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Exchange Rate Volatility and Its Impact on Nigeria's Exports: An Autoregressive Distributed Lag (ARDL) Analysis

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Abstract: Nigeria's trade volume and value with other countries have increased significantly. According to the Economic Complexity Index (ECI, 2021), Nigeria is ranked the 52nd largest economy in terms of total exports ($57.7 billion) and the 30th largest economy in terms of GDP ($440.83 billion in current US dollars). Nigeria's top five export destinations are Spain, the United States, France, and China. Using the standard demand function, this study examined the effect of exchange rate volatility on Nigeria's exports to the top five export destinations for the period 1995–2020 in an autoregressive distributed lag (ARDL) mode. The empirical results show that exchange rate volatility, gross domestic product, and population are strong determinants of real exports in Nigeria, both in the short and long run. The results further show that the depreciation of the naira tends to increase exports for France and Spain in the short run and for France, India, and Spain in the long run. While it reduces exports for China and the USA in the short run, its impact is insignificant for India in the long run. Relative prices had an adverse effect on exports in most countries, both in the short and long run. Among others, this study recommends that the standard organization of Nigeria, in conjunction with the export promotion council, should synergize and set up a standard itch-free verification system that will ensure that Nigerian goods meant for export are of international quality. More so, monetary authorities should improve the availability of hedging instruments and promote the use of hedging among exporters to support them in coping with exchange-rate uncertainty. Lastly, there is a need for an appropriate pricing template for categories of export products to avoid the deleterious effects of relative prices. This study also recommends that future studies can investigate the asymmetric effects of exchange rate volatility on exports.

Keywords: Trade; Export; Exchange Rate Volatility; ARDL; Gross Domestic Product

JEL Classification: F10; F13; F14; O40

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1. Introduction

The fluctuating nature of currency rates continues to be a key cause of concern for developing countries, particularly following the demise of the Bretton Woods exchange rate system and the adoption of a flexible exchange rate with a concomitant enduring trade deficit. The main cause of concern was the increased volatility of exchange rates, which created risk to trade and its consequent negative impact on imports and exports, which are vital to the development of developing nations. Exchange rate volatility increases uncertainty in international trade because economic agents are unable to foresee the domestic value of foreign transactions to determine whether they should engage in international trade operations. According to Clark (1973), increased exchange rate volatility lowers the volume of international trade and affects profits. Manzur (1993) argues that exchange rate volatility has a significant impact on rent and purchasing power.

Although a significant amount of empirical research has been conducted on the influence of exchange rate volatility on trade, there is still no agreement on this topic. Others have demonstrated that exchange rate volatility is negatively linked with trade (Lin et al., 2018; Vo et al., 2019; Sugihartie et al., 2020), whereas some authors have discovered a favorable association between exchange rate volatility and trade (Hall et al., 2010; Umaru et al., 2013; Kang, 2016). Additionally, several studies indicate that exchange rate volatility has a negligible impact on trade (Baum & Caglayan, 2010; Senadza & Diaba, 2017; Bajo-Rubio et al., 2019). In the short and long terms, exchange rates are thought to behave differently. According to Krugman and Obstfeld's 2003 theory, exchange rates can change in response to monetary policies, political developments, and changes in both current and future expectations. Exchange rates are thought to be volatile in the short term. Gärtner (1993) suggested that the long-term volatility of exchange rates is greater than the factors that affect them. Although significant empirical research on exchange rate volatility and trade has been conducted in Nigeria (Onafowora & Owoye, 2008; Odili, 2015; Yakub et al., 2019), the majority of these studies concentrated on exchange rate volatility and trade flow, exchange rate volatility, and Nigeria's imports, while others have attempted to examine its effects on exports but did so at the sectoral or product category level, and only a small number of studies have examined its effects. Therefore, in light of the above, it was deemed necessary for this study to contribute to the growing body of literature by examining how exchange rates affect Nigeria's exports. This study seeks to determine whether there is a significant relationship between exchange rate volatility, the real effective exchange rate, GDP, population, and Nigeria's exports to its top five export trading partners.

2. Review of Related Literature

2.1. Profile of Nigeria's International Trade (1995-2020)

By engaging in trade that includes both imports and exports, a nation can improve its internal output and consumption while generating income from the rest of the world in the form of revenue. Nigeria's international trade has grown dramatically over the past few decades. The value of all trades had an erratic pattern, as depicted in Figure 2.1. From $17.41 billion in 1995 to 138.49 billion in 2008, it increased steadily until falling to $106.38 billion in 2009 and then rose again to $156.58 and $215.78 in 2010 and 2011, respectively. In 2012, 2014, and 2015, it fell to $202.85, $157.94, and $168.84 billion, before dropping to an all-time low of $83.85 billion in 2016. This erratic pattern in the trend continued; the total trade value increased to $99.0, $131.10, and $152.47 billion in 2017, 2018, and 2019, but dropped to $90.36 billion in 2020.

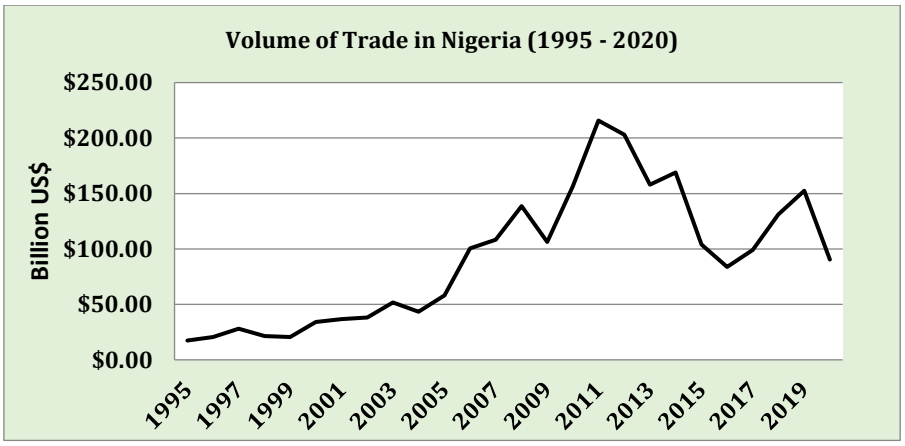

Figure 2.1. Nigeria's Total Trade value (1995 – 2020)
Source: World Integrated Trade Solution (WITS) Data

From $17.41 billion in 1995 to $90.36 billion in 2020, the value of all trade increased dramatically, amounting to a 419% rise in trade throughout that time. Nigeria had the lowest overall trade value (19.41 billion dollars) in 1995, and the highest (215.78 billion dollars) in 2011. Between 1995 and 2020, export trade increased by 228%, from $10.64 billion to $34.90 billion, while imports increased by 719%, from $6.77 billion to $55.46 billion. It is clear from the following that Nigeria imports 3.15 times as much as it exports. Figure 2.2 shows that the total export value peaked in 2012 at $143.70 billion but then fell to $51.92, $37.30, $49.49, and $61.51 billion in 2015, 2016, 2017, and 2018, respectively, as a result of the sharp decline in oil prices that followed the global economic crisis of 2016–17, which had a negative impact on the revenue from oil exports as well as the slow growth in the non-oil sector, which was largely caused by high production costs. Despite this, the value of export trade was

$1,347.73, representing 56.57% of the total external trade value at the time, showing that Nigeria's economy is export-driven. The total trade value for 1995–2020 was $2,386.78 billion.

Figure 2.2. Nigeria's Export Trade Value (1995 – 2020)
Source: World Integrated Trade Solution (WITS) Data

The export-GDP ratio, as depicted in Figure 2.3, exhibits an irregular pattern; it contributed marginally more, from 10.64% in 1995 to 25.02% in 2000, and decreased to 22.17% in 2002. It continued to oscillate until 2006 and then maintained a downward oscillating pattern until 2016, when it reached 9.22% and further decreased to 8.83% in 2020. It is important to note that the export-GDP ratio was highest in 2000, at 36.02%, approximately one year after the return to democratic rule.

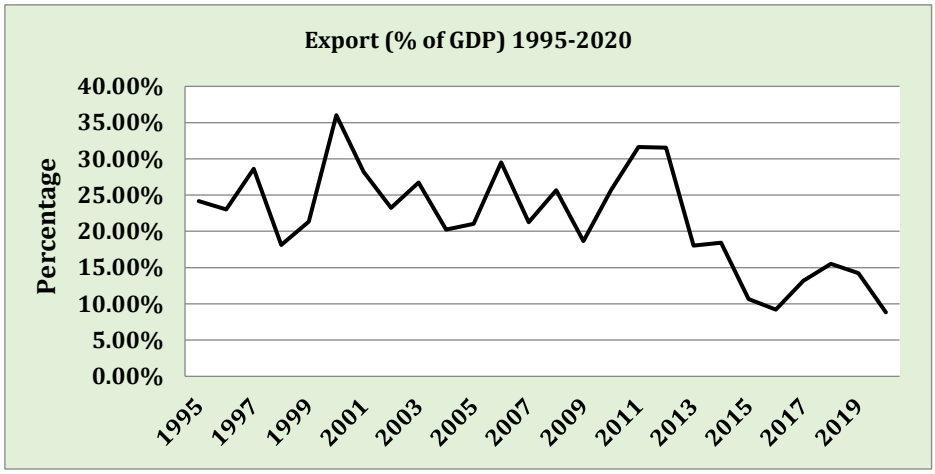

Figure 2.3. Nigeria's Export-GDP Ratio (1995 – 2020)
Source: World Integrated Trade Solution (WITS) Data

2.2. Exchange Rate Volatility and Trade

One of the issues in this discussion is the trade effect of exchange rate volatility. Proponents of fixed exchange rates have long argued that the risks associated with exchange rate volatility discourage economic agents from engaging in cross-border trading. Opponents have maintained that there are useful instruments to hedge against exchange rate volatility, and hence, the effect should be immaterial. Several studies discuss the relationship between exchange rate volatility and international trade. The underlying premise is that increasing exchange rate uncertainty may result in a drop in trade volume because countries may not want to risk their expected trade benefits if they are risk-averse (or even risk-neutral). Indirectly, due to its impact on the structure of output, investment, and governmental policy, exchange rate volatility can also have an impact on international trade (Brodsky, 1984).

In terms of the impact of exchange rate depreciation on exports, different schools of thought hold divergent views. The traditional school of thought believes that depreciation of a country's currency reduces export prices and increases the volume of exports. The structuralist school of thought opined that the depreciation of a currency from an initial trade deficit reduces national income as well as export demand by its importers (Hirschman, 1949). Currency depreciation was also viewed from a dual perspective: export price reduction on the one hand and increasing import prices (Kandil & Mirzaie, 2002).

Exchange rates behave differently over the short and long terms. Exchange rates are extremely volatile in the short term and can change in response to monetary policies, political events, and shifts in both present and future expectations (Krugman and Obstfeld, 2003). By contrast, according to Gärtner (1993), exchange rates are more volatile over the long term than the factors that influence them. Furthermore, according to Samuelson and Nordhaus (2001), in the long term, exchange rates are influenced by the relative costs of commodities in various nations. Divergent schools of thought hold opposing opinions regarding the effect of exchange rate depreciation on exports. According to traditional view, a country's currency devaluation lowers export prices and raises export volumes. According to the structuralist school of thought, a currency's depreciation following an initial trade deficit lowers both the country's income and the demand for exports from its importers (Hirschman, 1949). Additionally, the dual effects of currency depreciation were considered: decreasing export prices and rising import prices (Kandil & Mirzaie, 2002).

2.3. Empirical Literature

According to the empirical literature, exchange rate volatility can have either a beneficial or negative impact on trade. In contrast to the positive effect, which increases the value of exports and decreases the volume of imports into the country,

increasing volatility is anticipated to increase the level of risk assumed by an exporter, which reduces the volume of exports and increases the volume of a country's imports. According to Samuelson and Nordhaus (2001), depreciation of the home currency encourages the creation of exports and import substitutes, which raises domestic prices. Depreciation also contributes to inflation because export prices and import substitutes are both included in the nation's general price index. The more the economy experiences higher inflation the more a currency depreciates, and there will be a change in production resources as a result of the increase in domestic prices for exports and import alternatives. Since higher foreign revenue translates into higher foreign demand for both foreign and domestic goods, exports are likewise reliant on foreign income. Consequently, increased exports result from increased foreign income (Krugman & Obstfeld, 2003). The research of Sugiharti et al. (2020), Bahmani-Oskooee and Gelan (2018), who discovered that an increase in exchange rate volatility reduces exports, and Chi & Cheng (2016), who discovered that an increase in the volume of exports is caused by a decrease in exchange rate volatility, provide evidence for this. According to Doganlar (2002), there may be a decrease in trade during times of high volatility due to the high transaction costs incurred by businesses as a result of exchange rate swings.

Yakub et al., (2019), found that exchange rate volatility is negatively related to trade flow in the short-run and positively related to trade flow in the long run. Onafowora and Owoye (2008) showed that exchange rate volatility has a significant effect on exports both in the long and short run. The volatility of Nigerian Naira was found to be negatively related to export volume, while the volatility of the US dollar was positively associated with exports in Nigeria (Aliyu, 2010). Yunusa, (2020), examined the effect of exchange rate volatility on Nigerian crude oil export to its trading partners (UK, USA, Italy, France, Spain, Canada and Brazil) using ARDL. The ARDL result indicates that the exchange rate volatility of Nigeria's trading partners was statistically significant for all of them, suggesting that the exchange rate volatility between Nigeria and its trading partners is crucial in determining the volume of crude oil exports made by Nigeria to its trading partner. Havi (2019) evaluated how changes in the real exchange rate affected Ghana's export and import growth using monthly data. The empirical study showed that the main drivers of export growth over the long term were output growth, real exchange rate depreciation, and greater volatility.

The effects of real exchange rate volatility and the pace of economic growth on Nigeria's exports and imports over the long and short terms were examined by Odili (2015). The findings indicate that exports and imports were impacted by real exchange rates, exchange rate volatility, foreign income, gross domestic product, terms of trade, and changes in exchange rate policy both in the short and long term. Using the Granger causality test and the ARDL bounds testing approach, Yakub et al.'s (2019) investigation into the effect of exchange rate volatility on trade flow in

Nigeria found that the impact was detrimental in the short term but not in the long term. Carmen and Nicolae (2011) investigated the effects of exchange rates on Romania's export. It was found that exports were significantly affected by a sudden shift in exchange rates. Using annual data, Muhammed (2014) investigated the impact of Pakistan's exchange rate fluctuations on GDP, imports, exports, trade balances, and foreign exchange reserves from 1952 to 2010. The analysis employed the correlation removal approach, multicollinearity detection, and the Granger causality test. This outcome demonstrates that a declining exchange rate benefits exports.

3.1. Model Specification and Estimation

To examine the impact of exchange rate volatility on Nigeria's exports to its major export trading partners, this study estimated the standard demand model comprising consumers' income (or GDP) and relative price, which has been used in many previous studies (Doğanlar, 2002; Fitrianti, 2017; Bahmani-Oskooee & Aftab, 2017; Vo et al., 2019 and Thuy & Thuy, 2019), augmented by an exchange rate volatility variable, real effective exchange rate, and population specified as follows:

$$lnEXP_{it} = \beta_0 + \beta_1 lnGDP_{it} + \beta_2 lnPOP_{it} + \beta_3 lnREER_t + \beta_4 lnExvol_{it} + \beta_5 lnRel\_Price_{it} + \varepsilon_{it} \quad (3.1)$$

where EXP_{it} is the export volume to country i at time t; GDP_{it} is country i's income proxied by gross domestic product at time t; POP_{it} is country i's population at time t; REER is the real effective exchange rate of the host country at time t; $Exvol_{it}$ is the volatility of the real effective exchange rate against country I at time t; Rel_Price is the relative price between host and partner country i at time t; and ln is the natural log. According to international trade theory, an increase in trading partner's income and population stimulates exports; thus, the signs of β_1 and β_2 are expected to be positive. β_3 can take a positive sign for the real effective exchange rate if the Nigerian naira depreciates, leading to higher exports. However, β_3 could be negative if the naira appreciates, leading to a decrease in exports. The relationship between exchange rate volatility and export volume is ambiguous; thus, it is expected that β_4 could either be positive or negative, and finally, any increase in relative prices is predicted to discourage exports; hence, the sign of β_5 is expected to be negative.

This study used the autoregressive distributed lag (ARDL) model to analyze the effect of exchange rate volatility on Nigeria's export performance. The Wald or F-statistic in a generalised Dickey-Fuller type regression, which is used to test the significance of the variables under consideration in a conditional unconstrained equilibrium correction model, serves as the procedure's underlying statistic (UECM). The ARDL method has a number of benefits over conventional methods. First, it provides valid results of the cointegration test on whether the underlying

series are I(1), I(0), or a combination of both. Second, the test is reliable in cases involving structural breaks. Third, it can be used for small sample sizes, which typically occur in developing countries. To use the ARDL bounds test cointegration approach, we must ensure that the stationarity of all variables is not I(2). Stationarity is checked using the augmented Dickey-Fuller unit root test. The bounds test approach basically consists of two parts. The first stage is to look into whether there is a long-term relationship between the variables that are included. Following Pesaran et al. (2001), the ARDL bound test is employed to specify equation (3.1) as an error correction model (ECM) in equation (3.2):

$$\Delta lnEXPi_t = \alpha_0 + \sum_{j=1}^{a} \alpha_1 \Delta lnEXP_{t-j} + \sum_{j=1}^{b} \alpha_2 \Delta lnGDP_{t-j} + \sum_{j=1}^{c} \alpha_3 \Delta lnPOP_{t-j} + \sum_{j=1}^{d} \alpha_4 \Delta lnREER_{t-j} + \sum_{j}^{e} \alpha_5 \Delta EXVOL_{t-j} + \sum_{j=1}^{f} \alpha_6 \Delta lnREL_{PRICE}{}_{t-j} + \lambda_1 lnEXP_{t-1} + \lambda_2 lnGDP_{t-1} + \lambda_3 lnPOP_{t-1} + \lambda_4 lnREER_{t-1} + \lambda_5 EXVOL_{t-1} + \lambda_2 lnRel\_Price + \varepsilon_{it} \quad (3.2)$$

Where all variables are as previously defined; Δ is the first difference operator, α_1-α_6 indicates the short-run coefficients while $\lambda_1 - \lambda_6$ captures the long-run effects and ε is the white noise. Optimal lag length (*a, b, c, d, e, f, g, h)* of the ARDL model is selected based on the Akaike Information Criterion (AIC). To validate the effect of long-run relation in the equation, we use the bound test and apply the F test to verify the presence of cointegration. This is carried out via the exclusion of the lagged level variables in the above equation. It follows then that the test for the absence of any level relationship between variables entails the test of the null hypothesis (H_0: $\lambda_1 = \lambda_2 = \lambda_3 = \lambda_4 = \lambda_5 = \lambda_6 = 0$) against the alternative (H_0: $\lambda_1 \neq \lambda_2 \neq \lambda_3 \neq \lambda_4 \neq \lambda_5 \neq \lambda_6 = 0$). The computed F-statistic was then compared with the two sets of critical values provided by Pesaran et al. (2001). One set assumes that all variables are I(0) and the other assumes that they are I(1). The null hypothesis of no cointegration is rejected if the estimated F-statistic is greater than the upper critical value. The null hypothesis of no cointegration cannot be ruled out if it is lower than the lower bound. Although if it is within the parameters, the test results are not definitive. The robustness of the models was then assessed using stability tests and diagnostic tests on the residuals.

In various research, many sorts of factors have been employed to forecast exchange rate volatility. This analysis used real effective exchange rate volatility, which was derived by estimating the generalized autoregressive conditional heteroscedasticity (GARCH) model as initially described by Bollerslev (1986), utilizing returns on the real monthly exchange rate, as in Havi's (2019) research. Peride (2003) found that utilizing GARCH modeling to estimate the proxy for exchange rate volatility yielded

a more statistically significant result in the study that looked at the analysis of panel data for international trade.

3.2. Nature, Description and Sources of Data

This study used a secondary time series dataset of annual observations on a sample of top-five export trading partners of Nigeria for a period of 26 years (1995–2020) in order to accomplish its research goals. Secondary data on Nigeria's trading partners were collected annually, and the countries included were: China, France, India, Spain, and the United States.

Table 3.1. Variable Sources

S/N	Variables	Source
1	Export Value	IMF, Directory of Trade Statistics
2	Gross Domestic Product	World Bank, World Development Indicators (WDI) online database.
3	Population	The UN Population Division, World Population Prospects, 2017 via the World Bank, World Development Indicators online database.
4	Real Effective Exchange Rate	Data on Nigeria's real effective exchange rates was obtained from the Central Bank of Nigeria Statistical Bulletin 2021.
5	Exchange Rate Volatility	We obtained the exchange rate volatility using the GARCH (1,1)
6	Relative Price	World Bank, World Development Indicators (WDI) online database

Source: Author's Compilation

4. Presentation and Discussion of Results

The results of the Autoregressive Distributed-Lag (ARDL) estimations and other test statistics are examined in this section. The regression generally runs over the period of 1995-2020.

4.1. Unit Root Result:

The variables are assumed to be either I(0) or I(1) in the bounds test. To make sure that none of the variables are I(2) or above, unit root tests must still be used in the ARDL performed. In view of this, the level of stationarity of each variable is examined using the Augmented Dickey-Fuller (ADF) unit root test based on the Akaike Info Criterion maximum lag set at 5. All the variables are in natural log, except the real effective exchange rate volatility index (Exvol). The test results show that there are a variety of integration orders, and no variable is I(2), according to the

test statistics in Table 4.1. As a result, the cointegration between the variables can be assessed using the ARDL bounds test.

Table 4.1. Summary of Unit Root Test Results

Variables	Level	1st Difference	Conclusion
Trading Partner: China			
lnEXP	-2.157285	-4.828007***	*I(1)*
lnGDP	-1.976213**		*I(0)*
lnPOP	-3.402382*		*I(0)*
lnREER	-41.52311***		*I(0)*
EXVOL	-3.212114**		*I(0)*
lnRel_Price	-1.84285	-3.204014**	*I(1)*
Trading Partner: France			
lnEXP	1.941166	-4.501211***	*I(1)*
lnGDP	-1.211137	3.539478***	*I(1)*
lnPOP	12.42286***		*I(0)*
lnREER	-41.52311***		*I(0)*
EXVOL	-3.212114**		*I(0)*
lnRel_Price	-1.023090	-3.386415**	*I(1)*
Trading Partner: India			
lnEXP	-2.192574	-5.567444***	*I(1)*
lnGDP	-0.88815	-3.651657***	*I(1)*
lnPOP	-2.857580*		*I(0)*
lnREER	-41.52311***		*I(0)*
EXVOL	-3.212114**		*I(0)*
lnRel_Price	-0.265805	-4.461421***	*I(1)*
Trading Partner: Spain			
lnEXP	-1.972458	-5.357177***	*I(1)*
lnGDP	-1.460808	-2.962138**	*I(1)*
lnPOP	-2.419305	-2.753342*	*I(1)*
lnREER	-41.52311***		*I(0)*
EXVOL	-3.212114**		*I(0)*
lnRel_Price	-0.536771	6.167470***	*I(1)*
Trading Partner: USA			
lnEXP	-0.884307	-3.51170***	*I(1)*
lnGDP	-2.324641	-3.331677*	*I(1)*
lnPOP	-2.208598**		*I(0)*
lnREER	-41.52311***		*I(0)*
EXVOL	-3.212114**		*I(0)*
lnRel_Price	-0.237985	-3.672107	*I(1)*

****, **, * indicates statistical significance at 1%, 5% and 10% respectively.*
Source: Author's computation (using Eviews)

4.2. ARDL Bounds Testing for Long-Run Cointegration

The following ARDL models were chosen for China (1,0,0,0,2,0); France (1,0,1,2,1,1); India (1,2,2,2,1,1); Spain (1,2,0,2,1,1); and the United States (1,2,0,2,1,1). (1,1,0,0,0,0). The requirement that the errors of Equation (3.2) be serially independent is a fundamental tenet of Pesaran et al. (2001)'s Bounds Testing approach. The outcome shows that, at the 1% level of significance, we cannot rule out the null hypothesis, hence the chosen model is appropriate for testing the cointegration connection between the variables. We utilise the critical value bounds provided by Narayan due to the small sample size (2005). The result of bounds testing is shown in Table 4.2.

Table 4.2. Bounds Test Results for Cointegration Relationship

Critical bounds value of the *F-statistics*

K	***1% level***		***2.5% level***		***5% level***		***10% level***	
	I(0)	**I(1)**	**I(0)**	**I(1)**	**I(0)**	**I(1)**	**I(0)**	**I(1)**
5[PS]	3.41	4.64	2.98	4.18	2.62	3.79	2.26	3.35
Calculated F-statistics:			**China**	**France**	**India**	**Spain**	**USA**	
			5.69	6.88	4.98	20.47	1.16	

Pesaran, et al (2001:300), Table CI (iii), Case III: Unrestricted intercept and no trend.
Source: Author's computation (using Eviews)

The result of the F-statistics of 5.69 for China, 6.88 for France, 4.98 for India, and 20.47 for Spain exceeds the upper bound of the critical value of α = 1%. As a result, the null hypothesis that there is no long-term link between the variables under examination is rejected. In other words, there is a long-term relationship between the variables. So, we evaluated the long-run and short-run models. However, in the context of the USA, the F-statistic of 1.16 is less than the critical value's lower bound of = 10%. Therefore, it is not possible to rule out the null hypothesis that there is no long-term association between the examined variables. As a result, only the short-run model was estimated for the USA because we came to the conclusion that there is no long-run association among the variables.

4.3. Estimated ARDL Model Result

Tables 4.3a and 4.3b, as well as 4.4a and 4.4b, give the findings of the estimated short-run and long-run associations between the variables based on the chosen ARDL models. To be precise, only the short-run model was estimated for export trade between Nigeria and the United States of America because the results of the bounds indicated that cointegration was not evident.

Table 4.3a. Estimated Short-Run Coefficients for the Selected ARDL Model

Variables	China	France	India
Δ(lnEXP(-1))	0.5310*** (0.1833)	0.051 (0.183)	-0.241 (0.237)
Δ(lnGDP)	1.3536 (1.401)	2.322*** (0.774)	0.584 (3.029)
Δ(lnGDP(-1))			12.603* (6.477)
Δ(lnGDP(-2))			
Δ(lnPOP)	-100.78 (77.624)	-28.051 (31.905)	-43.559 (79.559)
Δ(lnPOP(-1)		-6.520*** (2.290)	0.187 (0.928)
Δ(lnREER)	-1.0116* (0.587)	2.259*** (0.824)	1.186 (1.139)
Δ(lnREER(-1))		-0.503** (0.210)	0.117 (0.315)
Δ(lnREL_PRICE)		-20.779** (8.080)	-9.809 (8.356)
Δ(lnREL_PRICE(-1))		-16.725* (9.045)	0.283 (10.429)
Δ(lnREL_PRICE(-2))	19.3093* (9.860)		
Δ(EXVOL)	-237.79* (128.922)	-725.69** (273.54)	-443.09 (394.84)
ECT(-1)	-1.436*** (0.311)	-0.673* (0.348)	-0.184 (0.468)

Table 4.3b. Estimated Short-Run Coefficients for the Selected ARDL Model

Variables	Spain	USA
□(lnEXP(-1))	-0.020 (0.078)	0.806 (0.482)
□(lnGDP)	-2.829* (1.381)	15.079** (6.352)
□(lnGDP(-1))		-18.380* (10.447)
□(lnGDP(-2))	-4.416** (1.562)	
□(lnPOP)	20.442*** (4.401)	13.746 (55.750)
□(lnPOP(-1)		
□(lnREER)	2.513*** (0.351)	-1.2203** (0.573)
□(lnREER(-1))	-2.793*** (0.241)	
□(lnREL_PRICE)	-22.695*** (3.260)	2.164 (17.483)
□(lnREL_PRICE(-1))	-22.258*** (3.078)	
□(lnREL_PRICE(-2))		
□(EXVOL)	-774.94*** (88.837)	307.15** (132.22)
ECT(-1)	-1.776*** (0.209)	-0.680 (0.525)

Standard errors are in parentheses; ***, **, and * indicate 1%, 5%, and 10% level of statistical significance, respectively;

Source: Author's Computation (using Eviews)

Table 4.4a. Estimated Long-Run Coefficients for the Selected ARDL Model

Variables	China	France
lnEXP(-1)	0.1551 (0.195)	0.1800 (0.189)
lnGDP	2.0808** (0.937)	1.3482* (0.741)
lnGDP(-1)		
lnGDP(-2)		
lnPOP	-148.58*** (56.683)	63.8204*** (18.150)

lnPOP(-1)		-28.018*** (7.618)
lnREER	-1.779*** (0.568)	2.322*** (0.768)
lnREER(-1)		-2.470*** (0.699)
lnREL_PRICE		-23.466*** (8.088)
lnREL_PRICE(-1)		17.599** (8.222)
lnREL_PRICE(-2)	22.206** (9.269)	
EXVOL	-33.5452 (135.62)	-775.30*** (263.97)

Table 4.4a: Estimated Long-Run Coefficients for the Selected ARDL Model

Variables	India	Spain
lnEXP(-1)	0.247 (0.213)	-0.238 (0.205)
lnGDP	1.437 (2.353)	-3.531 (2.896)
lnGDP(-1)	-5.215** (2.111)	3.085 (4.722)
lnGDP(-2)		-4.614 (3.515)
lnPOP	36.625** (14.967)	20.724*** (5.094)
lnPOP(-1)	-9.534*** (2.668)	
lnREER	2.832*** (1.012)	2.416** (0.936)
lnREER(-1)	-3.070*** (0.888)	-2.444*** (0.472)
lnREL_PRICE	-19.118** (8.906)	-20.828*** (5.183)
lnREL_PRICE(-1)	17.305** (7.980)	20.668*** (5.558)
lnREL_PRICE(-2)		
EXVOL	-1081.17*** (330.10)	-633.77*** (166.30)

Standard errors are in parentheses; ***, **, and * indicate 1%, 5%, and 10% level of statistical significance, respectively;

Source: Author's computation (using Eviews)

Table 4.5. Diagnostic Statistics

Partner Country	F-statistics	R^2	LM-test	DW-statistics
China	47.94***	0.9544	0.2382	1.968
France	21.05***	0.9376	0.5184	1.806
India	36.38***	0.9629	0.1587	2.369
Spain	31.12***	0.9739	0.0054	3.014
USA	2.16*	0.5353	0.6125	1.823

4.3.1. Analysis for China

Tables 4.3 and 4.4 display the findings of the short-run and long-run coefficients, respectively. Only at the 1% level did the first lag of the dependent variable (lnEXP) have a positive, statistically significant short-run effect on export. The short-run elasticity of lnEXP(-1) was 0.53%, which means that a 1% increase in exports from the previous year improves current exports to China by 0.53% in the short run. GDP had no short - term influence on exports, but in the long run, as was theoretically predicted, it had a positive and statistically significant impact on exports at the 5% level of significance. According to the predicted long-run GDP coefficients, a rise in

China's GDP would result in a long-term increase of 2.08 percent in Nigeria's exports. In the long run, the population's coefficient was statistically significant at the 1% level, but it was not appropriately signed as expected. In the short run, it was not statistically significant. Over time, China's imports from Nigeria will decrease by 148.58 percent for every 1 percent growth in population. A corresponding rise in population will result in a more than proportionate increase or drop in exports, according to this result, which shows that China's exports are very elastic in relation to population.

Economic theory states that the real effective exchange rate's coefficient could either be positive or negative. Nigeria's exports are negatively impacted both in the short and long terms by the real effective exchange rate. This suggests that a decrease of Nigerian exports to China results from the naira's depreciation against the dollar. Contrary to a priori predictions, the short-run and long-run coefficients of relative price were positive and statistically significant at the 5% and 1% levels, respectively. This shows that as the relative price between Nigerian and foreign goods increases, Nigerian goods become more affordable, which increases demand for exports. Both in the short term and the long term, the predicted exchange rate volatility coefficient had a negative sign. But only in the short term did it have a 10 percent significant effect on real exports. Nigeria's exports are decreased by around 237.79% for every one percent increase in exchange rate volatility due to the country's elasticity of -237.79%. This result is consistent with the risk-averse exporters' behavioural theories proposed by Clark (1973). By increasing adjustment costs, such as irreversible investment, as a result of increased uncertainty and risk, higher exchange rate volatility will reduce export volume, assert Arize and Malindretos (1998). The error correction component's coefficient, ect(-1), is appropriately signed and statistically significant at the 1% level of significance. It suggests that a system for error correction is in place so that the departure from long-run equilibrium has a sizable impact on Nigeria's exports to China. Real export (lnEXP) disequilibria brought on by the shock of the previous year are anticipated to recover to the long-run equilibrium in the current period by roughly 1.43 percent.

In Table 4.5, the diagnostic statistics were shown. The R-square value was quite high, meaning that the explanatory variables account for 95.44 percent of the systematic variation in the model. At the 1% level of significance, the F-statistic value of 47.94 was statistically significant. We draw the conclusion that our model exhibits goodness of fit and that the explanatory variables are collectively relevant in explaining Nigeria's export demand. The LM test reveals that there is no serial correlation between the residuals, with a chi-square of 0.2382 and a Durbin-Watson value of 1.968.

4.3.2. Analysis for France

The first lag of the dependent variable (lnEXP), as shown in tables 4.3 and 4.4, was not statistically significant in either the short-run or the long-run in explaining the change in current export. The GDP coefficient had a statistically significant effect on exports in the short and long runs at 1% and 10% levels of significance, respectively, and was appropriately signed as would be expected theoretically. According to the predicted GDP coefficients, a rise in France's GDP will result in a short-term increase in Nigerian exports of 0.77 percent and a long-term increase of 1.34 percent. In contrast to a priori expectations, the estimated population coefficient significantly reduced exports over the short term; but, over the long term, it correctly signed as expected and reached statistical significance at the 1% level. For every 1% increase in France's population, Nigeria's exports will rise by 63.82%. This outcome also demonstrates that Nigeria's exports to France are significantly influenced by the population of France.

In both the short- and long-term, the coefficient of the real effective exchange rate showed inconsistent performance. This suggests that a depreciation of the naira tends to improve exports (as expected) as real prices declined. Additionally, it demonstrates that its effect on exports was both positive and statistically significant over the short- and long-term. Furthermore, the real effective exchange rate has a negative short- and long-term impact on Nigeria's exports at first lag. This suggests that a weakening of Nigerian exports to China results from the naira's depreciation against the dollar. The short-run and long-run coefficients of relative price at the 10% and 5% levels, respectively, were negative and statistically significant, as predicted a priori. This implies that Nigerian items become increasingly costlier as the relative cost of Nigerian and foreign goods increases. In turn, this will result in a decline in export demand. Both in the short- and long-term, the estimated exchange rate volatility had a negative sign, and its effects on real exports were statistically significant at 5% and 1%, respectively. The short-run and long-run coefficients of -725.69 and -775.30 correspondingly show that a one percent rise in exchange rate volatility reduces Nigeria's real exports by 725.69 and 775.30 percent, respectively. This result is consistent with Clark's theoretical models of the behaviour of risk-averse exporters (1973). Increased exchange rate volatility, according to Arize and Malindretos (1998), will result in higher adjustment costs, such as irreversible investment, as a result of elevated uncertainty and risk.

At the 10% level of significance, the coefficient of the error-correction term ect(-1) is correctly signed and statistically significant, indicating the existence of an error-correction mechanism that makes the divergence from long-run equilibrium significantly affect Nigeria's exports to China. The result of -0.673 indicates that the real export shock disequilibria in the current period will return to the long-run equilibrium at an adjustment speed of 0.67 percent. Table 4.5 presents the diagnostic

statistics, and the coefficient of determination (R^2) was determined to be high, with a value of 0.9376, indicating that only 93.76 percent of the model's systematic variation is explained by the regressors that are included. The F-statistic, with a value of 21.05, was significant at the 1% level, demonstrating that our model has good fit and that the explanatory variables are jointly significant in explaining trade flow in Nigeria. The LM test with a chi-square of 0.5184 and Durbin-Watson statistics of 1.806 demonstrates that there is no serial correlation between the residuals in this case.

4.3.3. Analysis for India

According to tables 4.3 and 4.4, the first lag of the dependent variable (lnEXP) was not statistically significant in either the short-run or the long-run for explaining the change in current export. While the GDP coefficient was correctly signed in the short run, as predicted by theory, and statistically significant at the 10% level, its impact on real export in the long run was contradictory to economic theory and statistically significant at the 5% level. Nigeria's export will increase by 12.6% in the near term as India's GDP rises, but in the long run, actual export would decrease by 5.2 percent. This shows that over time, India's GDP has a significant detrimental effect on the actual exports of the nation. This result agrees with that of Thuy & Thuy (2019), who found a short-term inverse relationship between Vietnam's real export and the income of its trading partners. In line with Engel's (1857) theory that the demand for necessities declines as income rises, this unfavourable correlation may be caused by the fact that the majority of agricultural and mineral products are exported in their unprocessed or minimally processed states. As a result, an increase in real foreign income may result in a decrease in the expenditure on Nigerian goods.

The population coefficient was not significant in the short run, but it was significant at the 1% level with an elasticity of 36.62 percent in the long run, as expected. According to model expectations, the real effective exchange rate's coefficient only has a long-term favourable effect on real exports. This suggests that, when actual prices decline, a depreciation of the naira tends to enhance exports (as expected). The coefficient of relative pricing was negative over the long run and significant at the 1% level, contrary to what was predicted theoretically, but had no short-term impact on exports. This implies that a decrease in export demand is brought on by an increase in relative pricing that make Nigerian goods relatively expensive. Real exports were negatively impacted only in the long-term by exchange rate volatility. Nigeria's exports are reduced by approximately 1,081.79 percent for every one percent rise in exchange rate volatility. This illustrates the scenario of risk-averse exports and suggests that currency rate fluctuation has a very significant negative impact on Nigeria's exports to India. The empirical findings showed that the error correction term is statistically insignificant despite having the correct sign (negative).

This suggests long-run equilibrium convergence and a lack of an error correction mechanism.

According to the diagnostic statistics presented in Table 4.5, the R-square value was determined to be high, meaning that the explanatory variables account for 96.29 percent of the systematic variation in the model. The F-statistic had a value of 36.38, which at the 1% level of significance was significant. We draw the conclusion that our model exhibits goodness of fit and that the explanatory variables are collectively relevant in explaining Nigeria's export demand. There is no serial correlation between the residuals, according to the LM test, which has a chi-square of 0.1587. Additionally, Durbin-Watson statistics of 2.369 corroborated this.

4.3.4. Analysis for Spain

according to tables 4.3 and 4.4 In terms of explaining the variation in current export, the first lag of the dependent variable (lnEXP) was not statistically significant either in the short-run or the long-run. Real exports are only adversely affected in the short term by GDP. According to the predicted GDP coefficients, a rise in Spain's GDP will result in a short-term decrease in Nigerian exports of 2.82 percent. This finding is in line with that of India, where it was found that GDP had a long-term negative impact on real exports, as well as Thuy & Thuy's (2019) finding that shows that there was a short-term inverse link between Vietnam's real exports and its trading partners' income. According to a priori predictions, it was discovered that the population was positively and significantly associated to exports at a 1% significant level in both the short- and long-term. For every 1% rise in population in Spain, real exports are expected to increase by 20.44% in the short term and 20.72% in the long run. The real effective exchange rate has positive and statistically significant effects on exports both in the short and long terms, indicating that a depreciation of the naira tends to increase exports as real prices fall. Exports will increase by 2.5 percent in the short term and by 2.4 percent in the long run as real effective exchange rates rise.

In accordance to the a priori assumptions, the short-run and long-run coefficients of relative price were both negative and statistically significant at 1%. This means that if relative prices rise, Nigerian goods will become relatively expensive, which will lower demand for exports. Similar to the majority of the partner nations under study, the estimated coefficient of exchange rate volatility was negatively signed both in

The short-run and long-run coefficients of relative price were both negative and statistically significant at 1%. Accordingly, if relative prices increase, Nigerian goods will become relatively more expensive, which will reduce the demand for exports. The estimated coefficient of exchange rate volatility was estimated to be negatively signed both in the short and long term, and its impact on real exports was statistically significant at the 1% level of significance, similar to the majority of the partner countries under study. short and long-term and its effect on real exports was statistically significant at the 1% level of significance. A one percent rise in exchange

rate volatility results in a decline in Nigeria's real exports of 774.94 percent in the short run and 633.77 percent in the long run respectively. The co-integration relationships between the model's variables were further supported by the fact that the error correction term's coefficient, ect(-1), was correctly signed and statistically significant at the 1% level of significance. This finding suggests that an error correction process exists. The estimated value of the error correction factor in the export equation, which is 1.77 percent, implies the speed of adjustment to the long-run equilibrium in response to the disequilibrium caused by short-run shocks in the preceding period.

Table 4.5 presents the diagnostic data. The coefficient of determination (R2) was found to be quite high, indicating that only 97.39 percent of the systematic variance in the model is explained by the included regressors. The explanatory variables are jointly significant in explaining trade flow in Nigeria, and our model offers goodness of fit, according to the F-statistic, which had a value of 31.12 and was significant at the 1% level. The Durbin-Watson statistics of 1.806, which demonstrate the absence of serial correlation between the residuals, are incompatible with the LM test's chi-square of 0.0054, which demonstrates the presence of serial correlation among the residuals.

4.3.5. Analysis for USA

Our study for the USA was based on the short-run parameters listed in Table 4.3 since the bounds test for long-run cointegration was unable to prove the existence of a long-run relationship in the case of the USA. The obtained coefficients showed that the population, relative price, and the dependent variable's first lag lnEXP(-1) were not statistically significant in explaining the change in real exports for our model over the research period. However, the GDP coefficient was correctly signed and significant at the 5% level, showing that a rise in American income will, in the short term, boost Nigeria's export demand. Population and relative pricing had no impact on exports to the USA during the study period. The real effective exchange rate has a negative impact on real exports, showing that as the value of the real effective exchange rate (the naira) rises, the relative cost of Nigeria's export goods to the USA rises, which lowers demand for those goods abroad. The exchange rate volatility term's coefficient was significant at the 5 percent level and showed a positive influence on real exports, suggesting that export volume will rise in the short term if exchange rate volatility rises. This finding is probably connected to the income effect in the De Grauwe (1988) model, which contends that this effect encourages risk-averse enterprises to increase export performance in order to prevent sharp drops in revenue. In order to retain their trading worth, exporters in this category might therefore pursue a strategy of increasing their exports.

Based on the diagnostic statistics shown in Table 4.5, the R-square value shows that the explanatory variables account for 53.53 percent of the systematic variation in the

model. The F-statistic had a value of 2.16, which was significant at the 10% level. As a result, we can draw the conclusion that the explanatory factors are mutually significant in explaining export demand in Nigeria and that our model has a good fit. The absence of serial correlation between the residuals is demonstrated by the LM test with a chi-square of 0.6125. Additionally, supporting this was the Durbin-Watson statistic of 1.823.

4.4. Stability Test

As part of the diagnostic test, we further applied the cumulative sum (CUSUM) and the cumulative sum of squares (CUSUMSQ) tests to examine the stability of the long- and short-run parameters. Based on the results in figures 4.1, 4.2, 4.4, and 4.5, we may accept the hypothesis of the correct specification of the regression model if the plots of CUSUM and CUSUMSQ lie within critical bounds at the 5 percent level of significance. The statistics of the CUSUM and CUSUMSQ tests also show no evidence of structural breaks in the series and that the residual variances are stable over the studied time period for China, France, Spain, and the USA, except for India, where there is evidence of structural breaks in the short run, as

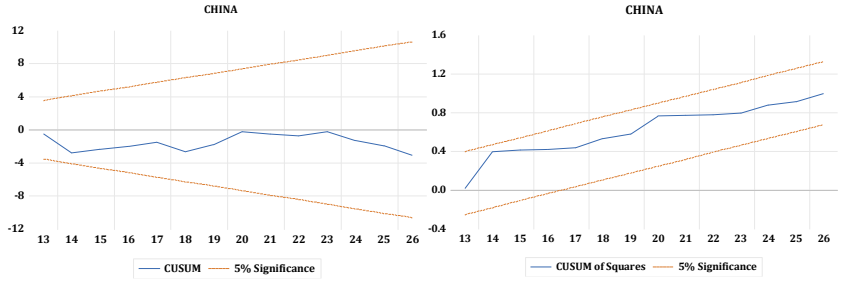

Figure 4.1. Plot of Cumulative Sum of Recursive Residuals and Cumulative Sum of Squares of Recursive Residuals for China

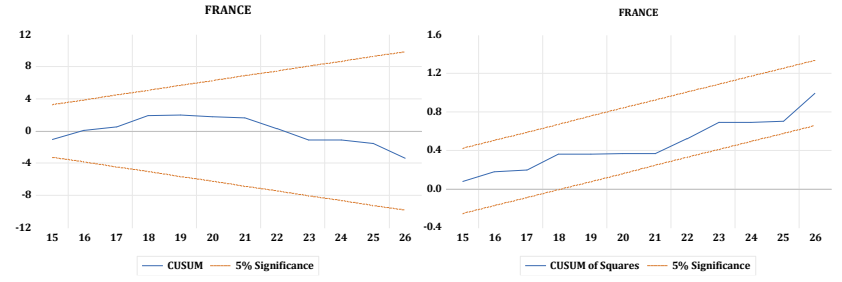

Figure 4.2. Plot of Cumulative Sum of Recursive Residuals and Cumulative Sum of Squares of Recursive Residuals for France

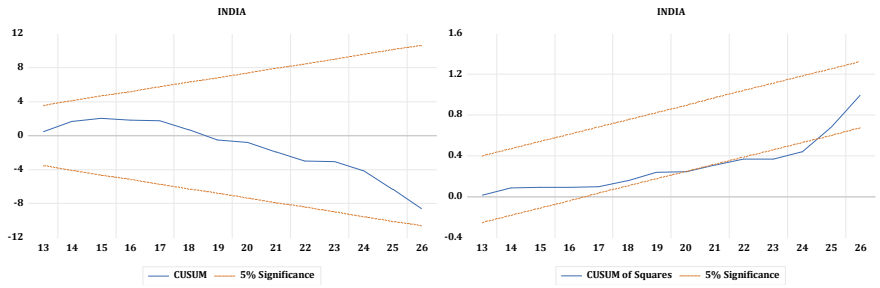

Figure 4.3. Plot of Cumulative Sum of Recursive Residuals and Cumulative Sum of Squares of Recursive Residuals for India

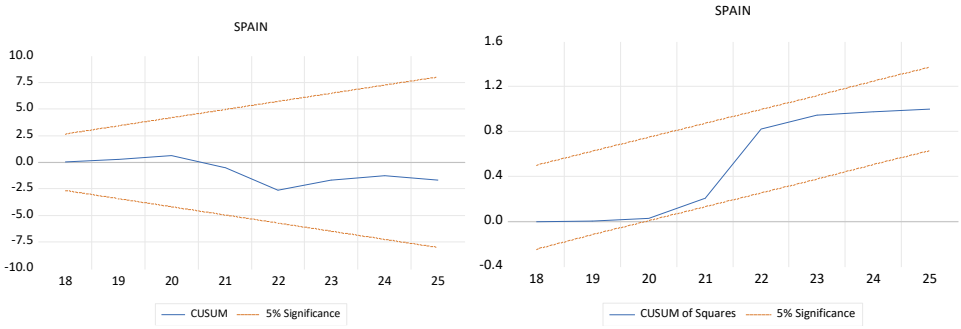

Figure 4.4. Plot of Cumulative Sum of Recursive Residuals and Cumulative Sum of Squares of Recursive Residuals for Spain

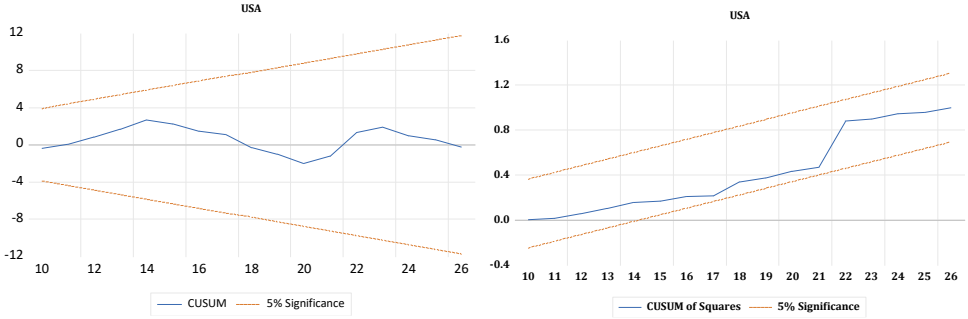

Figure 4.5. Plot of cumulative sum of recursive residuals and cumulative sum of squares of recursive residuals for USA

5. Conclusion

This study examined the impact of exchange rate volatility on Nigeria's export to the top-five export trade partner countries, namely China, France, India, Spain, and the United States over the period of 1995–2020 using the autoregressive distributed lag (ARDL) estimation technique. The results showed that in the short run, exports are positively associated with partner country's income for France India and USA; negatively associated with Spain's income, while it was not significant for China. In the long-run, income was found to be positively and significantly related with exports to China and France while it had a negative but significant effect on export to India and Spain. Population had a significant positive influence on export to Spain while it's influence on export to France was significantly negative in the short-run. It was also found not to be significantly associated with export to China, India and the USA in the short-run. The performance of population in the long-run was not different from the short-run as it exhibited mixed impact. It had a significant positive effect on real export for France, India and Spain while it was significantly negative for China. The impact of real effective exchange rate on export showed that the depreciation of the naira tends to increase exports for France and Spain and reduces exports for China and USA in the short-run while its impact was insignificant for India. Also, in the long-run, an increase in real effective exchange rate exerts a positive influence on exports to France, India and Spain while it had an adverse effect on export to China. Relative price had a mixed performance on export for the trading partners in the short-run. For France and Spain, it had an adverse impact as theoretically expected. Its impact on real export for China was positive indicating that an increase in relative price, increases exports while its impact for India and USA where insignificant in the short-run.

This same pattern was carried into the long run, where relative exerted a negative effect on exports for France, India, and Spain, while China had a positive impact as it were in the short run. Exchange rate volatility exerted a strong negative impact on China, France, and Spain, while its impact on exports for the USA was positive and insignificant for India. In the long run, the volatility of the exchange rate impacted negatively on exports for France, India, and Spain, while its impact for China was found to be insignificant. It is worthy of note that the impact of exchange rate volatility on exports was highest for Spain, followed by France, in the short run, while in the long run, it was highest for India, followed by France. One unanticipated finding is that the income has a negative impact on the export volume of Nigeria. Spain in the short run and India in the long run This suggests that as the income of these trading partners increases, they tend to import fewer Nigerian goods, which may reflect that the position of Nigerian products in the international market remains low-grade. This study therefore recommends that the standard organization of Nigeria, in conjunction with the export promotion council, should synergize and setup a standard, itch-free verification system that will ensure that Nigerian goods

meant for export are of international quality. More so, monetary authorities should improve the availability of hedging instruments and promote the use of hedging among exporters to support them in coping with exchange-rate uncertainty. Lastly, there is a need for an appropriate pricing template for categories of export products to avoid the deleterious effects of relative prices. This study also recommends that future studies can investigate the asymmetric effects of exchange rate volatility on exports and also the effects of exchanger rate volatility on exports at a disaggregated or commodity level.

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