Croatian Review of Economic, Business and Social Statistics (CREBSS)
UDK: 33;519,2; DOI: 10.1515/crebss; ISSN 1849-8531 (Print); ISSN 2459-5616 (Online)
Vol. 9, No. 1, 2023, pp. 1-15

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Dependence between foreign trade performance and exchange rate volatility: Panel ARDL approach

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Abstract

The purpose of this study is to analyse the influence of exchange rate shocks on foreign trade (exports and imports) of fifteen economies within the ECOWAS sub-region. To accomplish the goal of this paper, Autoregressive Distributed Lag (ARDL) procedure was employed to investigate the impact volatility in the exchange rate market has on foreign trade in both long- and short-term with data between 1980 and 2020. To compute volatility, it relied on the GARCH (1, 1) model which predicted the conditional variances as proxy for volatility. Our empirical results are distinguished into export model and import model, and reveal that volatility in exchange rate influence foreign trade performance (exports and imports) negatively in the short-run, though statistically insignificant. The impact however becomes positive in the long run, and statistically significant for the two models. These results signpost that while the volatilities in foreign exchange market appear to deteriorate the international trade of these economies in the short-term, it substantially and significantly causes its improvement in the long-term. Hence, our results validate the J curve effect in the case of these ECOWAS economies. Policy implication from the findings suggests that to develop a robust international trade and ultimate economic growth, it is recommended that policymakers of these economies maintain a short-term stability in their foreign currency markets by way of adopting some intervention measures.

Keywords: ARDL ECOWAS, exchange rate, exports, imports, trade performance, volatility.

JEL classification: C13, F5, G10.
DOI: 10.2478/crebss-2023-0001

Received: January 04, 2023
Accepted: July 04, 2023

Acknowledgments: We thank the anonymous referees for the useful suggestions which improved the study.

Introduction

Foreign trade has long been seen as an important factor in a country's economic development. It usually appears in the current account of the Balance of Payments (BOPs), where the credit side contains exports and imports documented on the debit side. Because of clear disparities in resources, such as natural vegetation, raw materials, soil, climate, physical and ecological factors, foreign trading is inescapable as a result of unevenly distributed factor endowments with productive power across various nations of the world. Furthermore, worldwide commercial activities may be influenced by economic development, capital accumulation and foreign capital inflows, advancement in technology, legislation, and government alliances. Also, Mercantilism in the 17th and 18th centuries, theory of opportunity cost, comparative/relative advantage theory, absolute advantage theory, theory of general equilibrium, are among the theories surrounding international trade. The central premise of all of these theories is Ricardo's (1817) theory of comparative advantage, which stated that an economy might concentrate on the manufacture of those products wherein there is comparative cost advantage or least difficulty in manufacturing and then sell to the rest of the world. Thus, in today's world, no country can be self-sufficient in terms of the production and consumption of every commodity it requires. The converting of one currency to another currency, usually between two countries' currencies, is known to as the foreign exchange rate; and this transaction is carried out in the foreign exchange (FOREX) market. Several empirical evidence exist that a number of exchange rate regimes exist in the global economy. There was the fixed exchange rate regime in which economies were subject to the Gold Standard, which lasted from 1879 to 1934 (Senadza, Diaba, 2017). Following that, the Bretton Woods system was established, wherein the US dollar was linked to a specific amount of gold while other economies' currencies were linked to the United States Dollar. In the 1970s, this system failed, and a market floating exchange rate system was instituted, through which the rate of exchange is decided by the market forces of demand and supply of foreign currency in the FOREX market (Bahmani-Oskooee, Gelan, 2018). Together with the flexible exchange rate system, there is also the popular managed float rate system, in which the monetary authority (typically the central bank) intervenes on behalf of the government to keep the value of currency within predetermined bounds.

The influence of the fluctuations in exchange rate on trading activities has sparked intense arguments among policymakers and academics since the treaty in Bretton Woods collapsed in 1973. The size of such discussions is greater, particularly in nations with modest stages of economic advancement. Concerning African economies, the problem of exchange rate volatility might become a more challenging matter for their pursuit in achieving the objective outlined in their development policies, which would transform their economies into sustainable and long-term growth. Further, as these countries strive for consistent economic growth, they may liberalize the inflow and outflow of capital and financial transactions across their borders, exposing them to increasing exchange rate dynamics. In contrast, exchange rate volatility may cause uncertainty among traders who wants

to maximize their returns, increase risk aversion, and reduce the intensity of their involvement in the foreign trading activities (exports and imports), resulting in a lower value and amount of trade and further stifling economic development. Despite the fact that such anticipation necessitates some symptoms of concern, the influence of exchange rate instability on exports and imports movements suggest that the outcome could be beneficial or negative. Accordingly, foreign trade may actually increase if the heightened exchange rate dynamics stimulates merchants to increase their amount of trading so as to counterbalance any predicted reduction in possible rewards. Therefore, the probable dualistic impacts of the dynamics in the foreign exchange market on foreign trade movements will be validated empirically in this study. Sequel to the fact that growth in major economies in African has been fueled by a steep surge in the amount of foreign trade, which has been caused primarily by increased need for unrefined resources and higher commodity prices, examining the influence of exchange rate volatility on foreign trade performance is both well-timed and crucial for these ECOWAS states.

The investigation on the short- and long-run macroeconomic implications of managed or semi-floating exchange rate systems with rising volatility in exchange rate on foreign trade, particularly in least developed countries, would be beneficial. This paper scrutinizes the nexus between exchange rate volatility and the performance in foreign trade using selected ECOWAS economies in the face of enduring deficits in their current accounts and the issues surrounding their management. Although there are existing researches on the nexus between exchange rate volatility and foreign trade performance in emerging economies in general (see e.g., Nguyen, Do, 2020; Sugiherti et al., 2020; Thuy, Thuy, 2019; Latief, Lefen, 2018; among others), given the expected regional disparities, a focus on Africa and ECOWAS in particular is relevant. Several studies have been conducted on countries in SSA with specific attention on particular countries (see e.g., Yakub et al., 2019; Zaki et al., 2019), and their findings are unlikely to be usefully generalizable. Moreover, to the extent that we are aware of, much research attention has not been given on the effect of currency rate fluctuation on exports and imports in ECOWAS countries. Recently, few studies analysed the association between exchange rate dynamics and trade performance in panels of SSA economies, but they randomly selected their samples without concentrating on a particular sub-region (such studies include: Bahmani-Oskooee, Gelan, 2018; Bahmani-Oskooee, Arize, 2020; Shuaibu, Isah, 2020; Senadza, Diaba, 2017). For example, Bahmani-Oskooee and Gelan, 2018 considered 12 SSA countries without a specific sub-region; their study was based on bounds-testing and comparative. Given the characteristics of the ECOWAS region and its uniqueness, it has become necessary to investigate how the dynamics in the currency market influence their international commercial and trading activities. Thus, due the significance of this subject, the current study analyses the implications of exchange rate volatility on foreign trade movements with data from fifteen ECOWAS nations covering the years 1980 to 2020. In Africa, particularly in the ECOWAS region, the issue over currency rate volatility and its effects on foreign trade (exports and imports) has received little empirical attention. In this paper, we employ the exchange rate volatility modeled by GARCH (1,1) and panel ARDL to address the problem. Hence, the main objective is to empirically examine the relationship between exchange rate volatility and foreign trade performance, and also to test whether the J curve effect can be validated in these ECOWAS economies.

The study is divided into five sections: section 1 introduces the study and its motivation, section 2 includes a theoretical background and literature review.

Section 3 contains the methodology, data, and preliminary analysis. The empirical evidences, analysis and discussions are exhibited in part 4, and section 5 offers some concluding comments.

Theoretical and empirical review

The review of theories underpinning the connection between exchange rate dynamics and general trading activities and prior studies are presented herein. Several researches (Arize et al., 2017; Senadza, Diaba, 2017; Bahmani-Oskooee, Gelan, 2018) have looked into the effects of exchange rates volatility on foreign trade. The idea supporting the negative impact of exchange rate volatility on global trade movements gained prominence in Ethier's (1973) book. The model of Ethier is based on the decision making of firms that are risk-averse with respect to forward exchange cover and imports in a period of currency rate fluctuations. The trading reaction in the face of exchange rate volatility is deductively negative under the assumption of risk aversion, albeit the magnitude of this inverse correlation reduces with the firm's speculative activities (Ethier, 1973). Further, other scholars such as Clark (1973), McKenzie (1999) established a comparable concept to the model of Ethier, whereas Demers (1991) and Franke (1991) developed the risk-neutral hypothesis. Moreover, according to Bahmani-Oskooee and Hegerty (2007) several theoretical evidences supported the assertion that exchange rate volatility favourably influences foreign trade performance among countries.

Empirically, diverse studies have been carried out on the exchange rate-trade relationship for developed and developing markets. For example, Hall et al. (2010) examine the link between exchange rate volatility and exports performance in developing countries and find positive significant relationship; implying that the liberalisation of capital markets of these economies can decrease the influence of shocks in exchange rate on exports performance. Also, Latief and Lefen (2018) examine whether exchange rate volatility influence international trade in a panel of 7 Asian developing markets. By constructing different proxies for exchange rate volatility, they find that volatility in the currency market negatively impact international trade of the sampled economies operating the "One Belt One Road" (OBOR) project. Similarly, Lin et al. (2018) analyse the modulating role of credit constraints in the exchange rate dynamics-trade performance nexus for a large sample of 132 economies. By developing a small open economy general equilibrium model, they find that on average the exports activities of credit constraint firms is negatively associated to exchange rate volatility, while the influence on the exports of unconstraint firms appear to be ambiguous. This suggests that the exports performance of firms that are more constraint are more affected than those of less constraints firms.

Thuy and Thuy (2019) analyse whether exchange rate fluctuations affect the Vietnamese exports market by using quarterly data from 2000 to 2014. Their results reveal that the volatility in exchange rate significantly deteriorates the level of exports in Vietnam in the long-term. Also, as Vietnamese currency depreciates, exports decline (improve) in the short-run (long-run), which validates the presence of J curve effect. In another study, Nguyen and Do (2020) examine the impact of the volatility in exchange rate on the Vietnamese exports performance for a period from 2009 to 2018. With the adoption of error correction model, they submitted that exchange rate volatilities do not influence international trade in the short-term, but significantly influenced external trade in the long-term. Similarly, Vo et al. (2019) analyse the disaggregated reactions of exports to exchange rate depreciation and volatility in Vietnam to its major trading associates between 2000 and 2015. By

employing GARCH based and long-run cointegrating models, it was discovered that in the short-run, depreciation in exchange rate enhances manufacturing exports, while the volatility in exchange rate declines exports in long-run; and the outcomes are dependent on exports type and destination of exports.

Héricourt and Poncet (2015) analyse the effect of exchange rate volatility on trading activities of Chinese firms and recorded that the volatilities in the currency market deteriorate the trade performance of firms, and the impact is worsened in firms that are financially vulnerable. Bostan et al. (2018) examine whether exchange rate dynamics affect the exports and imports activities through international commercial trade competitiveness in Romania and find negative impact of exchange rate volatility on both exports and imports. Recently, Abbas et al. (2020) investigate the link between exchange rate fluctuations and China's trading activities with its performance across high-income, middle-income and low-income economies for the period from 1992-2017. By using the global vector autoregressive (G-VAR) model, they submitted that the exchange rate policy in China negatively affects its imports but positively impact its exports with its trading associates. The study therefore established that the Chinese Renminbi is a domineering currency in international trade. Sugiharti et al. (2020) analyse the relationship between Indonesia's exports activities with its top 5 partners in the exports market and its exchange rate volatility. By estimating the linear and nonlinear models, they concluded that the dynamics in FOREX market have an adverse impact on the exports performance of the Indonesian economy.

In Africa, only a few studies have been carried out on how the volatilities in exchange rate influence foreign trade performance in SSA economies, with the majority of these being time series studies. For example, Osei-Assibey (2010) generating a volatility index with the GARCH approach examines the relationship between cross-border trading activities and exchange rate dynamics within 3 SSA countries, and with their trading associates. Using a gravity formulation, it was concluded that the impact of volatility on trading profitability is negligible. Zaki et al. (2019) argued that real exchange rate depreciation causes exports values to increase but does not influence the quantity of exports in the case of Egyptian trade performance. Yakub et al. (2019) examined how trade flows are impacted by exchange rate variations in Nigeria and documented that the dynamics in exchange rate adversely impact trade movements in the short-term, whereas the relationship is insignificant in the long-term. Suggesting that central bank should ensure stable FOREX market in the short-run.

Further, few studies have been conducted on a panel of randomly selected SSA economies. For example, Senadza and Diaba (2017) find that exchange rate volatility has negative (positive) impact on trade in the short-run (long-run) in a study for selected SSA countries. Shuaibu and Isah (2020) examined the symmetry and asymmetry influence of exchange rate fluctuations on the balance of trade in five economies in Africa, and find mixed results with positive influence in the short-run for Uganda and in the long-run for Algeria in the symmetry model. Conversely, in the asymmetry model, they observed positive effect in the case of South Africa and Uganda in the short-run and in Algeria and Uganda in the long-run. Bahmani-Oskooee and Gelan (2018) analyse the influence of exchange rate dynamics on trade flows in terms of exports and imports for twelve SSA economies. By considering the short-run and long-run properties, they documented mixed outcomes, which revealed that exchange rate volatility influences majority of the economies' trade movements in the short-term, while there were constraints in the association in the long-term. It was concluded that the level of global and domestic economic

activities were key factors determining trade flows. Also, Bahmani-Oskooee and Arize (2020) examined how uncertainties in the exchange rate market influence exports and imports of thirteen African economies; by analyzing symmetry and asymmetry models, they argued that the nature of the relationship is asymmetrical. Therefore, our current paper uses data from fifteen ECOWAS economies to offer more insight on how the volatilities in exchange rate influence foreign trade. Unlike prior studies, we investigate the link between exchange rate volatility and foreign trade performance in both the short-term and long-term, and in two directions of trade – exports and imports. We also, test the J curve effect on the relationship between exchange rate and foreign trade performance.

Methodology and data issues

The goal of this paper is to analyze the short- and long-run influence of exchange rate volatility on foreign trade performance (exports and imports) in fifteen ECOWAS countries. To do so, the study employ a long panel data representation of the time series autoregressive distributed lag (ARDL) approach. This approach is suitable in handling the existence of potential non-stationarity and heterogeneity in long period and large sample size (see Pesaran, Smith, 1995; Pesaran, Shin, 1995 and Pesaran et al., 1999 for details). Several studies have used the same model previously (see for instance; Adeniyi, Kumeka, 2020; Chaudhary et al., 2016; Alam, 2010).

The ARDL was employed for two reasons. Firstly, it would take into consideration both non-stationarity and heterogeneity impacts in trade performance data. Secondly, where there is non-stationarity or there exists a combination of I(0) and I(1), but not higher than I(1), it is more appropriate (Shin et al., 2014). Further, as indicated in Blackburne and Frank (2007), the dimensions of large sample size and large time period dynamic panels differ from the dimensions of large sample, small time period dynamic panels. Moreover, the Pooled Mean Group (PMG), Dynamic Fixed Effects (DFE), and Mean Group (MG) estimators are three popular strategies for the estimation of this type of dynamic heterogeneous panel data model. The MG estimator relies on averaging the coefficients after calculating N time-series regressions, whereas the PMG estimator combines pooling and averaging of coefficients (Blackburne, Frank, 2007). In the long term, the DFE is similar to the PMG estimator in that it limits the slope coefficient and error variances to be equal across all countries. Nonetheless, the Hausman test statistic is used to select the best model and to determine whether either of estimators differs in a systematic way. Equation (1) expresses the relationship between foreign trade, exchange rate and some explanatory variables:

$$FTR_{it} = \alpha_0 + \alpha_1 exr_{it} + \alpha_2 X_{it} + \varepsilon_{it} \tag{1}$$

where $FTR_t, exr_t, and\ X_t$ denote foreign trade (exports and imports of goods and services), nominal exchange rate and a covariates of exogenous variables, respectively. i and t represent country and time period counters, whereas α_0, α_1 and α_2 stand for the intercept and coefficients to be estimated. Lastly, the idiosyncratic disturbance/noise term is denoted by ε_t.

Consequently, following Equation (1), the long panel ARDL is given as:

$$FTR_{it} = \sum_{k=1}^{l} \delta_{ik} FTR_{i,t-k} + \sum_{j=0}^{q} \beta_{ij} X_{i,t-j} + \sum_{n=0}^{m} \gamma_{in} VOL_{i,t-n} + \mu_i + \varepsilon_{it} \tag{2}$$
$$k = 1,\ldots,p;\ j = 0,1,\ldots,q;\ n = 0,1,\ldots,m$$

$$\Delta FTR_{it} = \delta_{0i} + \delta_{1i}FTR_{i,t-1} + \delta_{2i}X_{i,t-1} + \delta_{3i}VOL_{i,t-1} + \sum_{j=1}^{N1}\vartheta_{ij}\Delta FTR_{i,t-j} + \sum_{j=0}^{N2}\varpi_{ij}\Delta X_{i,t-j} + \sum_{j=0}^{N3}\phi_{ij}\Delta VOL_{i,t-j} + \mu_i + \varepsilon_{i,t} \quad (3)$$

$$i = 1, 2, \dots, N; t = 1, 2, \dots, T$$

In Equations (2) and (3), FTR_t and X_t are as defined earlier; exchange rate volatility is denoted by VOL; the group-specific weight is captured by μ_i. We compute the long run elasticity/slope coefficients for all cross-sections as $-\frac{\delta_{2i}}{\delta_{1i}}$ and $-\frac{\delta_{3i}}{\delta_{1i}}$ with the assumption that in the long run, $\Delta FTR_{i,t-j} = 0$; $\Delta X_{i,t-j} = 0$ and $\Delta VOL_{i,t-j} = 0$. The exchange rate volatility coefficient for the short-run is represented by ϕ_{ij}. The setup error correction term (ECM) is specified in Equation (4):

$$\Delta FTR_{it} = \wp_i v_{i,t-1} + \sum_{j=1}^{N1}\vartheta_{ij}\Delta FTR_{i,t-j} + \sum_{j=0}^{N2}\varpi_{ij}\Delta X_{t-j} + \sum_{j=0}^{N3}\phi_{ij}\Delta VOL_{t-j} + \mu_i + \varepsilon_{it} \quad (4)$$

where $v_{i,t-1} = r_{i,t-1} - \varphi_{0i} - \varphi_{1i}p_{t-1}$ represents the symmetric ECM for individual economies; whereas the long-run equilibrium or speed of adjustment parameter is indicated by $\wp_i$ for all countries. The parameters φ_{0i} and φ_{1i} are computed as $-\frac{\delta_{0i}}{\delta_{1i}}$ and $-\frac{\delta_{2i}}{\delta_{1i}}$ respectively. It is assumed that both Equations (3) and (4), show symmetric connection of exchange rate volatility with foreign trade performance.

Data structure and preliminary analyses

The influence of exchange rate volatility on foreign trade is investigated using annual data for all the variables, namely nominal exchange rate, exports and imports, for a sample of fifteen ECOWAS economies with dataset running from 1980 to 2020. Some theoretical explanatory variables were also included in our model; these are the nominal GDP as a proxy economic growth, industrial activities proxied by the industry value added and the general price level proxied by the annual inflation rate measured in percentage. Data was sourced from the World Bank's World Development Indicators. In gathering the data, some missing values were discovered; in such a case we used cubic spline interpolations and backward casting to fill such gaps. The Generalized Autoregressive Conditional Heteroscedasticity (GARCH) model initially recommended by Engle (1982) and further supported by Bollerslev (1986) is used in the study to forecast and construct the volatility index. The GARCH (1,1) model takes into consideration volatility clustering, which is a feature that suggests volatility occurs in clusters. This model is most suitable in capturing volatility in key financial phenomena and events, for example, foreign exchange market fluctuations and other macroeconomic dynamics (Bollerslev et al., 1992; Granger, 1992; Franses, Van Dijk, 1996; Hansen, Lunde, 2005; Eriksson, 2013; Dyhrberg, 2015; Katsiampa, 2017). On building the GARCH model, given an exchange rate index as EXT_t and the exchange rate return as r_t. The returns on exchange rate was calculation by take the log-difference; that is, $r_t = log\,EXT_t - log\,EXT_{t-1}$. The index t in this study stands for annual observations. Even though higher-order models have occasionally been proven to be helpful, the

(AR(p) – GARCH(1,1)) autoregression with GARCH (1,1) disturbances is the most used empirical model for the return r_t, and it is stated as $\phi_p(B)r_t = \mu + \varepsilon_t$, with $\phi_p(B) = 1 - \phi_1 B - \cdots - \phi_p B^p$; $\varepsilon_t \approx N(0, h_t)$, where $h_t = \omega + \alpha\varepsilon_{t-1}^2 + \beta h_{t-1}$. The factor B is the backward shift operator defined by $B^k x_t = x_{t-k}$. The intercept is represented by μ and is typically estimated to be equal to close to zero (see Bollerslev, 1986). Benin Republic, Burkina Faso, Cabo Verde, Cote d'Ivoire, Gambia the, Ghana, Guinea, Guinea-Bissau, Mali, Mauritania, Niger, Nigeria, Senegal, and Togo are among the ECOWAS countries with available data. The analysis begins with descriptive statistics and present the group statistical aspects of the series using standard approaches for variables with time series qualities. Table 1 presents the summary statistics.

Table 1 Descriptive statistics and pairwise correlations

Panel A Variables	Exports	GDP	Imports	Exchange rate	Industry	Inflation
Mean	25.4253	26.9470	25.8081	4.9205	25.3315	8.0704
Std. dev.	3.1693	3.1066	3.0821	2.5886	3.1936	13.1476
Min.	12.5728	15.2707	12.4599	-8.1993	13.1394	-7.7966
Max.	32.0094	32.6696	31.7832	9.1932	31.5247	122.8745
Observations	615	615	615	615	615	615

Note: *Exports* and *Imports* represent the exports and imports of goods and services as proxy for trade performance; *GDP* represents nominal gross domestic product as a proxy for economic development; *inflation* is the inflation of consumer prices in annual percentages; *exchange* rate is the nominal official exchange rates while *industry* represents the industrial value added of the sample economies.

Next the panel unit root tests are conducted on all variables, as is required for panel series with large T. When non-stationarity is an issue, the recommended dynamic heterogeneous panel data model is frequently considered. Three different categories of panel unit root tests are taken into consideration. Group one includes unit root tests process by Harris and Tzavalis, Breitung et al. (2007) and Levin et al. (2002). Group two includes Im et al. (2003) and Maddala and Wu (1999) unit root process, whereas group three deals cross-section dependence (CD) of Pesaran (2007). Table 2 presents the different unit root results.

Table 2 Panel unit root tests

Test method	Exports	GDP	Imports	Exchange rate	Industry	Inflation	Volatility index
Null hypothesis: unit root with common process							
LLC t*	-4.0624***I*	-4.7302*** *I*	-3.9006*** *I*	-6.4059*** *I*	-4.0703*** *I*	-7.0415*** *I*	-11.1164*** *I*
Breitung(λ) t-stat	-10.4500***f*	-6.9088*** *f*	-10.0705*** *f*	-9.0227*** *f*	-12.4217*** *f*	-7.5298*** *I*	-14.8143*** *I*
H-T ρ	0.0115*** *f*	0.2981*** *f*	0.1096*** *f*	0.2046*** *f*	0.1822*** *f*	0.4827*** *I*	0.1791*** *I*
Null hypothesis: unit root with individual unit root process							
IPS W Stat $\bar{Z}_{\bar{t}}$	-12.8552*** *f*	-12.4159*** *f*	-12.8389*** *f*	-4.8715*** *I*	-12.8363*** *f*	-8.7423*** *I*	-12.2037*** *I*
ADF Fisher χ^2	2.1847** *f*	4.0293*** *I*	4.0130*** *f*	5.3273*** *I*	2.9894*** *f*	2.8027*** *I*	3.7053*** *I*
Pesaran CD test[2]	-3.477*** *I*	-1.986** *f*	-2.390*** *I*	-2.686*** *I*	-2.620***f*	-4.055*** *f*	-2.341*** *I*
Cross-sections	15	15	15	15	15	15	15
Periods	41	41	41	41	41	41	41
Observations	615	615	615	615	615	615	615

Note: *I* and *f* denote stationarity at level and at first difference respectively, while ***, **, * indicate statistical significance at 1%, 5% and 10% respectively. LLC, H-T and IPS represent Levin, Lin & Chu, Harris-Tzavalis and Im, Pesaran & Shin respectively.

As indicated in Table 2, Peseran (2007) which test assumes the H_0 of homogeneous non-stationary against the H_1 of possible heterogeneous, indicate the rejection of the H_0. This therefore confirms that there exists of cross-sectional dependence (CD)

among the variables. Considering the other panel unit root tests, we find that the variables for exports, imports and industry value added are at first difference stationary in all the test types except under Levin et al. (2002). The proxy for economic growth, nominal GDP is stationary at level when we used Levin et al. (2002) and ADF Fisher, but stationary at first difference in the other unit root tests. Also, I(1) order of integration was evidenced in the results for nominal exchange rate in the case of Breitung and Harris-Tzavalis unit root tests, whereas it is integrated at order I(0) in the other tests. Last, the series for inflation reveals level stationarity in all the unit root tests. Overall, our unit root test results are on the borderline between I(0) and I(1), and there is no evidence of I(2). Moreover, concentrating the CD test results of Pesaran (2007), we confirm the presence of heterogeneous cross-sections among the variables. Hence, the basis on which the fundamental structure of this paper is estimated to capture the essential non-stationarity and heterogeneity that is suitable in long panel data analyses. Fundamentally, the unit root test results confirm panel ARDL is the appropriate estimation framework for this study.

Empirical results

To conduct the analysis, first is the employment of the MG, DFE, and PMG estimators to estimate the long- and short-run exports and imports models, and then rely on the Hausman test to decide which estimator results are suitable. Also, in performing the empirical analysis, the investigation followed a step-wise process; that is, for the export model, the estimation was done first as export model with exchange rate volatility as a single exogenous covariate, and then export model with exchange rate volatility and other exogenous covariates. Similarly, the import was carried out as import model with exchange rate volatility as a single exogenous covariate and import model with exchange rate volatility and all exogenous covariates. As evidenced the PMG estimator is extensively supported as the efficient estimator for both exports and imports estimations on the basis of the Hausman test results. Hausman test results are shown in Table 3, while the results for PMG for the exports and import models are presented in Table 4.

Table 3 Results from Hausman test for model – PMG, MG and DFE

	Exports model			Imports model		
Ho: Difference in coefficients not systematic						
	PMG vs. MG	PMG vs. DFE	MG vs. DFE	PMG vs. MG	PMG vs. DFE	MG vs. DFE
$\chi^2(4)$	1.42	0.10	0.04	0.50	1.00	0.03
p-value	0.8412	0.9987	0.9998	0.9734	0.9102	0.9999
Conclusion	ACCEPT Ho	ACCEPT Ho	ACCEPTHo	ACCEPT Ho	ACCEPT Ho	ACCEPT Ho
Appropriate model	PMG	PMG	MG	PMG	PMG	MG

Table 4 Panel Regression Results for Exchange Rate Volatility and Trade Performance

MODEL/VARIABLE		Exports			Imports		
		(1)	(2)		(3)	(4)	
		PMG	PMG		PMG	PMG	
Long-run estimates	Lngdp		0.9220*** (0.1390)			1.2140*** (0.0860)	
	Lniva		0.1190 (0.1340)			-0.2860*** (0.0834)	
	Infl		-0.0036 (0.0028)			0.0061*** (0.0019)	
	Lnvol	0.4736*** (0.0862)	0.1460*** (0.0312)		0.3563*** (0.0662)	0.0522*** (0.0189)	
	Constant	3.4513*** (0.5279)	-0.6920*** (0.1850)		3.7449*** (0.6090)	0.0070 (0.0505)	
Short-run estimates	Δ.lngdp		0.4030*** (0.1480)			0.5070*** (0.1400)	
	Δ.lniva		0.3370** (0.1520)			0.1770** (0.0900)	
	Δ.infl		0.0018 (0.0012)			-0.0005 (0.0009)	
	Δ.lnvol	-0.0122 (0.0143)	-0.0032 (0.0045)		-0.0196* (0.0102)	-0.0005 (0.0059)	
	$v_{i,t-1}$	-0.1378*** (0.0204)	-0.2760*** (0.0576)		-0.1478*** (0.0234)	-0.3140*** (0.0544)	
Number of groups		15	15		15	15	
Obs per group		40	40		40	40	
Observations		600	600		600	600	

Note: The log of exports and imports are the dependent variables. ***, ** and *represent significant statistical levels at 1%, 5% and 10% respectively. The values in parentheses are standard errors. The Regressions employ the GARCH based exchange rate volatility proxy. lngdp is the natural logarithm of GDP, lniva is the natural logarithm of industry value added, infl is inflation, vol is exchange rate volatility, and $v_{i,t-1}$ is the speed of adjustment term.

As displayed in Table 4, the estimated empirical results for both long-run and short-run for the exports equation for the PMG estimator are presented in columns (1) and (2), respectively. As stated previously, column (1) captures the model with exchange rate volatility only, whereas column (2) captures the model with exchange rate volatility and other exogenous variables. From column (1) it can be seen that there is a negative and statistically insignificant relationship between exchange rate volatility and exports of goods and services in the short-run. Specifically, it is obvious that a percentage point increase in exchange rate volatility causes the exports of goods and services to deteriorate by around 0.0122 percent in the short-run. Concentrating on the PMG outcomes in column (2), it is seen that the volatilities in exchange rate also affects exports negatively in the short-run, though it remains statistically insignificant at all conventional levels. This indicates that as exchange rate volatility rises by 1% this will result to a decrease of 0.0032% in exports. This further portends that in the short-term period, exchange rate volatility deteriorates the exports capability of these ECOWAS economies, but the volatility in exchange rate appears not to be a key determinant of foreign trade performance given its weak statistical significance. Our findings here are consistent with the theoretical postulations of Ethier (1973); Clark (1973); Mckenzie (1999). Empirically, this is similar to the findings in Senadza and Diaba (2017); Arize et al. (2017), and Khan et al. (2014). For example, Khan et al. (2014) argued that volatility in the foreign exchange rate market has a negative effect on thirteen least developed countries, five emerging East Asian markets and the trading partners of Pakistan respectively. However, our

results differ with the findings in Zaki et al. (2019), Vo et al. (2019) and Shuaibu and Isah (2020) who found significantly positive impact of exchange rate volatility on exports. Further, the control variables in terms of economic growth, industry value addition and inflation percentage have positive impact on exports in the short-term, which are in support of the *a priori* expectations. Specifically, in terms of the magnitudes, a 1 percentage point increase in economic growth and industry value added will result to about 0.403 and 0.337 percentage points rise in exports, respectively, with GDP and industry value added being significant at 1% and 5% conventional levels, while in the case of inflation, a 1 percentage point rise in inflation rate will cause exports to increase by 0.0018 percentage, but statistically insignificant. In addition, the speed of adjustment indicated by error correction term (ECT) has the expected conventional properties; it is statistically significant at the one percentage level, less than one and negative at –0.138 (–0.276) for model one (two). This particularly indicates that approximately 13.8% (27.6%) of the yearly short-run adjustments take place in the long-term steady-state for model one (two).

Next, the long-run results reveal that in model one column (1), exchange rate volatility and exports of goods and services have positive relationship and the relationship is statistically significant at the one percent conventional level. In specific terms, it reveals that one percentage movement in the currency market will result to improvement in the exports of goods and services of these West African economies by around 0.474 percent in the long-term. Further, considering the results of the long-run estimates in model two column (2) with exchange rate volatility and other covariates, on the other hand, we also find that exchange rate volatilities have a positive relationship with the exports of goods and services, and also contrary to the short-run, it is highly significant statistically. Specifically, as the volatility in foreign exchange rate market intensifies by just one percentage point, the exports of goods and services increases by approximately 0.146 percentage points in the long-term period. This, therefore, suggested that in the case of ECOWAS economies, exports of goods and services might eventually be positively influenced by the volatilities in the currency market in the long-run. This supports the theoretical underpinning of Franke (1991). A plausible reason could be that immediately there is an increase in volatility, market participants who usually exhibit risk aversion would instantly restrain or delimit on any high-risk exporting commitments in order to minimize likely losses from commercial activities. Also, the long-term period allows investors and market participants to adjust their inputs and the whole production plans with the aim of maximizing benefits that go with the risky but beneficial in the international exports of goods and services. The findings on the positive relationship between exchange rate volatility and foreign trade exports of goods and services are in line with the theoretical explanations and prior empirical studies such as Senadza and Diaba (2017); Thuy and Thuy (2019); Nguyen and Do (2020). In terms of the other explanatory variables, similar to the short-run results, we also find positive and significant coefficient of the GDP in the long-run. Precisely, a percentage rise in economic growth will cause exports of goods and services to rise by around 0.922 percentage points in the long-term. What this portends is that as a country continues to accumulate its GDP, the more the amount of exporting activities with other countries. The expectation of a positive coefficient for industry value added is confirmed, but it is statistically insignificant at the conventional levels. Lastly, the general price levels proxied by inflation rate however, did not retain its short-run sign (i.e. it now has a negative link with exports of goods and services) and is insignificant at any of the conventional levels. Furthermore, the results for the imports model are displayed in columns (3) and (4) in Table 5 for PMG estimator. These results are

qualitatively similar to those of the exports model. Overall, given that the variations in the foreign exchange market deteriorate foreign trade performance in the short-term, but improve it in the long-term; our results validate the J curve effect in the case of these ECOWAS economies.

Concluding remarks

There have been heated debates within the academia and policy circles on the volatility of FOREX market and the characteristics of its connectedness with foreign trade performance in the past decades. This study investigated the relationship between currency exchange volatility and the level of foreign trade (considering both exports and imports of goods and services) with data from 15 ECOWAS countries. The study contributes to the empirical literature on exchange rate markets and international trade performance by extending the argument to the context of West African states. Employing the panel ARDL model with a PMG estimator, the results revealed that in the short-run, exchange rate volatility has insignificant relationship with both exports and imports (trade performance), whereas it has very high significant influence on both exports and imports of goods and services in the long-term. The sign of the association between foreign trade and exchange rate volatility is negative in the short-run but it turns positive and significant in the long-run for both the exports and imports models. The results signify that while volatilities in the currency markets of the ECOWAS economies appear to contemporaneously exert deteriorating effects on trading activities, the effects become favourable as markets adjust in the long-term. Also, the J curve effect was validated in this study. Moreover, given the adoption of managed or semi-flexible exchange rate systems by majority of developing economies in Africa as part of structural economic transformation, the positive relationship between foreign exchange market volatility and international trade in the long-term appears to be a good omen. The policy implication from the study's findings is that to improve trade performance (exports and imports) and eventual economic growth of ECOWAS economies, it is suggested that a more stable exchange rate be maintained via mediation in the FOREX market. This study is not without some limitation: first, the study investigated only West African countries. Therefore, future studies can extend the analysis by investigating other sub regions in Africa such as Southern African, East Africa and North Africa, and other developing countries. Second, due to unavailability of relevant and higher frequency data for most of the sampled economies, this study employed low frequency data – annual data to compute volatility in exchange rate markets. Hence, future studies should employ higher frequency data as it becomes available.

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