify our modelling approach which panel threshold model.

Equally, to buttress the nonlinearities and structural break in our dataset, and for the empirical support of panel nonlinear model, we report, as one of the diagnostics, the non-parametric estimator to simulate time varying coefficients. This test helps to display the time varying coefficients as they evolve smoothly overtime. The estimator is non-parametric and therefore there is no assumption on the functional form of the model. However, if there is nonlinearities in the amount of time variation on the coefficients of the regressors, we can say that there are sufficient nonlinearities in the behaviour of the series being modelled. Thus, establishing nonlinearities justify the use of panel threshold model.

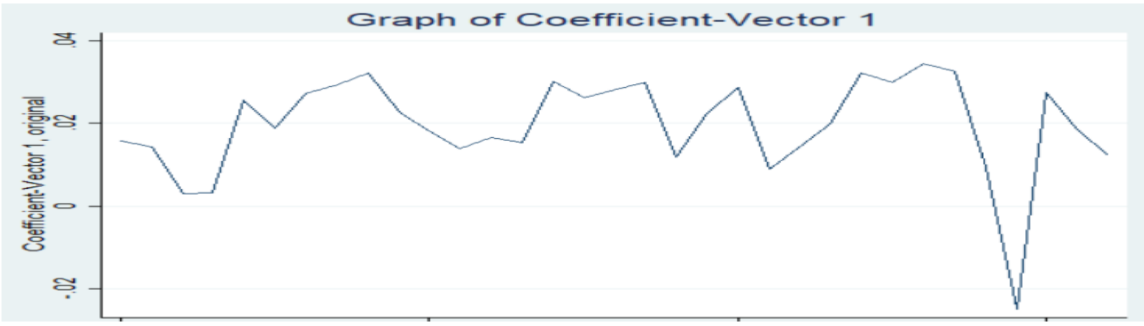

Fig. 6: Structural Coefficient of Caseee

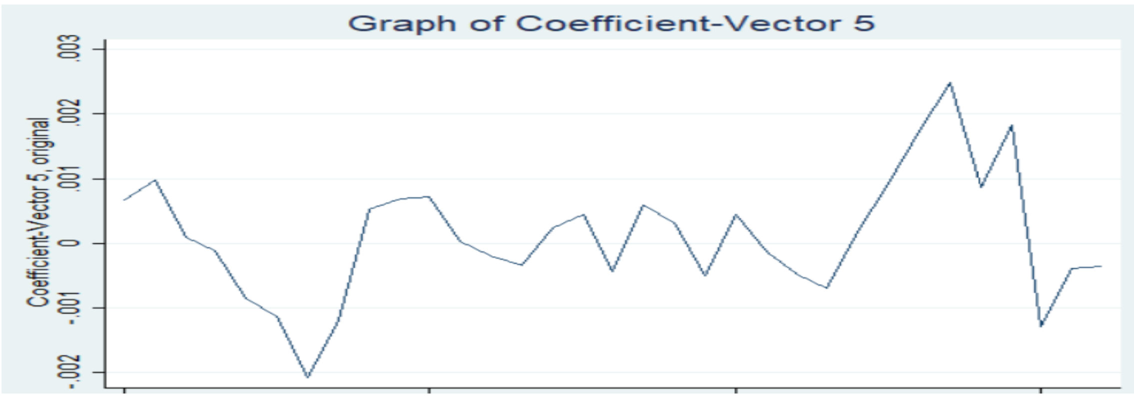

Fig. 7: Structural Coefficient of Govt. expenditure Prices

Evidently, from figures (6 and 7), we follow Degui et al. (2011) and fit our data with non-parametric estimator for time-varying coefficients panel data with fixed-effects. We estimate and display the coefficients as they vary overtime so that evidence of parameter change can further be assessed. The figures (6 and 7) are evidence that there are parameter changes in government expenditure and the number of reported exchange rates volatility of the pandemic. The evolution of the parameter instability provides empirical support for all the variants of threshold models fitted in our research.

In the last empirical exercise of model and data diagnostic, we run Breusch-Pagan LM test of independence and Modified Wald test for groupwise heteroskedasticity in fixed effect regression model. We are able to strongly reject the null serially independent errors for Breusch-Pagan LM test. This implies that the data indicates cross sectional dependence in terms of shocks among the sampled countries used in the study. In the groupwise heteroskedasticity test in fixed effect, the null of equal variance among block of countries is strongly rejected by the data. This suggests that heteroskedasticity in the panel data cannot be grouped into blocks. This finding confirms the earlier assumption that the dataset is characterized with structural breaks, extreme values, jumps up and down sudden spikes.

VI. SUMMARY, CONCLUSION AND RECOMMENDATIONS

A. Summary

The study examined the impact of exchange rate volatility on economic growth in WAMZ countries, Nigeria, Ghana and The Gambia, from 1989 to 2019. Exchange rate volatility was generated using the GARCH approach. This study aims at contributing to the current and intense debate among economists the effects of exchange rate volatility on economic growth, to establish the nature and extent of the relationship between exchange rate volatility and economic growth, within the WAMZ in both the short and long runs within the period of this study.

The paper chose economic growth as the dependent variable, the first lag of Rgdp, has a significant and positive relationship with the dependent variable, Rgdp within the countries. (see table 4.3), while exchange rate volatility has a negative but insignificant relationship with economic growth. The study also indicate that inflation is negatively and significantly related to economic growth within the countries whereas interest rate is positively and insignificantly related to economic growth.

Given the importance of exchange rate on economic growth through facilitating international trade and investment in the WAMZ region, these countries' monetary authorities, government and other relevant agencies should adopt measures that will discourage imports and encourage exports and adapt an exchange rate policy that principally seeks to stabilize exchange rates with the zone. A predictable and relatively stable exchange rate seems to be essential in enhancing economic growth.

B. Policy Recommendations

- This study indicates the importance of exchange rate stability and harmonization, to promote economic growth within the WAMZ.
- Therefore, the countries in the WAMZ must prioritize the enhancement and promotion of a stable exchange rate and interest rate policy that will encourage investors in the zone if steady economic growth is to be attained in the WAMZ.
- Adequate steps including low inflation rate, interest rate harmonization must be put in place for the fine tuning of exchange rate dynamics which otherwise can frustrate the impending monetary integration by the WAMZ member states.
- To maximize the benefits inherent in economic integration in the WAMZ region, individual economies within the WAMZ, should eradicate all forms of trade barriers that hinders economic integration deepening.
- WAMZ member countries, should promote investments in the critical sectors of the individual member countries, including agriculture, manufacturing, infrastructural development, education, to promote economic growth, reduce exchange rate volatility, as well as hasten the integration drive in the region.

REFERENCES

[1.] Alagidede, P. & Ibrahim, M. (2016). On the causes and effects of exchange rate volatility on economic growth: Evidence from Ghana. *International Growth Centre*.

[2.] Arneric, J. and Peric, B. S. (2018). Panel GARCH model with cross-sectional Dependence between CEE Emerging Markets in Trading Day Effects Analysis, *Romanian Journal of Economic Forecasting* XXI(4), 71-84.

[3.] BarquellilA; Ben-Salha O &Zmami M (2018). Exchange rate volatility and economic growth. *Journal of Economic Integration*, 33(2), 1302-1336.

[4.] Belke A & Setzer R (2003). Exchange rate volatility and employment growth: empirical evidence from the CEE economies (no. 1056) Munich.

[5.] Danladi J & Uba U (2015). Does volatility of exchange rate affect economic performance in the West African Monetary Zone? a case of Ghana and Nigeria. BJEMT 11(3).

[6.] Dixit, A. K., Dixit, R. K., Pindyck, R. S., &Pindyck, R. (1994). Investment under uncertainty. New Jersey, USA: *Princeton university Press*.

[7.] Edwards S & Levy-Yeyati E (2005): Flexible exchange rates as shock absorbers. *European Economic Review*, 49(8), 2079-2105.

[8.] Fofanah, P. (2020) Effects of exchange rate volatility on trade: Evidence from West Africa. *Journal of Economics and Behavioral Studies*.

[9.] John, B. E. &Tawaih, V. K. (2015). Seasonality of exchange rates in Ghana, *Journal of Research in Economics and Social Sciences*, 5, 3

[10.] Lee, J. (2010). The link between output growth and volatility: Evidence from a GARCH model with panel data. *Economics Letters*, 106 (2):143-145.

[11.] Levy-Yeyati, E. &Sturzenegger, F. (2003b). To float or to fix: evidence on the impact of exchange rate regimes on growth. *American Economic Review* 93(4), 1173-1193.

[12.] Meniago& Eita (2017). The effects of exchange rate changes on Sub-Sahara African trade. *International Journal of Sustainable Economy*.

[13.] Obeng (2017). Effects of exchange rate volatility on non-traditional exports in Ghana. *Journal of Business and Enterprise Development*.

[14.] Onanuga, A. T &Onanuga O. T (2015). A comparative analysis of exchange rate volatility in the West African Monetary Zone. *CBN Journal of Applied Statistics* 6 (2)

[15.] Oshinloye, M; Onanuga O &Onanuga A. (2015). Exchange rate behaviour in the West African Monetary Zone: a GARCH Approach. MPRA Paper No. 83324

[16.] Oztruk, Ilhan (2006). Exchange rate volatility and trade: A literature review. *International Journal of Applied Econometrics and Quantitative Studies*, 3 (1)

[17.] Sekkat, K., &Varoudakis, A. (1998). Exchange rate management and manufactured exports in Sub-Sahara Africa, *OECD Development Centre*, Working Paper no. 134.

[18.] Raji, R. O. (2013). Impact of misaligned real exchange rate on economic performance: A case study of West African Monetary Zone. *Journal of Economics and Finance* 1(6)

[19.] Sambujang, M; Olusanya, E. O. & John, M. K. (2014). Modeling volatility in the Gambia exchange rates: An ARMA-GARCH approach, International Journal of Economics and Finance 6, 10

[20.] Serven, L. (1997). Irreversibility, uncertainty and private investment: Analytical issues and some lessons for Africa. *Journal of African Economies*, 6(3), 229–268

[21.] Stockman, A.C. (1978). A theory of exchange rate determination. University of California, discussion Paper no. 122.

[22.] Tarawalie, A. B.; Sissoho, M; Conte, M; &Ahortor, C. R. (2013). Export performance and exchange rate volatility: Evidence from the WAMZ. *ResearchGate*.

[23.] Uba, U. P. (2015). Exchange rate volatility and economic growth in Nigeria. Researchjournal's *Journal of Economics*.

[24.] Umaru H; Niyi, A. & Davies, N. (2018). The effects of exchange rate volatility on economic growth of West African English-Speaking countries. *International Journal of Academic Research in Accounting, Finance and Management Sciences* 8(4), 131-143.

[25.] Vieira, F.V., Holland, M., Gomes da Silva &Bottecchia, L. C. (2012). Growth and Exchange Rate Volatility: A Panel Data Analysis, Applied Economics, vol.45, Issue 26.