Exchange Rate Volatility and Domestic Investment: Evidence from Twelve ECOWAS Countries

Anthony E. Akinlo[‡] and Olufemi G. Onatunji[†]

Abstract

This paper examines the dynamic relationship between exchange rate volatility and domestic investment for twelve ECOWAS countries over the period 1986-2017. We employed the ARDL bound testing approach for co-integration and error correction modeling techniques by incorporating real GDP, real interest rate, real exchange rate, and exchange rate volatility as essential drivers of domestic investment. The results of the ARDL Bound test confirm the existence of long-run relationship among the variables in the selected countries. Furthermore, the findings show that exchange rate volatility is negative and statistically significant only in the case of Nigeria, Sierra Leone, Guinea, Gambia, Cote d'lvoire, Togo, and Liberia but insignificant in Cabo Verde, and Senegal. However, contrary to many theoretical predictions and hypotheses, exchange rate volatility is found to be positive but insignificant in Ghana, Benin, and Burkina Faso.

Keywords: Exchange rate volatility, Domestic investment, ARDL, ECOWAS Countries

JEL Classification: F31, F37

[‡] Corresponding Author, Department of Economics. Obafemi Awolowo University, Ile-Ife, Nigeria. He is currently on leave at Redeemer's University, Ede; Nigeria. E-mail: aakinlo@oauife.edu.ng, Tel. No: +234 803 370 0756.
[†] Redeemer's University, Ede, Nigeria. E-mail:gphhemax12@gmail.com; Tel. no.: +234 706 227 8452

1. Introduction

Since the collapse of the Bretton Woods system in the1970s, many developing countries have become susceptible to different macroeconomic shocks, notably exchange rate volatility. The transition from the fixed exchange rate to floating exchange rate systems have resulted in significant fluctuations of many currencies (Ojede and Lam, 2016). Given this development, many researchers have attempted to examine the effect of exchange rate volatility on different macroeconomic variables including economic growth, trade flow, financial openness, private investment, and foreign direct investment[1].

However, one major observation from existing studies on exchange volatility is that not many studies have looked at its impact on domestic investment. This is particularly so in African where emphasis has been on attraction of foreign direct investment for growth and development. Given the importance of domestic investment in the growth process, it is crucial to understand how the variable is affected by exchange rate volatility. Hence, the purpose of the study to examine the effect of exchange rate volatility on domestic investment in some selected ECOWAS countries.

The study contributes to the existing literature in the following ways. First, the study will shed better light on the effect of exchange rate volatility in ECOWAS sub-region taking into consideration each country's heterogeneity[2]. This approach is in contrast to the study of Soleymani and Akbari (2011) that employed fixed panel approach. Secondly, the study employs GARCH method to extract the volatility series used in the analysis.

The rest of the paper is organized as follows. Section 2 introduces the measures of exchange rate volatility and ARDL model. Section 3 provides the data sources and empirical results. Section 5 gives concluding remarks.

2. Methodology

2.1 Measures of exchange rate volatility

In the literature, different approaches have been utilized to measure exchange rate volatility. These include variants of Standard Deviation, Autoregressive Conditional Heteroscedasticity (ARCH), and Generalized Autoregressive Conditional Heteroscedasticity (GARCH). However, there has been no consensus among the researchers about the appropriate techniques that measure exchange rate volatility (Clark *et al.* 2004 and Asteriou *et al*. 2016). According to Engle (1984), the unconditional measures of volatility, such as standard deviation, ignore information regarding the random process of the generation of the exchange rate. Similarly, Offutt and Branford (1986) and Canova (1998) argue that these measures are capable of worsening the problem of an outlier. Hence, this study employs GARCH model proposed by Engle (1982) and Bollerslev (1986) to generate our exchange rate volatility[3]. To generate conditional variance of the exchange rate, we specify our GARCH (1, 1) model as:

[1] Examples of such studies include Dell'Ariccia, (1999), Mckenzie, (1999), Arize et al. (2000), Esquivel and Larrain, (2002), Clark et al. (2004), Adewuyi and Akpokodje, (2013), Al-Abri and Baghestani, (2015), Asteriou et al. (2016), Alagidede and Ibrahim (2016), Cushman and De Vita (2017) and Calderon and Kubota, (2017).

[2] However, an exception is the recent study by Iyke and Yo (2017) that focused on Ghana.

[3] The GARCH model has many advantages. One, it captures both volatility clustering and unconditional return distribution with a heavy tail. Two, the model distinguishes predictable and unpredictable elements in the real

Let ARCH (p)

$$u_t^2 = \delta_0 + \sum_{j=1}^{p} \gamma_j u_{t-j}^2 \quad (1)$$

where u_t^2 is the conditional variance, and u_{t-j}^2 is the previous period squared residual derived from previous period information about volatility. From the mean equation (1), by reparameterizing ARCH (p) into the GARCH model (1, 1), we have:

$$h_t = \gamma_0 + \omega_1 h_{t-1} + \gamma_1 u_{t-1}^2 \quad (2)$$

where h_t is the conditional variance, $\gamma_1$represents the ARCH parameters, ω_1 denotes the GARCH parameter, u_{t-1}^2 depicts information about previous volatility measured as the lagged squared residual terms and h_{t-1} is the previous forecast error variance

2.2 The ARDL bound testing

To investigate the relationship between exchange rate volatility and domestic investment for the sample of twelve ECOWAS countries within the period of 1986-2017, we utilize the ARDL bounds test approach proposed by Pesaran *et al.* (2001). This approach has many advantages over other co-integration approaches. This approach is applicable irrespective of the order of integration of variables, and thus obviates the need for pre-testing the integration order of variables. It allows the variables to have different optimal lag length. Also, it yields robust results for small sample sizes. Finally, it integrates both the short-run dynamics and long-run dynamics together without loss of any long-run information (see Pesaran *et al*. 2001, Iyke and Shin-Yu Ho, 2017).
The ARDL model is presented as follows:

$$\Delta DI_t = \rho_0 + \sum_{J=1}^{P} \alpha_j \Delta DI_{t-j} + \sum_{j=1}^{q} \beta_j \Delta GDP_{t-j} + \sum_{j=1}^{r} \emptyset_j \Delta R_{t-j} + \sum_{J=1}^{s} \Psi_j \Delta REER_{t-j} + + \sum_{j=1}^{t} \omega_j \Delta VOL_{t-j} + \lambda_1 DI_{t-j} + \lambda_2 GDP_{t-j} + \lambda_3 R_{t-j} + \lambda_4 REER_{t-j} + + \lambda_5 VOL_{t-j} + \mu_t \quad (3)$$

where Δ is the first difference operator, $\alpha, \beta, \emptyset, \Psi, and\ \omega$ are the coefficient of short-run estimates; λ_{1-5} denotes as the long-run estimates; μ is error term; p,q,r,s and t are the optimal lag lengths selected based on the chosen length selection criterion. Pesaran *et al.* (2001) suggest an F-test for joint significance of the coefficients of the lagged level of variables. For example, the null hypothesis of no long-run relationship between the variables in Eq. (3) $H_0: \lambda_1 = \lambda_2 = \lambda_3 = \lambda_4 = \lambda_5 = 0$ is tested against the alternative hypothesis of co-integration $H_0: \lambda_1 \neq \lambda_2 \neq \lambda_3 \neq \lambda_4 \neq \lambda_5 \neq 0$. Pesaran et al. (2001) further computed two sets of critical values (lower and upper critical bounds) for a given significance level where the lower critical value assumes that all variables are *I(0)* and the upper critical value suggests that the variables are *I(1)*. If the F-statistic exceeds the upper critical value, then the null hypothesis of co-integration is rejected in favour of the alternative hypothesis. Thus we conclude that there is long-run relationship. If the F-statistics falls below the lower critical bound, we cannot reject the null hypothesis of no co-integration. However, if the F-statistics lies between the lower and upper critical bounds, it is inconclusive. Given that the long-

exchange rate formation process, and three, it is prone to overstate volatility (see Arize *et al.* 2000, and Darrat and Hakim, 2000).

run relationship among the variables is confirmed, then the error correction model of equation 3 can be estimated:

$$\Delta DI_t = \rho_0 + \sum_{j=1}^{P} \alpha_j \Delta DI_{t-j} + \sum_{j=1}^{q} \beta_j \Delta GDP_{t-j} + \sum_{j=1}^{r} \emptyset_j \Delta R_{t-j} + \sum_{j=1}^{s} \Psi_j \Delta REER_{t-j} + + \sum_{j=1}^{t} \omega_j \Delta VOL_{t-j} + \varphi ECM_{t-j} + \mu_t \quad (4)$$

where φ represents the coefficient of the error correction model (ECM), μ_t is the error term and ECM indicates the speed of convergence to long run equilibrium.

3. Data Sources and Empirical Results

The study uses annual data for the selected twelve ECOWAS countries covering the period 1986-2017[4]. Gross fixed capital formation as a percentage of GDP is used as a measure of domestic investment, while real GDP in constant 2010 US dollar is used as a proxy of economic growth. Real exchange rate is the nominal effective exchange rate adjusted for a relative movement in national price indicator of the home country and selected countries, real interest rate is used as a proxy of cost of capital in each country, and exchange rate volatility is the unpredictable fluctuation in the exchange rate generated from GARCH model proposed by Bollerslev (1986). Data on all variables are sourced from World Development Indicators Database (CD- ROM 2017) and IFS (2017). All variables employed in the paper are in logarithmic form except real interest rate and exchange rate volatility.

Empirical Results

Table 1 reports the descriptive statistics of all the variables employed in the analysis. The results in table 1 show that there is a high level of consistency among the variables in all the selected countries. The variables show a positive average (mean) in all selected countries, with the highest and lowest real GDP reported in Nigeria and Gambia, respectively. Also, the standard deviations that measure exchange rate variability show that the highest and least exchange rate volatility is reported in Guinea and Togo, respectively suggesting that Guinea has been experiencing unstable currency over time. Except for Burkina Faso, Cote d'lvoire, and Togo, domestic investment is negatively skewed in the remaining countries. This finding suggests that the probability of a decrease in domestic investment is very high in these countries.

[4] The study could not cover all the ECOWAS countries due to data constraints. Hence, the following countries were incorporated, such as Nigeria, Ghana, Cote d'lvoire, Sierra-Leone, the Gambia, Togo, Benin, Burkina Faso, Cabo Verde, Guinea, Liberia, and Senegal

Table 1: Descriptive Statistics

country	variable	mean	max	min	Std Dev	Skewness	Kurtosis
Nigeria	DI	2.379	2.850	1.698	0.339	-0.189	1.679
	GDP	26.066	26.863	25.342	0.518	0.292	1.493
	R	2.219	3.230	0.728	0.727	-0.380	2.291
	REER	4.597	5.597	3.893	0.425	0.882	3.335
	VOL	0.296	2.020	0.005	0.488	2.485	8.350
Benin	DI	2.928	3.353	2.168	0.295	-0.539	2.522
	GDP	22.290	22.931	21.736	0.388	0.031	1.696
	R	1.911	3.014	0.383	0.716	-0.253	2.130
	REER	6.152	6.597	5.578	0.299	-0.689	2.307
	VOL	0.069	0.229	0.001	0.079	0.762	1.923
B. Faso	DI	3.052	3.459	2.695	0.163	0.446	3.156
	GDP	22.406	23.239	21.675	0.497	0.151	1.663
	R	1.979	3.053	-0.215	0.752	-1.032	4.620
	REER	6.152	6.597	5.578	0.229	-0.689	2.307
	VOL	0.069	0.229	0.001	0.079	0.762	1.923
Cabo Verde	DI	2.787	3.769	-0.735	0.983	-2.134	8.082
	GDP	20.501	21.345	19.398	0.701	-0.297	1.553
	R	1.947	2.799	0.503	0.517	-1.033	3.782
	REER	4.458	4.813	4.219	0.151	0.636	2.775
	VOL	2.086	3.619	0.805	0.827	0.305	1.840
C. d'Ivoire	DI	2.448	3.018	2.110	0.252	0.686	2.705
	GDP	23.815	24.328	23.571	0.198	0.788	3.263
	R	1.767	3.067	-0.121	0.947	-0.278	1.881
	REER	4.633	4.881	4.347	0.134	0.294	2.442
	VOL	0.015	0.049	0.000	0.015	0.657	1.924
Gambia	DI	2.593	3.324	1.517	0.606	-0.743	1.948
	GDP	20.298	20.804	19.773	0.314	0.018	1.765
	R	2.976	3.570	2.081	0.301	-1.154	4.468
	REER	4.912	5.380	4.331	0.375	-0.126	1.279
	VOL	0.140	0.423	3.630	0.152	0.452	1.581
Ghana	DI	3.007	3.431	2.229	0.305	-1.076	3.340
	GDP	23.771	24.579	23.028	0.490	0.274	1.845
	R	1.822	2.682	0.214	0.763	-0.873	2.665
	REER	4.728	5.532	4.242	0.299	0.642	2.997
	VOL	0.200	2.038	0.004	0.404	3.324	14.696
Guinea	DI	2.912	3.312	2.625	0.125	-1.003	3.144
	GDP	22.359	22.933	21.784	0.333	-0.061	1.915
	R	2.524	3.135	1.735	0.507	-0.303	1.415
	REER	3.714	6.625	2.942	1.248	1.619	3.710
	VOL	0.665	0.835	9.570	0.218	-2.182	6.198
Liberia	DI	3.491	4.274	2.014	0.601	0.240	1.994
	GDP	20.726	21.643	19.296	0.651	-0.758	2.948
	R	2.346	3.415	1.082	0.661	-0.557	2.467
	REER	4.044	4.724	3.711	0.262	0.809	2.777
	VOL	0.204	1.817	0.004	0.411	2.657	9.646

Senegal	DI	3.059	3.289	2.607	0.171	-0.733	2.888
	GDP	22.934	23.546	22.463	0.331	0.253	1.704
	R	1.576	2.881	-0.333	0.779	-0.157	2.962
	REER	6.152	6.597	5.578	0.279	-0.689	2.301
	VOL	0.069	0.229	0.001	0.079	0.762	1.923
Sierra Leone	DI	2.224	3.726	-1.228	0.885	-2.176	9.623
	GDP	21.353	22.106	20.976	0.330	0.692	2.441
	R	1.960	3.302	-3.056	1.382	-2.395	9.334
	REER	4.814	5.796	4.509	0.243	2.041	9.403
	VOL	0.093	1.529	0.008	0.278	4.606	23.773
Togo	DI	2.826	3.240	2.390	0.217	0.380	2.643
	GDP	21.661	22.169	21.236	0.251	0.270	2.176
	R	1.575	3.321	-1.560	1.126	-0.879	3.577
	REER	4.631	4.914	4.358	0.126	0.618	3.058
	VOL	0.019	0.116	0.009	0.031	1.906	5.622

Before estimating the relationship between exchange rate volatility and domestic investment in selected ECOWAS countries, we first generated the exchange rate volatility series for each country using the GARCH model proposed by Bollerslev (1986). The results for the GARCH models are presented in Table 2. The results show that the estimated coefficients of the lagged conditional variance (ARCH terms) are statistically significant at 5% and 10 % significant levels in seven countries, namely Burkina Faso, Cote d'lvoire, the Gambia, Ghana, Nigeria, Liberia, and Senegal. However, it is positive but not significant in Benin, Cabo Verde, Guinea, Sierra Leone and Togo. These results confirm the presence of volatility clustering in these countries. In contrast, insignificant positive ARCH terms are found in these countries, which imply that random term of previous volatility cannot forecast current volatility. However, the summation values of ARCH and GARCH terms that capture the volatility persistence shows evidence of volatility persistence in ten countries namely Benin, Guinea, Nigeria, Ghana, Cote d'Ivoire, and the Gambia, since the value of the coefficients of ARCH and GARCH is close to or equal to unity[5]. Since the data series for exchange rate volatility has been generated, it is necessary to subject all variables to be employed to unit root tests to ascertain their stationarity properties to avoid the risk of spurious results. The results of the unit root tests conducted showed that all variables were stationary at first difference, except some variables that were found to be stationary at level[6].

[5] The significance of these estimated coefficients close to unity implies that volatility shock persistence crash out slowly and lower values implies that volatility shock persistence crash out rapidly (see Canova, 1998; Agenor *et al.* 2000; Brafu-Insaidoo and Biekpe, 2011and Omari *et al.* 2017).

[6] To conserve space, the results are not presented in this paper, but it is available upon request.

Table 2: Estimates of GARCH model

countries	Constant	γ_1	γ_2	$\gamma_1\gamma_2$	Log-likelihood	ARCH LM test
Benin	0.046	0.958	0.036	1.004	12.327	0.127(0.713)
Burkina Faso	0.697	0.902**	0.023	1.599	38 .564	0.957(1.457)
Cote d'Ivoire	0.575	0.418**	0.541	0.959	6.911	3.961(0.256)
Cabo Verde	0.104	0.873	-0.358	0.515	24.108	0.054(0.816)
Ghana	0.374	0.901*	0.084	0.985	3.672	0.279(0.060)
Gambia	0.027	1.478*	-0.310	1.168	13.557	1.215(0.279)
Guinea	0.359	0.446	0.485	0.931	4.078	5.140(0.000)
Liberia	0.030	0.334**	-1.700	1.034	9.856	8.633(0.067)
Senegal	0.046	0.958*	0.049	1.007	45.575	0.137(0.714)
Sierra Leone	0.076	0.584	0.804	1.388	11.934	1.854(0.772)
Nigeria	6.046	0.958*	0.068	1.026	12.321	0.137(0.463)
Togo	0.106	0.729	-0.564	1.293	7.280	0.519(0.821)

Note: p-values are in parenthesis; ***, ** and * represent significant at 1%, 5% and10% respectively.

Next, we check for the existence of a co-integration relationship among the variables using Pesaran *et al.* (2001) bounds test. To achieve this, we first determine the optimal lag length using Akaike Information Criterion (AIC) and Schwartz Information Criterion (SIC) due to sensitivity of F-statistics to the number of lags length[7]. The results of the ARDL bound test are reported in Table 3. The bounds test results indicate the rejection of the null hypothesis of no co-integration against the alternative hypothesis of co-integration at different significant levels. This finding confirms long-run relationship among the variables in all the selected ECOWAS countries except Benin.

Table 3: Results of ARDL Bounds Test

countries	Model	F-statistics	Critical value (1%)	Critical value (5%)	Critical value (10%)
Nigeria	2,1,0,1,1	7.61***	3.74-5.06	2.86-4.01	2.45-3.52
Togo	1,2,1,1,1	3.75*	3.74-5.06	2.86-4.01	2.45-3.52
Sierra Leone	2,0,0,1,0	6.09***	3.74-5.06	2.86-4.01	2.45-3.52
Senegal	3,1,0,1,1	3.52*	3.74-5.06	2.86-4.01	2.45-3.52
Liberia	1,1,0,1,0	9.37***	3.74-5.06	2.86-4.01	2.45-3.52
Guinea	1,2,1,1,1	6.41***	3.74-5.06	2.86-4.01	2.45-3.52
Benin	1,0,0,1,1	3.55*	3.74-5.06	2.86-4.01	2.45-3.52
Burkina Faso	1,1,0,2,1	7.27***	3.74-5.06	2.86-4.01	2.45-3.52
Cote d'Ivoire	1,1,1,1,1	3.82**	3.74-5.06	2.86-4.01	2.45-3.52
Cabo Verde	1,1,0,1,1	10.42***	3.74-5.06	2.86-4.01	2.45-3.52
Ghana	1,1,0,1,2	3.80**	3.74-5.06	2.86-4.01	2.45-3.52
Gambia	1,2,2,2,2	5.04**	3.74-5.06	2.86-4.01	2.45-3.52

Note: ***, ** and * represent significant at 1%, 5% and10% respectively.

Having confirmed the existence of long-run relationships among the variables, we estimate the error correction model comprising both long-run and short-run relationships. The results of the long-run

[7]We found that the results of the lag selection criterion used for each country varies and they produced conflicting results. Hence, we employed Schwartz Information Criterion (SIC) as the appropriate optimal lag length over the other alternatives due to its consistency and parsimonious in lag length selection, to avoid losing a lot of degree of freedom.

estimates are presented in Table 4. The results show that the economic growth measured by real GDP is positively significant in influencing domestic investment in seven countries, namely Sierra Leone, Nigeria, Ghana, Cote d'Ivoire, the Gambia, Togo, Liberia, and Senegal. These findings suggest that an increase in economic growth will enhance domestic investment in these countries. However, real GDP is negative, but statistically insignificant in the remaining countries. The effect of real interest rate on domestic investment is negative and significant in the case of Ghana, Cote d'Ivoire, Gambia, Cape Verde, Liberia, Nigeria, Sierra Leone, Guinea, Liberia, and Benin. The negative coefficient of real interest rate in these countries implies that an increase in the real interest rate will cause domestic investment to decline. However, real interest rate is positive but insignificant in Togo, and Burkina Faso. Similarly, the estimated coefficient of the real exchange rate is negative and statistically significant in eight countries but positively insignificant in the case of Benin, Togo, Senegal and the Gambia. This result is consistent with Ndikumana and Verick's (2008) results for Sub-Saharan countries. Overvaluation of the exchange rate will have an adverse effect on the investment decision of domestic firms, and thus their profitability. The coefficient of exchange rate volatility is negative and statistically significant[8] in Nigeria, Sierra Leone, Guinea, Gambia, Cote d'Ivoire, Togo, and Liberia. However, the coefficient of exchange rate volatility is not significant in Cape Verde, and Senegal. This finding suggests that exchange rate volatility might have created uncertainty, risk and higher cost for domestic firms which adversely affected their investment and profits. However, the coefficient of exchange rate volatility is positively insignificant in the case of Ghana, Burkina Faso and Benin. This result supports the finding of Iyke and Shin Yu (2017) for Ghana.

Table 4: Long-Run Estimates

countries	Constant	$In\,Y$	$In\,r$	$In\,reer$	vol
Sierra Leone	42.0(0.09)*	-3.52(0.83)	-1.71(0.06)*	18.3(0.14)	-19.2(0.04)**
Nigeria	8.99(0.04)**	0.79(0.05)**	-0.09(0.00)***	-1.95(0.09)*	-2.77(0.10)*
Ghana	9.44(0.00)***	5.51(0.06)*	0.18(0.06)*	-13.8(0.00)***	14.2(0.25)
Cote d'Ivoire	39.0(0.11)	6.07(0.03)**	-0.29(0.08)*	-78.5(0.73)	-22.9(0.08)*
Gambia	24.7(0.09)*	0.14(0.05)**	-0.48(0.10)*	-15.3(0.10)*	-24.6(0.04)**
Togo	38.4(0.14)	1.46(0.05)**	-0.72(0.21)	-14.1(0.09)*	-40.6(0.05)**
Cabo Verde	55.0(0.04)**	-0.88(0.38)	-0.09(0.00)***	-7.74(0.42)	-12.6(0.05)**
Guinea	30.1(0.00)***	0.46(0.36)	-0.07(0.09)*	-1.24(0.07)*	-29.8(0.03)**
Liberia	22.0(0.39)	-1.23(0.15)	-0.84(0.07)*	11.9(0.14)	-30.3(0.07)*
Benin	30.5(0.18)	-0.56(0.20)	-1.77(0.08)*	-43.3(0.08)*	37.5(0.13)
Burkina Faso	43.1(0.05)**	0.34(0.97)	-1.06(0.44)	71.3(0.32)	21.6(0.67)
Senegal	18.8(0.31)	2.47(0.00)***	0.44(0.25)	0.19(0.97)	-34.6(0.56)

Note: ***, ** and * represent significant at 1%, 5% and10% respectively. The numbers inside parenthesis are the significant values.

The results of the short-run estimates with lagged and current period value of explanatory variables[9] are presented in Table 5. The results show that real GDP is positive and statistically significant in seven countries, namely Benin, Burkina Faso, Nigeria, Ghana, the Gambia, Senegal, and Sierra Leone. Real interest rate is negative and significant in seven countries, namely Sierra Leone, Nigeria, Cote d'Ivoire, the Gambia, Togo, Benin, and Senegal. The coefficient of real interest rate is positive in Ghana, Carbon Verde, Guinea, Liberia, and Burkina Faso but significant

[8] The negative coefficient of exchange rate volatility is consistent with the findings of Hayakawa and Kimura, 2009; Bahmani-Oskoee and Hajilee (2013).

[9] For to space conservation, the lagged or contemporaneous variables are not reported in our table

only in Carbon Verde and Liberia. The coefficient of real exchange rate is positive but statistically insignificant in Nigeria, Ghana and Liberia. In contrast, real exchange rate is negative and significant for Cote d'Ivoire, Sierra Leone, the Gambia, Burkina Faso, Cape Verde, and Guinea. In the short-run, the coefficient of exchange rate volatility is positive on domestic investment in Burkina Faso, Benin, Guinea, Ghana, Cape Verde, Togo, and the Gambia. However, negative relationship is found in Sierra Leone, Nigeria, Cote d'Ivoire, Senegal, and Liberia but significant only in Cote d'Ivoire, Nigeria, Liberia, and Senegal. The estimated error correction terms (ECTs) has the correct sign and statistically significant in all the selected countries. The magnitude of the adjustment coefficient reported for these countries varies among the selected countries. Togo, Ghana, and Senegal have the highest speed of adjustment of over 77 percent while Guinea and Liberia have the lowest speed of adjustment of less than 35 percent. Finally, the results suggest that the estimated model passes the standard diagnostic tests in the selected countries except in Guinea and Gambia where there is evidence of model misspecification.

Table 5: Short-Run Estimates with Diagnostic Tests

Countries	$In\,Y$	$In\,r$	$In\,reer$	vol	ECT	LM	$Rest$	$Norm$	$Heter$
Sierra Leone	32.1(0.10)*	-1.17(0.02)**	-16.1(0.01)***	-1.18(0.31)	-0.77(0.03)**	0.82	0.90	0.61	0.82
Nigeria	9.92(0.07)*	-0.21(0.03)**	37.7(0.15)	-0.44(0.03)**	-0.51(0.00)***	0.46	0.54	0.33	0.49
Ghana	3.86(0.05)**	0.24(0.61)	0.51(0.67)	10.1(0.02)**	-0.79(0.05)**	0.70	1.05	0.84	2.45
Cote d'Ivoire	0.38(0.32)	-0.01(0.01)***	-5.04(0.05)**	-1.46(0.01)***	-0.47(0.01)***	2.33	0.54	1.08	1.98
Gambia	0.46(0.05)**	-0.63(0.03)**	-5.01(0.20)	30.1(0.17)	-0.44(0.02)**	6.74	3.68	0.11	0.41
Togo	-1.25(0.53)	-0.24(0.03)**	37.7(0.01)***	21.6(0.12)	-0.81(0.01)***	0.47	0.51	0.39	1.86
Cabo verde	-0.43(0.36)	0.41(0.10)*	-3.83(0.04)**	26.5(0.55)	-0.68(0.01)***	0.58	0.04	0.67	0.31
Guinea	2.54(0.35)	0.58(0.11)	-1.47(0.10)*	38.2(0.65)	-0.34(0.05)**	2.84	7.50	0.13	0.10
Liberia	0.12(0.33)	0.55(0.03)**	9.48(0.20)	-34.2(0.00)***	-0.20(0.03)**	2.45	0.26	0.23	1.60
Benin	0.95(0.02)**	-0.58(0.10)*	-23.2(0.18)	56.6(0.34)	-0.60(0.00)***	1.16	0.45	3.84	1.37
Burkina Faso	0.66(0.07)*	0.30(0.52)	-9.31(0.05)**	28.1(0.56)	-0.58(0.05)**	6.01	0.12	0.09	0.20
Senegal	0.28(0.03)**	-0.12(0.01)***	-5.88(0.21)	-41.9(0.10)*	-0.79(0.01)***	3.84	4.25	0.01	0.24

Note:***, **and* denote significant at 1%, 5% and 10% respectively. The numbers in parenthesis are the significant values

5. Conclusion

In this paper, we examine the dynamic relationship between exchange rate volatility and domestic investment for twelve ECOWAS countries over the period 1986-2017. The study has employed the bounds testing approach for co-integration and error correction modeling techniques by incorporating real GDP, real interest rate, real exchange rate, and exchange rate volatility as essential drivers of domestic investment. The results of the bounds test confirm the existence of long run relationship among the variables in the selected countries. Furthermore, the findings show that exchange rate volatility is negative and statistically significant in Nigeria, Sierra Leone, Guinea, Gambia, Cote d'Ivoire, Togo, and Liberia, but insignificant in Cabo Verde and Senegal. However, exchange rate volatility is positive but insignificant in Ghana, Benin and Burkina Faso.

The question that arises is: what are the policy implications of the findings above? The results show the need to ensure exchange rate stability in the sub-region. One possible way of achieving this is the adoption of a single currency in the sub-region. This policy will help to address the issue of multiple currencies and exchange rate fluctuations that affect intra-regional trade. Elimination of exchange rate fluctuations in the sub-region will undoubtedly enhance the level of domestic investment given the inverse relationship between the phenomena. Moreover, considering present world international monetary environment that is devoid of unanimously accepted rules of ethical monetary conduct; ECOWAS is not immune to monetary shocks precipitated by policies adopted in the developed world. The adoption of a single currency offers ECOWAS the opportunity of putting up a collective and effective force against these disruptions. Such a policy will afford each country in the sub-region opportunity of having a single currency whose value relative to other currencies can better enhance growth and employment creation.

However, the main problem is the modalities for achieving this goal of a single currency in the sub-region because of the vast disparity in the exchange rate systems of Francophone and Anglophone West African countries. Indeed, the recent unilateral renaming of CFA Franc as the ECO and adopting it as a common currency has stoked divisions with the five Anglophone countries in the 15-member Economic Community of West Africa States (ECOWAS) who want to adopt the new currency on a slower pace and as a new currency for the whole region, not just as a replacement for the CFA Franc. Hence, there is the need for the two groups to go back to the drawing board to chart a new roadmap for the actualization of the single currency objective devoid of rancour and political colouration. This suggests that the proposed ECOWAS single currency must be home-grown, taking into consideration the peculiarities of the sub-regions.

Moreover, concerted efforts should be taken by these countries to implement sound and stable macroeconomic policies that will counteract their exposure to business uncertainty and risks. These countries must ensure that they create favourable business climate for domestic firms via various incentives such as easy access to domestic credit, low lending rate, tax relief, and foreign exchange market intervention scheme. These policies will help to boost domestic investment. The exchange rate is one of the main determinants of domestic investment in the countries considered; therefore accommodative monetary policy should be pursued in these countries to enhance their domestic investment. Efforts should be made to stabilize their foreign exchange market without resulting in an increase in interest rate, which could have an adverse effect on the investment decisions of the firms. The significance of interest rate on domestic investment suggests that

conscious actions should be taken against massive government borrowing to finance many government activities to avoid a continuous rise in interest rate.

Finally, governments in the sub region must introduce to measures to promote high quality exports. Increase in exports will help to generate more foreign exchange in these countries. Moreover, there is the need for governments to reduce their high level of dependence on imports of raw materials and finished goods. Reduction in imports will help to reduce demand for foreign exchange.

References

Adewuyi, A. O., and Akpokodje, G., (2013). Exchange Rate Volatility and Economic Activities of Africa's Sub-Groups, *The International Trade Journal*, 27(4), 349-384.

Agenor, P.R., McDermott, C., Prasad, E., (2000). Macroeconomic fluctuations in developing countries. *World Bank Review* 14, 251–285.

Aizenman, J., 1992. Exchange Rate Flexibility, Volatility, and Domestic and Foreign Direct Investment. IMF Staff Papers, 39, 890–922.

Al-Abri, A., and Baghestani, H., (2015). Foreign investment and real exchange rate volatility in emerging Asian countries, *Journal of Asian Economics*, http://dx.doi.org/10.1016/j.asieco.2015.01.005

Alagidede, P. & Ibrahim, M., (2016). On the causes and effects of exchange rate volatility on economic growth: evidence from Ghana. *Journal of African Business*, 1-25.

Ángeles, M., Gómez, T., (2000). Exchange Rate Volatility Effects on Domestic Investment in Spain, 1-34

Arize, A., T. Osang, and D. Slottje, (2000). Exchange-rate Volatility and Foreign Trade: Evidence from Thirteen LDCs," *Journal of Business and Economic Statistics*, 18, 10-17.

Asteriou, D., Masatci, K., Pılbeam, K.,(2016). Exchange rate volatility and international trade: international evidence from the MINT countries. *Economic Modelling*, 58, 133–140

Atella, V., Atzeni, G.E., Belvisi, P.L., (2003). Investment and exchange rate uncertainty. *Journal of Policy Modeling* 25:811–824

Auboin, A., Ruta, M., (2013). The Relationship between Exchange Rates and International Trade: *A Review of Economic Literature*. 12, 577–605.

Bahmani-Oskoee and Hajilee (2013). Exchange rate volatility and its impact on domestic investment. *Research in Economics* 67, 1-12.

Bahmani-Oskooee, M., Tanku, A., (2008). Black market exchange rate vs. official rate in testing the PPP: which rate fosters the adjustment process. *Economics Letters* 99: 40–43.

Bernand, I. N. and Sin-Yu, H. (2017) Exchange rate volatility and Domestic Investment in Ghana. MPRA Paper No. 80474, posted 30 July 2017 12:12 UTC.https://mpra.ub.uni-muenchen.de/80474/

Bildiri Meliki and Ersin Ozgur (2015). An investigation of the relationship between Biomass Energy Consumption, Economic growth and oil prices. *Procedia-social and Behavioural science* 210: 203-212

Binding, G., Dibiasi, A., (2017). Exchange rate uncertainty and firm investment plans evidence from Swiss survey data. *Journal of Macroeconomics* 51: 1–27

Bollerslev, T.(1986). Generalized Autoregressive Conditional Heteroskedacticity, *Journal of Econometrics*, 31, 307-327.

Brafu-Insaidoo, W and Biekpe N. (2011). International capital flows and investment volatility in selected sub-Saharan African countries. *Review of Development Finance* 1: 223–228

Clark, P., Tamirisa, T., We, S., (2004). New look at exchange rate volatility and trade flows. IMF Occasional Paper No. 235. IMF, Washington, DC.

Calder´on, C´esar, Kubota, Megumi, (2017). Does Higher Openness Cause More Real Exchange Rate Volatility?*Journal of International Economics. doi*:10.1016/j.jinteco.2017.08.002

Campa, J.M. and Goldberg, L.S. (1995), "Investment in manufacturing, exchange rates and external exposure", *Journal of International Economics*, 38, 297 - 320.

Canova, F (1998). De-trending as business cycle facts: a user's guide. *Journal of Monetary Economics* 41, 533–540

Chiva, Adityasathyan (2014) Investment, exchange rates and relative prices: evidence from emerging economies. PhD thesis

Cushman, D.O and De Vita, G., (2017). Exchange rate regimes and FDI in developing countries: a propensity score matching approach, *Journal of International Money and Finance* , doi: http://dx.doi.org/ 10.1016/j.jimonfin.2017.07.018

Darrat, A. and Hakim, S. (2000). Exchange rate Volatility and Trade Flows in an Emerging Market: Some evidence from a GARCH process, savings and Development 24(3), 287-302.

Darby, J., Hughes Hallett, A., Ireland, J. and Piscatelli, L. (1999).'The impact of exchange rate uncertainty on the level of investment', *The Economic Journal*, 109:55–67.

Dell'Ariccia, G., (1999). Exchange rate fluctuations and trade flows: evidence from the European Union.IMF Staff. Paper. 46 (3), 315–334

Diallo Ibrahima Amadou (2008). Exchnage rate volatility and domestic investment: A Panel Data Cointegration Approach. MPRA Paper No. 13130 posted 3. February 2009 17:19 UTC. Online at http://mpra.ub.uni-muenchen.de/13130/

Duffrenot, G & Sugimoto, K (2010). Pegging the future West African single currency in regard to internal/external competitiveness: a counterfactual analysis," *William Davidson Institute Working Papers Series*wp974, William Davidson Institute at the University of Michigan.

Engle, R. F. (1982). 'Autoregressive conditional heteroskedacticity with estimates of the variance of UK inflation', *Econometrica*, 50, 987–1008.

Eregha, P.B (2010). Dynamic linkages between Foreign Direct Investment and Domestic Investment in ECOWAS countries: A Panel Cointegration Analysis, *a paper Presented at the 2011 Conference of the Centre for the Study of African Economies*, Oxford University, Oxford, UK between 20th-22nd March

Esquivel, G. and F. Larrain, (2012). ''The Impact of G-3 Exchange Rate Volatility on Developing Countries,'' UNCTAD G-24 Discussion Paper Series, No. 16 (January 2002), Geneva.

Harchaoui, T., Tarkhani, F. and Yuen, T. (2005), The effects of the exchange rate on investment: Evidence from Canadian manufacturing industries, *Bank of Canada* WP 2005-22.

Hayakawa, K and Kimura, F. (2009). The effect of exchange rate volatility on international trade in East Asia. *Journal of Japanese International Economies* 23: 395–406

Inder B (1993). Estimating long-run relationship in economics: A comparison of different approaches. *Journal of Economics*, 57:53–68.

Kremers, J.J., Ericson, N.R., Dolado, J.J., (1992). The power of cointegration tests, Oxford. Bulletin of Economics and statistics 54, 325–347.

Landon, S. and Smith, E.C. (2007) 'Investment and the exchange rate: Short Run and LongRun aggregate and sector level estimates', MPRA Paper, No. 9958, Munich, Germany

Linda S. Goldberg (1994). Exchange rates and Investment in United States industry. *The Review of Economics and Statistics*, 75(49): 575-588

McKenzie, M.D., (1999). The impact of exchange rate volatility on international trade flows. *Journal of Economic Surveys.* 13(1), 71–106.

Ndikumana, L and S. Verick (2008). The Linkages between FDI and Domestic investment unraveling the Developmental Impact of Foreign Investment in Sub-Saharan Africa. *Institute for the Study of Labour (IZA), working paper no.IZA DP No. 3296.*

Nucci, F. and Pozzolo, A.F. (2001) 'Investment and the Exchange Rate: "An Analysis with Firm-Level Panel Data", *European Economic Review,* 45, 259-83

Offutt, S.E., Blandford, R., (1986). Commodity market instability: empirical techniques and analysis. *Resource Policy* 12, 67–72

Ojede, A., Lam, E., (2016). The impacts of changes in monetary aggregates on exchange rate volatility in a developing country: Do structural breaks matters? *Economics Letters*, http://dx.doi.org/10.1016/j.econlet.2017.03.024

Omari, C.O., Mwita, P.N and Waititu, A.G. (2017). Modeling USD/KES Exchange Rate Volatility using GARCH Models, IOSR *Journal of Economics and Finance* 8(1): 15-26

Oshikoya, T. W. (1994), Macroeconomic determinants of domestic private investment in Africa: An empirical analysis, *Economic Development and Cultural Change* 42 (3), 573–596.

Oskooee, B.M., Hegerty, S.W., (2007). Exchange rate volatility and trade flows: a review article. *Journal of Economics*, 34 (3), 211–255.

Pesaran Hashem M., Shin Y., Smith R.J. (2001) Bounds Testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, 16: 289-326

Serven, L. (2003) 'Real Exchange Rate Uncertainty and Private Investment in Developing Countries', *Review of Economics and Statistics*, 85, 492-492.

Soleymani, M and Akbari, A (2011). The relationship between exchange rate uncertainty and investment in some of Sub-Saharan African Countries, *International Journal of Business and Public Management* 1(1): 51-57