Exchange rates and asymmetric shocks in West African Monetary Zone Countries

Mustapha, Saidi Atanda and Isiaka, Muideen Adejare
Department of Economics, Accounting and Finance, Bells University of Technology,
Ota, Nigeria;

IJMSSSR 2019
VOLUME 1
ISSUE 1 JANUARY - FEBRUARY

Abstract – The paper examines the asymmetric effects of exchange rate and inflation on output growth in WAMZ countries. Most of the countries in WAMZ are import dependent, and it is obvious that any shock in exchange rate will affect domestic inflation and by implication influence the pattern of output growth. Therefore, forming a monetary union necessitates understanding of exchange and inflation rates asymmetric effects on output growth in these countries. Quarterly data on real exchange rate, inflation and output growth were garnered for twenty-four (24) years. Findings from both the linear Autoregressive Distributed Lag (ARDL) and Non-Linear ARDL models show that the positive asymmetric shock of inflation increases output growth; while the negative asymmetric shock of inflation reduces WAMZ growth rate of output. More so, positive real exchange rate has negative asymmetric shock on WAMZ output growth. This indicates that the aftermath of currency appreciation in West Africa Monetary Zone (WAMZ) has negative impact on output growth of member countries. Howbeit, the size of the effect is considerably large, however, the period in which the complete effect is pass-through to output growth is four quartiles, which is approximately a year. The paper recommends that effective policy on inflation specifically, policy to increase positive asymmetric shocks in inflation before the complete pass-through of real exchange rate effects will either reverse or reduce the effects of exchange rate asymmetric shocks on output growth in these countries.

Keywords: Exchange rate, Asymmetric shocks, Inflation rate, Output growth.

JEL Classification: E32, F31 and F41

Introduction

Exchange rate is the price of one currency in terms of another. The price of the currency is the appropriate macroeconomic instrument of a country to relate with the outside world. This oftentimes, makes exchange rate debate essential, as its effects on national priorities are multi-dimensional. Similarly, the risk associated to the movement of exchange rate provides important basis for the curiosity about the effect of asymmetric shocks of exchange rates on national output and its attendance indirect effects on output growth through general price dynamics.

A movement of exchange rate in a stabilizing way will generate no significant shocks on macroeconomic variables such as outputs. Meanwhile, empirical evidences have shown that exchange rates are susceptible to non-fundamental shocks and therefore generate unnecessary volatility (Buiter, 2000). Hence, policy makers should be less disturb about the effect of fundamental shocks on exchange rate. A pertinent question to raise is that: can exchange rate shocks be characterized as separated from other macroeconomic variables such as output and price?

There are several approaches that have been adopted by empirical studies to examine whether the shocks from exchange rates stabilizes or destabilizes the rest of the macro-economy. Most of these researches take their basis from the work of Meese and Rogoff (1993 a & b). In this study, Meese and Rogoff examined the relationship between exchange rates and fundamental variables as indirect evidence that exchange rates do not stabilize the economy. Emerging studies have used the Vector Autoregressive models (VAR), specifically the structural VAR (SVAR) to address the stabilizing or destabilizing attributes of exchange rate shocks (see Thomas, 1997; Funke, 2000; Bjorneland, 2004; and Mustapha and Ogbeide, 2012). These studies built their respective models with different variables; many of them focused on the monetary and nominal shocks and concerned less about demand and supply shocks. This remains one of the areas the study intends to exploit.

The argument raised recently on forming a monetary union in the West African Monetary Zone (WAMZ) has paved way for discussions on whether entering into a monetary union allows the WAMZ countries to lose their respective stabilizing instrument. Most of the countries in WAMZ are import dependent, and it is obvious that

any shock in exchange rate will affect domestic inflation and by implication influence the pattern of output growth. At the country specific level, the intermediate exchange rate is positively linked with growth, but severely influenced by dynamics of exchange rate and its regimes (Ma and McCauley, 2011). However, comparatively, flexible exchange rate regime does not have significant impact on the developed economies (Ma and McCauley, 2011). Meanwhile, the real exchange rate dynamics has considerable effect on less developed and emerging countries; specifically, African countries (Mustapha and Ogbeide, 2012). For instance, exchange rate undervaluation shows that the currency is seriously depreciated, while exchange rate overvaluation indicates that the exchange rate is higher than it ought to be (Mustapha and Ogbeide, 2012; and Tang, 2015). This implies that, at the regional levels (i.e. WAMZ), the issue of exchange rate shocks (symmetry and asymmetry shocks) remains crucial to facilitates regional trade, moderates the changes in general price levels and stimulates output growth across the WAMZ countries.

More so, there are ongoing evidences on the relevance of exchange rate asymmetry shocks on output in developed countries (Alexius and Post, 2005;Audzei and Brazdik, 2015; Shingil and Panshak, 2017), however, little attention has been devoted to developing and emerging regions. The paper therefore, intends to contribute to existing studies in three folds: First, it offers to contribute to the raging evidences with special focus on the West African Monetary Zone countries. This will provide basis for the presence of either symmetry or asymmetry in exchange rate of these countries, a decision that has had less attention over the years. Second, the paper estimates the magnitude of the effect of asymmetries of exchange rate on output in these countries. This shall further provide sustainable policy dimensions on exchange rate and also serves as a reference point on the pooling of countries in this region for the proposition of a common currency in the monetary zone. Third, existing studies have concentrated on the Vector Autoregressive (VAR) model and Structural VAR model as the methodology for estimating the impact of exchange rate shocks. However, this method has failed to separate the exchange rate shocks into symmetric and asymmetric shocks. This is dealt with in the paper through the linear Autoregressive Distributed Lag (ARDL) model and the non-linear ARDL model, respectively.

The paper is structured as follows. In the next section the stylized facts is presented. Then the paper introduces the data and methods of analysis. This is followed by the empirical results, presentation and discussions and lastly, the paper concludes on the research with conclusion that is based on findings and operational policy recommendations.

Stylized Facts

Insights from the theoretical literature indicate that the choice of exchange rate regime depends on various characteristics of the economy, in terms of its stage of development, structure and its institutional features. Historical factors also play a role. Table 1 shows the factors listed in the IMF'S World Economic Outlook, 1997, as important considerations in the choice of exchange rate regime. The factors range from size and openness of the economy to type of shocks, capital mobility and credibility of policy makers.

- A few of the factors are elaborated upon as follows:

  Openness
- It has been argued that the more open an economy, the stronger the case is for fixing the exchange rate, since the potential costs to an economy increase where frequent changes to the exchange rate are required.
- In the context of the theory of optimum currency areas, fixed exchange rates have been recommended for small open economies wide open to international trade.The country can peg to the exchange rate of a much larger trading partner.If it does so, its economic structures would need to be aligned with those of the anchor area and its labour market should be flexible.
- However, the more open an economy is, the more vulnerable it is to external shocks. In this case, frequent adjustments to the exchange rate are necessary to mitigate foreign shocks.
- Thus, the degree of openness does not provide unambiguous answers for the choice of exchange rate regime.

Table 2 shows the evolution of exchange rate arrangements for selected West African countries. This classification system is based on members' actual, de facto, arrangements as identified by IMF staff. In 2000, out of the thirteen (13)countries in the sample, eight (8) of them adopt currency board; while four countries adopted independent floating exchange rate. In fact Nigeria was the only country that adopted managed floating exchange rate during this period. However, by 2010 eleven (11) of these countries have moved to conventional pegging (i.e. a situation where the country formally or de facto pegs its currency at a fixed rate to another currency or a basket of currencies where the exchange rate fluctuates within a narrow margin); meanwhile, Nigeria and Liberia remain as the two countries operating managed floating exchange rate regime. Since the exchange rate regime has been identified to drive the existence of asymmetry shocks in the exchange rate (see Shingil and Panshak, 2017).

Consequently, the factors that drive the exchange rate regime could also influence the presence of asymmetric shocks in exchange rates in these countries.

Table 1: Consideration in the Choice of Exchange Rate Regime

Characteristics of Economy	Implication for the Desired Degree of Exchange Rate Flexibility
Size of economy	The larger the economy, the stronger is the case for a flexible rate
Openness	The more open the economy, the less attractive is a flexible exchange rate
Diversified production structure	The more diversified the economy, the more feasible is a flexible exchange rate.
Geographical concentration of trade	The larger the proportion of an economy's trade with one larger country, the greater is the incentive to peg the currency of that country
Divergence of domestic inflation from World inflation	The more divergence a country's inflation rate from that of its main trade partner, the greater is the need for frequent exchange rate adjustment (But for a country with extremely high inflation, a fixed exchange rate may provide greater policy discipline and credibility to stabilization.
Degree of economy/financial development	High degree of economic and financial developmentmeans feasible flexible regime.
Labour mobility	The greater the degree of labour mobility, when wages and prices are downwardly sticky, the less difficult (and costly) is adjustment to external shocks with a fixed exchange rate.
Capital mobility	The higher the degree of capital mobility, the more difficult it is to sustain a pegged-but adjustable exchange rate.
Foreign nominal shocks	The more prevalent are foreign nominal shocks, the more desirable is a flexible exchange rate
Domestic nominal shocks	The more prevalent are domestic nominal shocks, the more attractive is a fixed exchange rate.
Real shocks	The greater an economy's susceptibility to real shocks, whether foreign or domestic, the more advantageous is a flexible exchange rate.
Credibility of policy makers	The lower the anti-inflation credibility of policy makers, the greater is the attractiveness of a fixed exchange rate as a nominal anchor.

Source: IMF. 1997 Exchange Rate Arrangements and Economic Performance in Developing Countries." *World Economic Outlook*

Table 2: Evolution of Exchange Rate Regimes for Selected African Countries

	1975	1980	1985	1990	1995	2000	2005	2010	2015
Nigeria	Intern	Float	Float	Fix		Managed Float	Managed Float	Managed Float	Managed Float
Ghana	Fix	Fix	Fix	Interim*	Float	Independent Float**	Managed Float	Conventional peg**	Conventional peg
Senegal	Fix	Fix	Fix	Fix	Fix	Currency Board****	Currency Board	Conventional peg	Conventional peg
Togo	Fix	Fix	Fix	Fix	Fix	Currency Board	Currency Board	Conventional peg	Conventional peg
Benin	Fix	Fix	Fix	Fix	Fix	Currency Board	Currency Board	Conventional peg	Conventional peg
Burkina Faso	Fix	Fix	Fix	Fix	Fix	Currency Board	Conventional peg	Conventional peg	Conventional peg

Cote d'Ivoire	Fix	Fix	Fix	Fix	Fix	Currency Board	Currency Board	Conventional peg	Conventional peg
Mali	Fix	Fix	Fix	Fix	Fix	Currency Board	Conventional peg	Conventional peg	Conventional peg
Sierra Leone	Fix	Fix	Interim	Interim	Interim	Independent Float	Independent Float	Conventional peg	Conventional peg
Niger	Fix	Fix	Fix	Fix	Fix	Currency Board	Currency Board	Conventional peg	Conventional peg
Guinea Bissau	N/A	N/A	N/A	Fix	Fix	Currency Board	Currency Board	Conventional peg	Conventional peg
Guinea	Fix	Fix	Fix	Fix	Float	Independent Float	Conventional peg	Conventional peg	Conventional peg
Liberia	Fix	Fix	Fix	Fix	Fix	Independent Float	Independent Float	Managed Float	Managed Float

*This stands for intermediate regime between fixed and flexible exchange rate, **the value of the currency is determined purely by demand and supply of the currency,

***the country (formally or de facto) pegs its currency at a fixed rate to another currency or a basket of currencies where the exchange rate fluctuates within a narrow margin.

****A monetary regime based on explicit legislative commitment to exchange domestic currency for a specified foreign currency at a fixed exchange rate, combined with restrictions on the issuing authority to ensure the fulfilment of its obligations.

Source, IMF staff reports (various); C. African rep (Central African Republic); DRC (Democratic Republic of Congo), Rep of Congo (Republic of Congo), Equator. Guinea (Equatorial Guinea).

1. Data and Methodology

Data:

The data used for the analysis of the study are thereby presented in Table 3.

Table 3: Data used for the Analyses

S/N	Definition of Variables	Acronyms	Source
1.	Growth of Gross Domestic Product	GDPGR	Central Bank Websites of each of the WAMZ countries
2.	Real Exchange Rate	RER	Central Bank Websites of each of the WAMZ countries
3.	Inflation Rate	INF	Central Bank Websites of each of the WAMZ countries

List of WAMZ countries:

i. Gambia;
ii. Ghana;
iii. Guinea;
iv. Liberia;
v. Nigeria; and
vi. Sierra Leone.

Data collected on each of the countries commenced from 1994 to 2017. The original form of the data is an annual frequency. However, this was later converted to quarterly observation without loss of pattern recognized and context.

Source: Author's Compilation

Methods

In order to examine the extent of exchange rate shock on WAMZ, the paper constructed both symmetric and Asymmetric model which represent the standard Autoregressive Distributed Lag Model and Non-Linear Autoregressive Distributed Lag Model. The very construction of NARDL permits to incorporate the possibility of asymmetric effects of *positive* and *negative* changes in explanatory variables on the dependent variable, unlike the case of ARDL, wherein the possible impact of explanatory variables remains the same.

However, in case the impact of segregated components of an explanatory variable is found to be same, then NARDL model boils down to the standard symmetric ARDL model. In addition, NARDL method provides graphs of cumulative dynamic multipliers used to trace out the adjustment patterns following the positive and negative shocks to explanatory variables. More importantly and interestingly the model is simple and comprehensive enough to permit any asymmetry switching from short-run to long-run or vice versa.

Standard ARDL assumes Linearity whereas NARDL assumes non-linearity so the former permits the effects of the variables to be same. For instance, a 1% increase in X has the same 1% decrease in X. The latter is asymmetric in the sense that the partial sums of positive and negatives changes that introduced asymmetry in the specification are unbalanced. Positive can have a different effect on the dependent variable from that of the negative.

In addition, the technique holds on the asymmetric assumption for the impact in NARDL while the conventional ARDL assumes that the impact of regressor(s) on the dependent variable is uniform. Therefore, for NARDL, it has two (2) possible coefficients for one regressor. For clearer evaluation, the model specification for this study will be in two categories, the first one focuses on Non-Asymmetric ARDL, while the second essences on Asymmetric ARDL.

Asymmetric ARDL Model

$$\overline{g_{it}} = \alpha + \varphi \overline{g}_{it-1} + \lambda \pi_{it} + \gamma RER_{it} + \varepsilon_{it} \quad (1)$$

Where

$\overline{g_{it}}$ = Real GDP growth rate of member countries

π_{it} = Inflation rate computed as log (cpi_t / cpi_{i-1})

RER_t= Real Exchange rate of WAMZ member countries

At this stage, thereal exchange rate variable is decomposed into positive and negative changes such that in the analysis, the paper is able to capture probable asymmetric behaviour of exchange rate on output. The consideration of exchange asymmetry is premised on the fact that economic agents such as households, business entities and government, may respond differently to positive and negative changes in exchange rate.

$$\overline{g_{it}} = \alpha + \varphi \overline{g}_{it-1} + \lambda^{+} \pi_{it}^{+} + \lambda^{-} \pi_{it}^{-} + \gamma^{+} RER_{it}^{+} + \gamma^{-} RER_{it}^{-} + \varepsilon_{it} \quad (2)$$

The decomposition of inflation and real exchange rate into positive and negative variable follows the approach proposed by Shin et al.(2014) which is considered to have computational advantages over the dummy variable approach (Van Hoang et al., 2016).

π_t^+ and π_t^- are defined theoretically as:

$$\pi_t^+ = \sum_{j=1}^{t} \Delta \pi_t^+ = \sum_{j=1}^{t} \max(\Delta \pi_j, 0) \quad (4)$$

$$\pi_t^- = \sum_{j=1}^{t} \Delta \pi_t^- = \sum_{j=1}^{t} \min(\Delta \pi_j, 0) \quad (5)$$

$$RER_t^+ = \sum_{j=1}^{t} \Delta RER_t^+ = \sum_{j=1}^{t} \max(\Delta RER_j, 0) \quad (6)$$

$$RER_t^- = \sum_{j=1}^{t} \Delta RER_t^- = \sum_{j=1}^{t} \min(\Delta RER_j, 0) \quad (7)$$

In order to exploit more useful dynamics in our model, we express equations (1) and (2) in autoregressive distributed lag (ARDL) model. Equation (9) is usually described as a nonlinear (asymmetric) ARDL model due to the disaggregated inflation and exchange rate (Shin et al., 2014). Equation 8 and 9 contains both short and long run parameters.

$$\bar{g}_t = \alpha_0 + \alpha_1 \bar{g}_{t-1} + \alpha_2 \pi_{t-1} + \alpha_3 RER_{t-1} + \sum_{i=1}^{p} \delta_i \pi_{t-i} + \sum_{i=1}^{q} \lambda_j \bar{g}_{t-j} + \sum_{i=1}^{q} \phi_j RER_{t-j} + \varepsilon_t \quad (8)$$

$$\bar{g}_t = \alpha_0 + \alpha_1 \bar{g}_{t-1} + \alpha_2 \pi^{+}_{t-1} + \alpha_3 \pi^{-}_{t-1} + \alpha_4 RER^{+}_{t-1} + \alpha_5 RER^{-}_{t-1} + \sum_{i=1}^{p} \lambda \bar{g}_{t-j}$$

$$+ \sum_{i=1}^{q} (\gamma^{+}_{j} \pi^{+}_{t-j} + \pi^{-}_{t-j}) + \sum_{i=1}^{q} (\phi^{+}_{j} RER^{+}_{t-j} + RER^{-}_{j}) + \varepsilon_t$$

Results and Discussion

This analysis is based on variables that are prone to common shocks among member countries. Majorly, the analysis focuses on how inflation and exchange rate shocks affect GDP growth of member's countries. The study also converted the low frequency yearly data to high frequency quarterly data with a view to measuring the degree of shocks in this economy. Since many countries in WAMZ are import dependent, it is obvious that any shock in exchange rate will affect domestic inflation and by implication influence the pattern of exchange rate. It is evidence from figure 2.1, that inflation in WAMZ exhibits pseudo periodic pattern throughout the entire period. However, the pattern can be linked to the exchange rate regime embark upon by members; during 1994-1999 periods about nine (9) countries moved from fixed exchange rate regime to currency board; and the effect was felt on downward trend in inflation rate, which represent an improvement in the region because inflation rate was very high in prior to 1994. In between year 2000 and 2003, inflation rate was stochastic or unstable because some countries have preferred conventional peg to currency board in stabilizing the fluctuation in exchange rate and by implication inflation. However, inflation was relatively stable within 2004-2010 periods, but hover around 20%. In fact during this period Sierra-Leone experienced deflation and between 2011-2017 periods, it shows the trend of inflation for WAMZ.

Similarly, from figure 2.2, increase in real exchange rate in early years corresponds with high inflation that was experienced in the prior to 1994; and when the real exchange rate is high, the relative price of goods at home is higher than the relative price of goods abroad. In the quest to reduce inflation in the region, the real exchange rate was stable between 2003 and 2012. Meanwhile, real exchange rate of Nigeria and Sierra Leone exhibit similar pattern (i.e. rising), while others maintain a downward trend.

Figure 2.1: General Price Dynamics in Africa's Small Open Economies

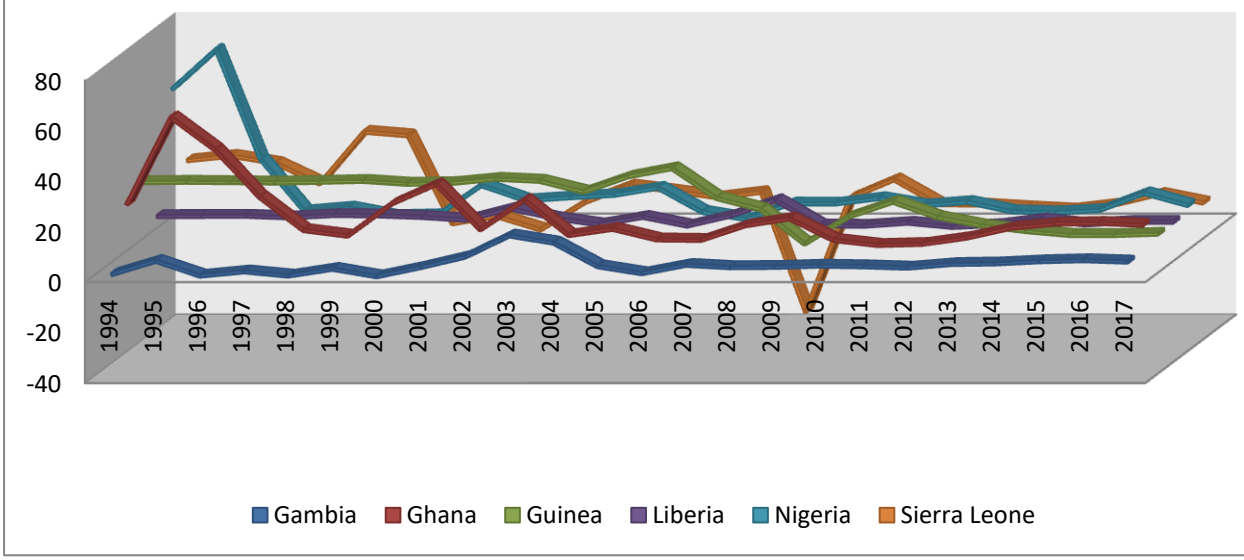
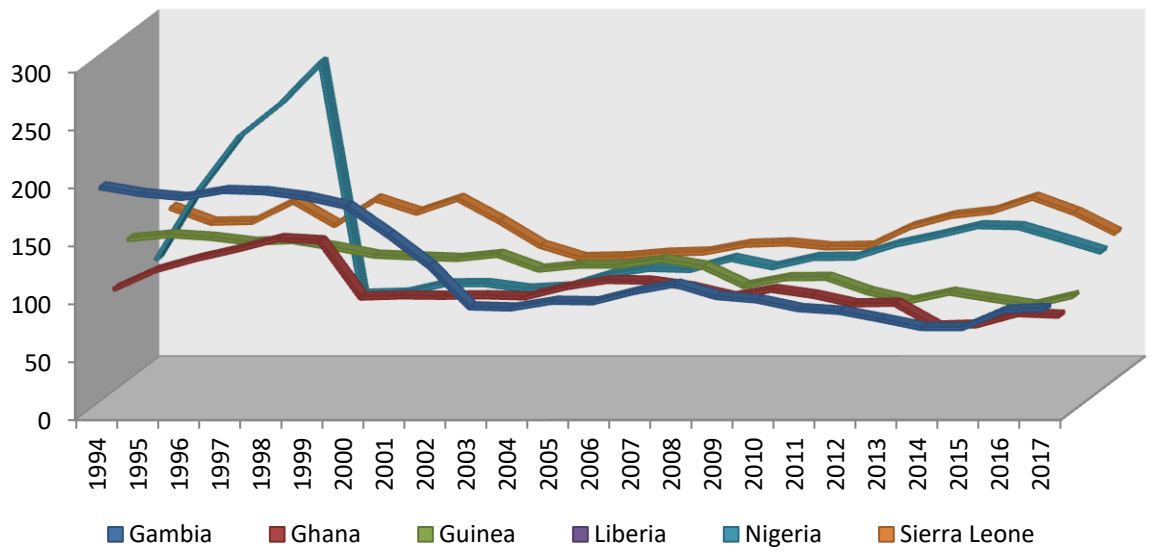


Figure 2.2: Real Exchange Rate in Africa's Small Open Economies



Panel Unit Root Test

Table 5 present the panel unit root test for all the variables used in the model. The null hypothesis establishes existence of unit root; while the alternate indicate non-existence of unit root. Hence, insignificant p-value indicate acceptance of H_o; while significant (i.e. $p<0.05$) indicate rejection of null hypothesis. It is obvious that all variables are non-stationary at level; but stationary at first difference. However, details on unit root test at level and first difference for all the countries are presented in table 4. The non-stationary indicate an instability in the variance of error term for each variable; and it should be noted that Ordinary Least Square method requires an error term that is independently, and identically distributed (i.e. zero mean values and constant variance).

Table 4: Result of Unit Root Test for Individual Country

Country		INF	YGap	RER
Algeria	Level	-1.766535	-2.617035*	-1.707921
	1st Difference	-5.376412***	-4.946932***	-3.478048***
Congo Democratic Republic	Level	-5.246930***	-3.857990***	-4.970814***
	1st Difference	-	-	-
Equatorial Guinea	Level	-4.947152***	-2.183496	-2.128600
	1st Difference	-	-7.613022***	-5.182981***
Gabon	Level	-5.079724***	-3.516801**	-1.336648[a]
	1st Difference	-	-	-2.155230**
Nigeria	Level	-2.740663	-3.105188**	-1.928772
	1st Difference	-5.349658***	-	-3.949136***
Congo Republic	Level	-4.223353***	-4.480803***	-1.734404
	1st Difference		-	-5.069843***

Table 5: Result of Panel Unit Root Test for Group (WAMZ)

Variables		Levin, Lin & Chu t*	ADF - Fisher Chi-square	Order of Stationary
GDPGR	Level	-3.41255***	37.8809***	I(0)
	First Difference	-8.30793***	79.5160 ***	I(1)
INF	Level	-11.8968***	89.2277***	I(0)
	First Difference	-7.34453 ***	83.3973***	I(1)
RER	Level	-0.75769	13.2010	Non-Stationary
	First Difference	-2.58290***	55.8973**	I(1)

*Significance levels: ***@1%, **@5%, *@10%,*
Source: Authors Computation

Panel Bound Co-Integration Test

Table 6 shows the summary of bound co-integration test. Since the calculated F-statistic (63.18, $p<0.05$) is greater than upper bound value (4.85) at 5% level of significant; the model is said to have co-integration or long run relationship between GDP growth and explanatory variables and for all WAMZ countries.

Table 6: Bound Co-integrating test for Each Country

Selected Small Open Economies	Model specification	F-statistics	lower bound	upper bound	Conclusion
Gambia	Linear	104.4946	3.79	4.85	Existence of co-integration
	Nonlinear	81.6253	2.86	4.01	
Ghana	Linear	317.6929	3.79	4.85	Presence of co-integration
	Nonlinear	200.2080	3.23	4.35	
Guinea	Linear	306.4153	3.79	4.85	Existence of co-integration
	Nonlinear	294.4540	3.23	4.35	
Liberia	Linear	264.0057	3.23	4.35	Presence of co-integration
	Nonlinear	296.7997	2.86	4.01	
Nigeria	Linear	189.9021	3.79	4.85	Existence of co-integration
	Nonlinear	136.6463	2.86	4.01	
Sierra-Leone	Linear	160.9971	3.79	4.85	Presence of co-integration
	Nonlinear	100.9615	2.86	4.01	

Source: Authors Computation

Discussion of Symmetric and Asymmetric Shocks Results

Table 7 presents the results of both the linear and non-linear ARDL. The resultsshow that one period lag of GDP growth rate and inflation are significant in explaining the symmetric shock in the long run, while the negative and positive asymmetric shock of inflation has negative impact on growth rate of output in the WAMZ. The positive asymmetric shock of inflation increases output growth by 0.651 percent; while the negative asymmetric shock of inflation reduces WAMZ growth rate of output by 0.693 percent. The implications therefore are: first, in the absent of asymmetric shocks in exchange rate of the WAMZ, immediate interactions between inflation and output growth remain prominent to proffer adequate policy framework to reduce the asymmetric effects of exchange rate on output growth in these countries. Second, net difference between asymmetric shocks of inflation is basically important to sustain the variability of output in WAMZ countries. Lastly, positive asymmetric shocks of inflation induces output growth, and therefore, should be sought after by the WAMZ countries.

Interactions between real exchange rate shocks and output growth show striking and interesting results. The four period lag of positive real exchange rate has negative asymmetric shock on WAMZ output growth rate; in which the economic activities falls by 1.05 percent. This indicates that the aftermath of currency appreciation in West Africa Monetary Zone (WAMZ) has negative impact on output growth of member countries. The results revealed that the size of the effect is considerable large, however, the period in which the complete effect is pass-through to output growth is four quartiles which is approximately a year. More so, effective policy on inflation specifically,

policy to increase positive asymmetric shocks in inflation before the complete pass-through of real exchange rate effects could either reverse or reduce the effects of exchange rate asymmetric shocks on output growth in these countries. Conversely, a four period lag of negative real exchange rate has positive asymmetric shock on WAMZ output growth; the output grows at 11.02%. However, the effect (i.e. positive or negative) of real exchange rate asymmetric shock on current GDP occurs at the far end of fourth quarters.Furthermore, impact of negative real exchange rate asymmetric shocks positively outweighs that of the positive real exchange rate on output growth. In sum, WAMZ countries should initiate policies that promote negative real exchange rate to benefit from exchange rate asymmetric shocks.

In the short run, symmetric shock of inflation and exchange rate reduces and increases output growth of WAMZ on average by 0.667 and 0.036 percent, respectively. However, both positive and negative asymmetric shock of inflation is not significant in influencing GDP growth in the short run; and similar results suffice to positive asymmetric shock of real exchange rate. Including the impact of other explanatory variables, the results show some levels of consistencies, nonetheless, negative asymmetric shock of exchange rate was significant in the short run and reducesoutput (GDP) growth in WAMZ countries by 4.4% on average.

Testing for the reliability of the estimators, results of the coefficient of determination (R^2) imply a good fit. The R^2 value for NARDL is 0.624 which indicates that 62.4% of variation in real GDP growth is jointly explained by independent variables while the remaining percent is caused by unexplained factors captured by the error term. The value of F-statistic is 11.91 ($p<.05$) which indicate that the overall regression result is statistically significant. Evident from post-estimation test, the model is free from serial correlation, but heteroscedasticity exist, and thus confirm the idiosyncratic features of countries in WAMZ. Moreover, in selecting the best model between ARDL and NARDL as techniques of measuring asymmetric shock, Non-linear Autoregressive Distributed lag model is preferred because the AIC and SIC of NARDL is less than that of ARDL.

Table 7: Estimation of Exchange Rate and inflation Shocks on GDP Growth
Dependent Variable: D(GDPGR)

Variable	**Coefficient**	**Prob.***	**Coefficient**	**Prob.***
Long-Run Coefficients				
	ARDL (Symmetric)		**NARDL (Asymmetric)**	
C	-0.575733	0.6451	1.625849	0.3804
GDPGR(-1)	0.820532	0.0000	-0.216706	0.0023
INF(-1)	-0.668280	0.0000	-	-
DINF_N	-	-	-1.335511	0.0000
DRER_P(-4)	-	-	-1.049901	0.0000
DINF_P			-1.323692	0.0002
DINF_N(-4)	-	-	-0.692703	0.0021
DINF_P(-4)	-	-	0.651551	0.0151
DRER_N(-4)			0.110206	0.0919
NARDL Short-Run Coefficients				
	ARDL		**NARDL**	
INF	-0.668280	0.0000	-	-
RER	0.035546	0.0706		-
INF_P(-1)	-	-	-0.062676	0.5491
INF_N(-1)	-	-	-0.176964	0.2201
RER_P(-1)	-	-	-0.056235	0.6075
RER_N(-1)	-	-	0.043931	0.0718
	0.748844			0.623938
R-squared		R-squared		
Adjusted R-squared	0.734573	Adjusted R-squared		0.571575
Akaike info criterion	4.447941	Akaike info criterion		4.163944
Schwarz criterion	4.710279	Schwarz criterion		4.495046
Hannan-Quinn criter.	4.513514	Hannan-Quinn criter.		4.297523
F-statistic	52.47589	F-statistic		11.91564
Prob(F-statistic)	0.000000	Prob(F-statistic)		0.000000

Durbin-Watson stat	2.083245		Durbin-Watson stat		1.870345
Post-Estimation Test					
Breusch-Godfrey Serial Correlation LM Test					
F-statistic	0.416188	Prob. F(2,86)	0.6609	No Serial Correlation	
F-statistic**	0.352889	Prob. F(2,77)	0.7038	No Serial Correlation	
Heteroskedasticity Test: Breusch-Pagan-Godfrey					
F-statistic	1.900399	Prob. F(5,88)	0.1023	No Heteroscedasticity	
F-statistic**	2.198132	Prob. F(11,79)	0.0225	Heteroscedasticity Exist	

Source: Authors Computation ***Output for NARDL*

However, in considering the idiosyncratic behaviour of members in WAMZ countries, table 8 is used to present the response of each country to asymmetric shock that comes from real exchange rate dynamics and inflation. It should be noted that the LR part is used to know the long-run effect; while the SR stands for short run effect. For instance,in Gambian, positive shock of exchange rate has a significant and negative impact on growth rate of output in the short-run; while the negative shock in exchange rate has positive effect on Gambians' output growth rate. The implication is that appreciation (depreciation) of currency in Gambia has negative(positive)effect on output (GDP) growth in the short-run.In the long run, negative exchange rate shock affect the growth rate of output adversely in one period lag; but positive in two period lags. The summary of asymmetric shock is presented in table 8.The cumulative effect of dynamic shocks on output (GDP) growth is presented in figure 3, respectively.

Table 8: Is there Asymmetric Shock?

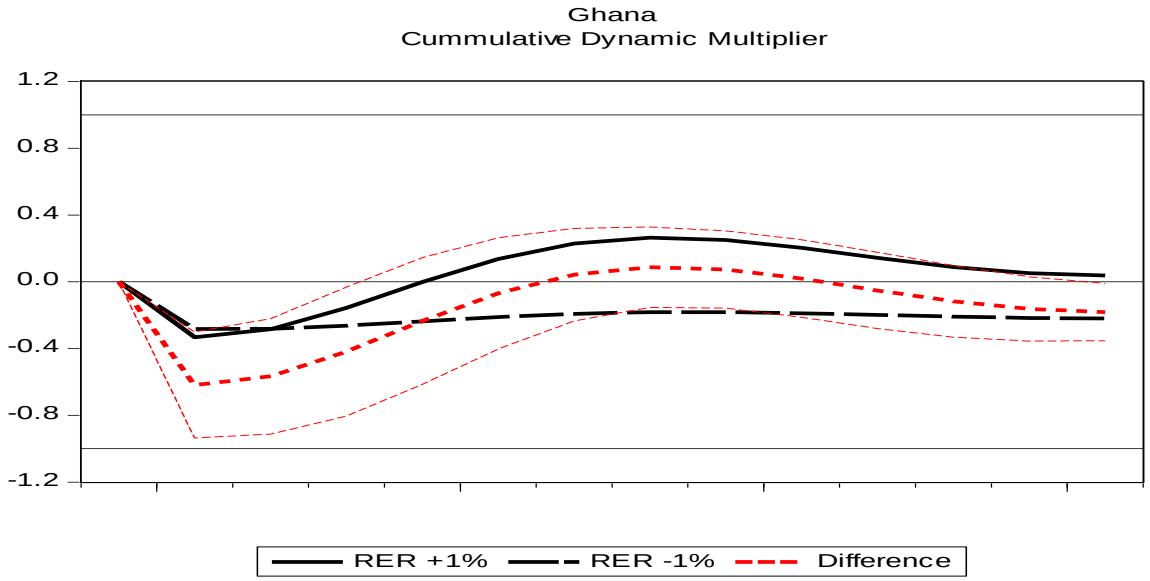
Variable	**Gambia**		**Ghana**		**Guinea**		**Liberia**		**Nigeria**		**Sierra Leone**	
Dynamics	**SR**	**LR**	**SR**	**LR**	**SR**	**LR**	**SR**	**LR**	**SR**	**LR**	**SR**	**LR**
RER_POS	YES	-	YES	-	YES	-	YES	-	YES	-	YES	-
RER_NEG	YES	-	NO	-	NO	-	YES	-	YES	-	YES	-
INF_POS	YES	-	NO	-	YES	-	NO	-	YES	-	YES	-
INF_NEG	YES	-	NO	-	YES	-	NO	-	NO	-	NO	-
ΔRER_POS(-1)	-	YES	-	YES	-	-	-	YES	-	-		YES
ΔRER_POS(-2)	-	NO	-	YES	-	-	-	YES	-	-		YES
ΔRER_POS(-3)	-	NO	-	NO	-	-	-	-	-	-		NO
ΔRER_POS(-4)	-	NO	-	NO	-	-	-	-	-	-		YES
ΔRER_NEG(-1)	-	YES	-	YES	-	-	-	YES	-	-		YES
ΔRER_NEG(-2)	-	YES	-	NO	-	-	-	YES	-	-		-
ΔINF_POS(-1)	-	YES	-	YES	-	YES	-	-	-	YES		YES
ΔINF_POS(-2)	-	YES	-	NO	-	YES	-	-	-	-		NO
ΔINF_NEG(-1)	-	NO	-	NO	-	YES	-	-	-	NO		YES
ΔINF_NEG(-2)	-	NO	-	NO	-	YES	-	-	-	NO		-

Source: Author's computation and Compilation (2018)

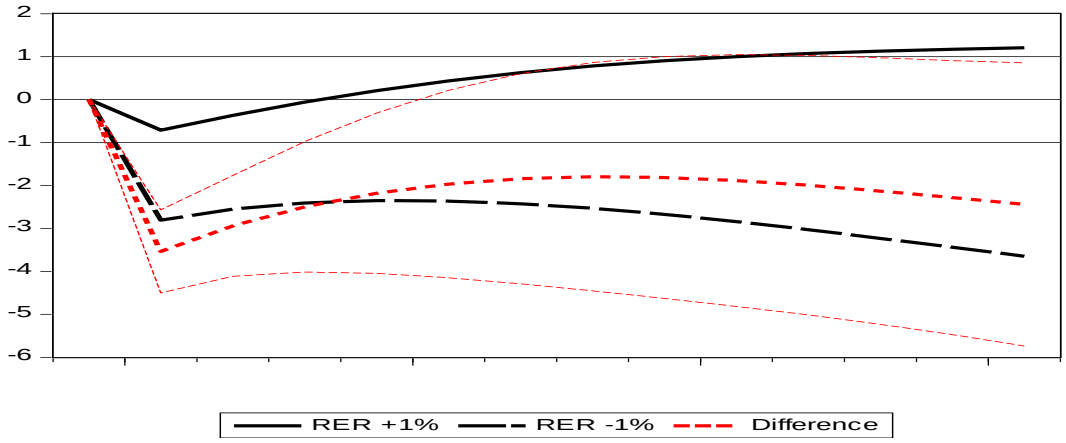
Table 8: Regression Output of Non-Linear ARDL

	Gambia		Ghana		Guinea		Liberia		Nigeria		Sierra Leone	
Variable	**Coef**	**Prob.***	**Coef**	**Prob.***	**Coef**	**Prob.***	**Coef**	**Prob.***	**Coef**	**Prob.***	**Coef**	**Prob.***
ΔGDPGR(-1)	1.498968	0.000	1.622014	0.000	1.724699	0.000	1.657723	0.000	1.523411	0.000	1.477878	0.000
ΔGDPGR(-2)	-0.74113	0.000	-0.72082	0.000	-0.84992	0.000	-0.70483	0.000	-0.68397	0.000	-0.670431	0.000
RER_POS	-0.33094	0.0146	0.027117	0.0606	0.049806	0.067	-0.70916	0.0421	-0.05102	0.0364	-0.626099	0.0041
RER_NEG	0.284317	0.0079	0.048279	0.1025	0.013196	0.1306	2.815529	0.000	-0.00752	0.0654	-0.495762	0.0042
INF_POS	1.728096	0.000	0.049062	0.4641	0.842967	0.000	-0.07742	0.7425	-0.40047	0.0963	-0.51646	0.0018
INF_NEG	0.080767	0.0395	-0.04599	0.4932	-0.27811	0.0136	-0.05551	0.8063	-0.08689	0.6167	0.096371	0.2196
ΔRER_POS(-1)	0.54745	0.0281	0.071349	0.0185	-	-	1.523348	0.0109	-	-	1.185485	0.0035
ΔRER_POS(-2)	-0.19197	0.1653	-0.10605	0.0457	-	-	-0.76513	0.0132	-	-	-0.702296	0.0698
ΔRER_POS(-3)	-	-	-	-	-	-	-	-	-	-	0.436184	0.2237
ΔRER_POS(-4)	-	-	-	-	-	-	-	-	-	-	-0.406929	0.0358
ΔRER_NEG(-1)	-0.42678	0.0312	0.167313	0.0305	-	-	-4.91473	0.000	-	-	0.44309	0.0068
ΔRER_NEG(-2)	0.193477	0.0678	-0.19892	0.1081	-	-	2.253178	0.000	-	-	-	-
ΔINF_POS(-1)	-2.77746	0.0001	-0.12926	0.0625	-1.75767	0.000	-	-	0.440283	0.0766	0.647222	0.0147
ΔINF_POS(-2)	1.356384	0.0006	0.177754	0.1449	0.929227	0.000	-	-	-	-	-0.176965	0.1908

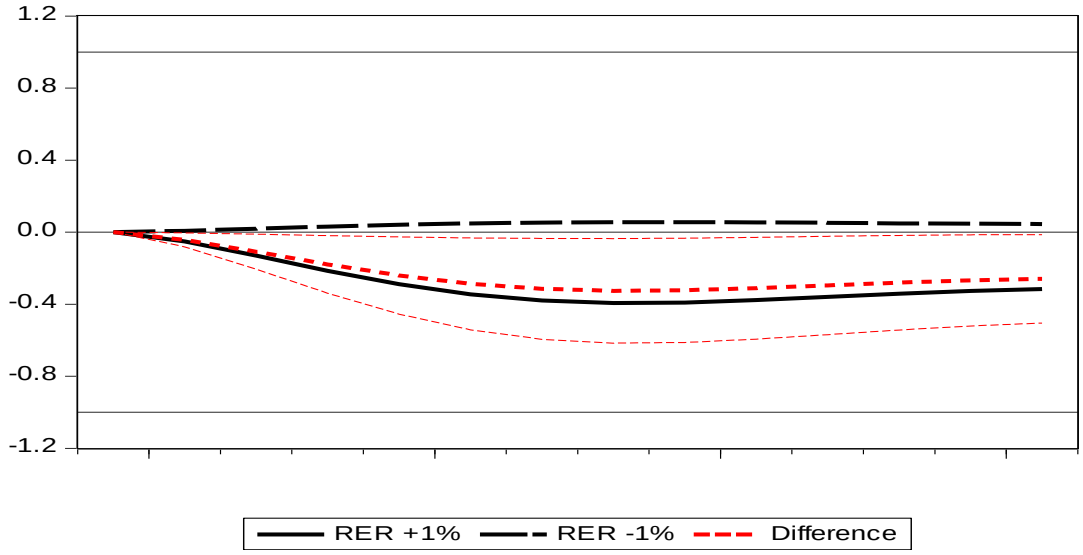
ΔINF_NEG(-1)	-	-	-	-	0.68724	0.0017	-	-	0.226361	0.3832	-0.181391	0.0475
ΔINF_NEG(-2)	-	-	-	-	-0.40263	0.0006	-	-	-0.19263	0.1433	-	-
C	0.200333	0.5635	-0.96477	0.0986	0.415285	0.0263	5.771855	0.0002	4.533363	0.0163	-0.492402	0.583
R-squared	0.927996		0.96721		0.971972		0.974393		0.93964		0.95089	
Adjusted R-squared	0.916628		0.962032		0.968378		0.97111		0.932763		0.941472	
F-statistic	81.62533		186.8137		270.4915		296.7997		136.6453		100.9615	
Prob(F-statistic)	0.000		0.000		0.000		0.000		0.000		0.000	
Durbin-Watson stat	2.248486		1.971161		2.07872		1.887013		2.010811		2.298828	



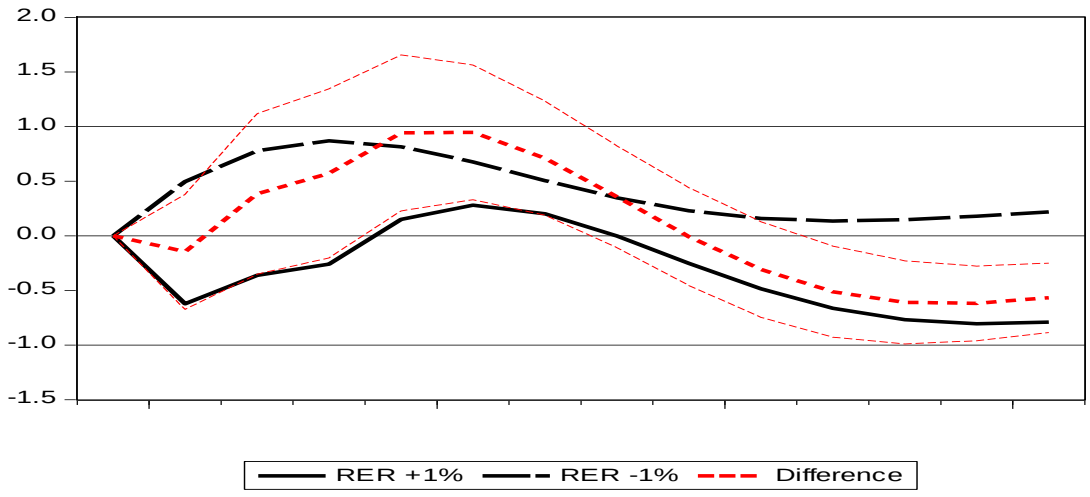
Libberia
Cummulative Dynamic Multiplier



Nigeria
Cummulative Dynamic Multipliers



Sierra Leone
Cummulative Dynamic Multiplier



In the individual country results in Table 8, the results show that Gambia experience asymmetric shock from both inflation and exchange rate in short and long run. For Ghana, asymmetric shock in the short run come from exchange rate, while in the long run the shock is influenced by exchange rate and inflation. More so, the asymmetric shock for Guinea emerged from inflation and exchange rate; but in the long run it is wholly influenced by inflation. In Liberia, it is only positive exchange rate shock that affects the growth rate in both the long and short run; while inflation is not significant at all. The implication is that their currency is overvalued and therefore makes their export to be costly to other countries, especially countries from Africa. This result could be linked to dollarization of the economy. In Nigeria, both positive and negative asymmetric shocks from exchange rate affects output growth rate in the short run; while positive shock from inflation is also evident in the short run. Surprisingly, asymmetric shock from exchange rate does not affect growth in the long run. The only shock experience during this period is attributed to positive shock from inflation. In Sierra Leone, the experience is quite similar to that of Gambia.This is because, asymmetric shock from exchange rate and inflation rate affect the output growth both in short and long run.

5.1 Conclusion and Recommendation

The study has primarily explained the basic concept of exchange rate and its dynamicsover time. However, it goes further to examine the asymmetric shocks of exchange rate and inflation on the output growth of West Africa Monetary Zones (WAMZ) countries. This is conducted by using Non-Linear Autoregressive Distributed Lag (NARDL) model to analyze the data set of members'countries between 1994 and 2017.The findings revealed that inflation rate symmetric shocks is significant in explaining output growth rate in the long run. Whilst, the negative and positive asymmetric shocks of inflation has negative impact on output growth rate in the WAMZ over the period under review. Similarly, four period lag of positive real exchange rate has negative asymmetric shocks on WAMZ output growth rate.This impact resulted in 1.05 percent decline in economic activities.

Conversely, four period lag of negative real exchange rate has positive asymmetric shock on WAMZ output growth. However, the effect (i.e. positive or negative) of real exchange rate asymmetric shock on current GDP occurs at the end of fourth quarters. This implies that depreciation of currency in West Africa Monetary Zone (WAMZ) has positive impact on growth rate of member countries.

In the short run, symmetric shock of inflation and exchange rate reduces and increases output growth of WAMZ on average by 0.667 and 0.036 percent respectively. However, both positive and negative asymmetric shock of inflation is not significant in influencing GDP growth in the short run; and similar thing occurs to positive asymmetric shock of real exchange rate. Meanwhile, negative asymmetric shock of exchange rate was significant in the short run, and reduces GDP growth in WAMZ zone by 4.4% on average.

Operational Policy Recommendations

Based on these findings, the paper makes the following recommendations:

i. Identifying the sources of the positive and negative shocks are much important to balancing the comparative convergence indices that can limit the success of WAMZ. In this light, policy makers in West Africa should consider delaying the introduction of the proposed monetary integration and work further towards stronger integration of the ECOWAS economies in terms of intra-regional trade, factor and labour mobility within the region.
ii. There is need to strengthen the central banks of these countries especially, in terms of price stability and exchange rate management.
iii. The trade war between the USA, China and West should be viewed as opportunity for WAMZ members to look inward and strategize to meet the trade gap. This calls for structural reforms on exchange rate management with special focus on effects of asymmetric shocks.
iv. There is also need to strengthen the supranational institutions such as West Africa Monetary Institution (WAMI) to work with relevant institutions in each country to promote sub optimal fiscal performance and encourage investment that will enhance their productivity and also, provide policy framework that can increase the benefits realized from exchange rate and its asymmetries.

References

1. Afees A. Salisu and Kazeem O. Isah and IdrisAdemuyiwa, (2017) "Testing for asymmetries in the predictive model for oil priceinflationnexus", *Economics Bulletin*, Volume 37, Issue 3, pages 1797-1804

2. Alexius, A. and Post, E. (2005), "Exchange rates and Asymmetric Shocks in Small Open Economies", Working Paper 10, Department of Economics, Uppsala Universitet, Sweden.

3. Audzei, V. and Brazdik, F., (2015), "Monetary Policy and Exchange Rate Dynamics: The Exchange Rate as a Shock Absorber", Czech Journal of Economics and Finance, 65, 2015, No. 5

4. Bjorneland, H., (2004), "The role of the exchange rate as shock absorber in small open economy", Open Economies Review 15, 23-43.

5. Buiter, W. H., (2000), "Optimal currency areas: Why does the exchange rate regime matter? With an application to UK membership in EMU

6. Central Bank of Ghana (2017) Policy Brief Understanding Exchange rate regimes and influence on Macro-economic Stability in Ghana.
7. De Grauwe, P., 2005. Economics of Monetary Union, 6th edition.Oxford University Press.
8. Frankel, J., and Rose, A., (1996). The Endogeneity of the Optimum Currency Area Criteria? NBER Working Paper 5770
9. Funke, M. (2000), Macroeconomic shocks in euroland vs the UK: Supply, demand or nominal?
10. Hamilton (2009). Causes and consequences of the oil shock of 2007-0 *http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1412014*
11. Hooker (2002). Are oil shocks inflationary? Asymmetric and non-linear specifications versus changes in regime.*Journal of money, credit and banking, 34(2): 540-561*
12. Hurst, Pesaran, Hernan, Smith and Akiyama's (1998).Is foreign direct investment beneficial for Mexico? *An empirical analysis, 1960-2001. World Development, 34: 802-817*GujaratiD.N(2007)BasicEconometricsMcGrawHill,NewDelhi4th eds
13. Iyoha, M. A., Oyefusi, S. A., &Oriakhi, D. E. (2003).An introduction to modern macroeconomics.*Benin: Mindex Publishing Co. Ltd.*
14. Karras, G. (2006) Is Africa and Optimum Currency Area? A Comparison of Macroeconomic Costs and Benefits, Journal of African Economies, 16, September 2006,
15. Maiyaki B.T. (2017)**,** The Challenges and Prospects for Regional and Economic Integration in West Africa**,** Asian Social Science 13(5):24
16. Ma, R. N. and McCauley (2011), "The evolving renminbi regime and implications for Asian currency stability", Journal of the Japanese and International Economies, 25 (1), 23-38.
17. Meese, R. A. and Rogoff, K., (1983a), "Empirical exchange rate models of the seventies: Do they fit out of sample?" Journal of International Economics 14, 3-24.
18. Meese, R. A. and Rogoff, K., (1983b), The Out-of-Sample failure of empirical exchange rate models: Sampling error or misspecification, in Frenkel (ed), Exchange Rates and International Macroeconomics, University of Chicago Press, Chicago.
19. McKinnon, R.(1963). Optimum Currency Areas.*American Economic Review*, 53, pp. 717-25 pp. 161-94.
20. Mundell, R.(1961). A Theory of Optimum Currency Areas.*American Economic Review*, 51 September.
21. Mustapha, S. A. and Ogbeide, F. I., (2012), "Estimating the Determinants of the Nigeria's Real Exchange Rate Dynamics", Asian African Journal of Economics and Econometrics (AAJEE), Vol. 12, No 2, Pages 305 – 324.
22. Shingil, M. E. and Panshak, Y., (2017), "Exchange Rate Dynamics, Inflation and Economic Growth: Empirical Evidence from Turkish Economy", IOSR Journal of Humanities and Social Science, Vol. 22 Issue 9 Version 3, Pp 42-49.
23. Tang, B. (2015), "Real exchange rate and economic growth in China: A cointegrated VAR approach", China Economic Review, 34, 293-310.
24. Thomas, A. (1997), "Is the exchange rate a shock absorber? The case of Sweden", Working Paper 97/176, IMF, Washington.

