CHAPTER TWELVE

EXCHANGE RATE VOLATILITY AND EXPORT PERFORMANCE IN NIGERIA'S EMERGING INDUSTRIES

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Abstract

This study examined the effects of exchange rate volatility on trade flows in Nigeria's emerging industries on the basis of annual data from 1981--2023. Specifically, the study evaluated the effects of the exchange rate, volatility, inflation, Nigeria's gross domestic product (GDP), and world GDP on trade flows in Nigeria's emerging industries, focusing on insurance and financial services, intellectual property, transport services, and information and communication technology exports. By utilizing the Krugman J-curve effect and the Marshall–Lerner condition, the results of the autoregressive distributed lag model reveal significant short-term and long-term dynamics. In the short run, exchange rate fluctuations and Nigeria's GDP positively influence insurance and financial services exports, whereas inflation has a negative effect. Intellectual property exports were adversely affected by world GDP, exchange rate volatility, and inflation in both the short and long run. It was also found that transport service exports were negatively impacted by inflation, whereas information and communication technology exports were highly sensitive to global economic conditions, with world GDP exerting a negative long-term effect. The study highlighted the need for policies that stabilize exchange rates, manage inflation, and mitigate the adverse effects of global economic fluctuations to support the growth of Nigeria's emerging industries.

Keywords: Autoregressive distributed lag model, emerging industries, exchange rate volatility, GARCH estimation, trade flows, trade dynamics

1. Introduction

In recent years, Nigeria's emerging industries have demonstrated significant potential for economic growth and development. However, these industries face substantial challenges due to exchange rate volatility. Adekoya and Dada (2020) reported that the fluctuation of the Nigerian Naira against major currencies has introduced instability in trade flows, impacting the ability of businesses to forecast costs, price goods competitively, and maintain stable supply chains.

Exchange rate volatility creates an environment of uncertainty that impacts trade flows in several ways. First, it complicates the pricing of exports and imports, leading to difficulties in setting competitive prices and managing profit margins. Firms in emerging industries may struggle to adjust their prices in response to sudden currency changes, affecting their competitiveness in both domestic and international markets (Adekoya, & Dada, 2020; Adekunle, & Adeniyi, 2020). Second, exchange rate volatility affects the cost of imported raw materials and technology, which are vital for the production processes in these industries. As the cost of imports fluctuates, firms face increased expenses and unpredictability in their supply chains. This instability can lead to production delays, increased operational costs, and potential losses, ultimately impacting the overall profitability and growth prospects of these industries (Akinlo, & Lawal, 2020; Olanipekun, & Alimi, 2021). Furthermore, the lack of a stable exchange rate environment undermines investment confidence. Investors are generally risk averse, and the unpredictability of currency movements can deter both domestic and foreign investment in Nigeria's emerging industries. This reduction in investment hampers the expansion and technological advancement necessary for these industries to thrive (Bakare, & Olubokun, 2022).

espite the evident impact of exchange rate fluctuations on trade flows, there remains a significant gap in the literature regarding the specific effects of exchange rate volatility on Nigeria’s emerging industries. Most existing studies focus on broader economic impacts (Bosupeng, Naranpanawa, & Su, 2024; Bussiere, Gaulier, & Steingress, 2020; George, 2024; Hashmi, Chang, & Shahbaz, 2020;

Kanu & Nwadiubu, 2020), neglecting the nuanced ways in which emerging industries are affected. Other studies focused on specific established sectors such as manufacturing and primary commodity exports (Bahmani-Oskooee, Usman, & Ullah, 2020; Handoyo et al., 2023; Kayani et al., 2023; Sohrabji, 2024; Sugiharti, Esquivias, & Setyorani, 2020; Urgessa, 2024). Adekunle and Adeniyi (2020) examined broad sectors such as agriculture, manufacturing, and services but did not address specific emerging industries within these sectors. Emerging industries, such as insurance and financial services, intellectual property, transport services, and information and communications technology (ICT), might exhibit different sensitivities to exchange rate volatility due to their unique characteristics and market dynamics. This gap in understanding limits the development of targeted strategies and policies that could mitigate the adverse effects of exchange rate volatility.

This study attempts to fill this gap by providing comprehensive analyses of how exchange rate volatility influences trade flows in Nigeria's emerging industries. By examining the relationship between currency fluctuations and trade dynamics, this research will offer valuable insights into the mechanisms at play and propose actionable recommendations for stakeholders to better navigate and manage the challenges posed by exchange rate volatility. Therefore, there is a need to model exchange rate volatility to account for the response of emerging industries in the transmission mechanism. This study therefore employs an autoregressive distributed lag (ARDL) framework to trace this transmission effect in Nigeria and contributes to the existing debate in a unique fashion. In view of this, the objective of this study is to estimate the effect of exchange rate volatility on trade flows in Nigeria's emerging industries.

2. Review of Related Literature

This subsection reviews the related literature in the spheres of conceptual clarification, theoretical reviews and exposition of the empirical literature.

Conceptual Review

(a) Exchange rate volatility: Exchange rate volatility is essential for understanding how currency fluctuations impact trade flows, especially in Nigeria's emerging industries. It refers to the degree of unpredictability in currency value changes over time, measured by tools such as standard deviation (Ajayi & Ojo, 2021). According to Owolabi (2018), volatility can be short-term, driven by speculative trading or political events, or long-term, influenced by economic fundamentals such as inflation, interest rates, and growth disparities between countries.

The causes of exchange rate volatility vary. Economic factors such as inflation and interest rates play a significant role, whereas political instability and policy decisions can lead to sudden currency shifts. Market speculation and global events, such as trade tensions or changes in commodity prices, also contribute to exchange rate fluctuations (Eze & Onyema, 2020). Volatility impacts trade flows by introducing pricing uncertainties, affecting export competitiveness, and increasing import costs. For emerging industries, this can lead to difficulties in setting stable prices and deterring foreign investment due to the associated risks (Bello, 2022).

Emerging industries are particularly vulnerable to exchange rate volatility because of their limited ability to absorb shocks and their reliance on imported inputs (Usman, 2021). However, Akinwale & Oseni (2019) reported that this volatility can also drive innovation, encouraging firms to diversify markets and develop financial strategies to manage currency risk. Adetunji and Olumide (2022) emphasized the need for sound macroeconomic policies in Nigeria to stabilize the exchange rate and support the growth of these industries.

Managing exchange rate volatility involves using hedging strategies such as forward contracts and options to reduce risks (Olufemi & Ayodele, 2020). The Nigerian government and the Central Bank play crucial roles through interventions and policy adjustments (Ibrahim & Ali, 2023). According to Okeke (2019), the diversification of markets and raw material sources helps firms mitigate the impact of currency fluctuations. Understanding and managing the effect of exchange rate volatility is crucial for the global competitiveness of emerging industries.

(b) Trade flows: Adeosun (2021) emphasized that trade flows—volume, value, and direction of goods and services exchanged between countries—are crucial for assessing economic activity in emerging industries. These flows, including exports and imports, are gauged by trade volume, value, and the trade balance, a key economic indicator. Olawale and Adeola (2019) highlighted the significant impact of exchange rates on trade flows. Exchange rate fluctuations affect the relative prices of domestic and foreign goods, influencing the trade balance. A stronger currency may lower import costs but increase export prices, potentially causing a trade deficit, whereas a weaker currency has the opposite effect. Additionally, global demand, trade policies, and production costs are critical factors shaping trade flows (Adeosun, 2021).

In Nigeria's emerging industries—such as technology, agro-processing, and renewable energy—Eze and Onyekachi (2020) noted that trade flows are vital but sensitive to exchange rate volatility. Fluctuations can disrupt pricing and contract negotiations, with a depreciating Naira potentially boosting exports by making Nigerian goods cheaper abroad but increasing the cost of imported inputs. Stable exchange rates are essential for maintaining industry competitiveness in global markets.

Different sectors in Nigeria experience varying impacts from trade flows. Favorable exchange rates may benefit agriculture by enhancing export competitiveness, whereas the technology sector might face higher costs for imported components because of a weaker Naira (Ogundipe, 2022). Trade flows are also crucial for Nigeria's balance of payments, reflecting economic health. Persistent trade deficits, worsened by exchange rate volatility, can lead to broader economic instability, making industry diversification critical for resilience against volatility and global economic shifts (Ogundipe, 2022).

Ojo and Oladele (2023) advocated for effective policies to improve trade flows in emerging industries, including exchange rate management, to reduce volatility and provide hedging tools. Trade facilitation measures, such as simplifying processes and enhancing infrastructure, alongside export promotion strategies such as subsidies and trade agreements, could boost global competitiveness. Managing factors affecting trade flows, especially exchange rate volatility, is crucial for enhancing the competitiveness and economic growth of Nigeria's emerging industries.

(c) Emerging industries in Nigeria: Emerging industries in Nigeria are new and rapidly growing due to technological innovations, changing consumer preferences, or economic diversification, which are vital to the country's economic development (Eze, 2022). They include sectors such as insurance and financial services, intellectual property, transport, and ICT, which are essential for reducing reliance on oil and gas, fostering innovation, and creating jobs (Adewale & Akinola, 2021). These industries are central to Nigeria’s diversification strategy, particularly given global oil price volatility and the need for sustainable growth (Ogundipe, 2023). The technology sector, driven by a youthful population and increased internet access, is a key component of Nigeria’s economic future (Adeosun, 2021).

However, challenges such as inadequate infrastructure, limited financing, and regulatory issues, coupled with exchange rate volatility, pose significant risks. Exchange rate fluctuations create pricing uncertainties, increase import costs, and complicate contract negotiations, affecting competitiveness (Olawale & Adeola, 2019). Industries often lack financial tools to hedge against these risks, making them vulnerable to economic shocks (Ojo & Oladele, 2023). To support these industries, strategies must include financial hedging, government interventions to stabilize currency, and policies to promote local sourcing and reduce import reliance. Improving infrastructure and simplifying regulations are also crucial for enhancing resilience against exchange rate volatility (Ogundipe, 2023; Ojo & Oladele, 2023).

Theoretical Framework

This study is built on two theories: the Krugman (1979), J-Curve Effect and Marshall (1920), and Lerner (1940) and Marshall–Lerner Condition. The Krugman (1979) J-Curve Effect suggests that after currency depreciation, a country's trade balance initially worsens before improving. This occurs because, in the short term, import prices rise faster than export prices can adjust, leading to a deteriorated trade balance. Over time, as exports become less expensive and imports become more expensive, demand adjusts, and the trade balance improves. In Nigeria's emerging industries, which rely on imports for inputs, this effect is particularly relevant. Initially, higher costs for imported goods worsen the trade balance, but if industries can boost exports and substitute local inputs, long-term improvements may occur.

The Marshall–Lerner condition, attributed to Marshall (1920) and Lerner (1940) determines whether currency depreciation will improve the trade balance, asserting that this happens when the sum of the absolute values of the price elasticities of demand for exports and imports exceeds one. This means that the trade balance improves if the demand for exports and imports is elastic. For Nigeria's emerging industries, if exports such as services are price elastic, depreciation could increase exports. However, if import demand is inelastic due to reliance on essential industrial inputs, the anticipated trade balance improvement might not occur.

Additionally, the condition assumes constant price elasticity, which may not hold in Nigeria because of varying factors such as market competition and infrastructure constraints. Despite the assumption of constant price elasticity, the Marshall–Lerner condition provides a theoretical benchmark for understanding how exchange rate changes might influence trade balances. It serves as a starting point for assessing the potential impact of currency depreciation on exports and imports, even if real-world conditions may vary. These theories have been used in this study to analyze the relationship between exchange rate volatility and trade flows in Nigeria's emerging industries.

Empirical Review

Since the Krugman (1979) J-curve effect and the Marshall–Lerner condition (Marshall, 1920; Lerner, 1940), studies have explored exchange rate volatility and trade flows. Kanu and Nwadiubu (2020) analyzed Nigeria’s trade from 1996--2018. The VAR model reveals an inverse relationship between the real effective exchange rate and export growth but a positive relationship with import growth. Adekunle and Adeniyi (2020) extended this to Nigeria's agriculture, manufacturing, and services sectors from 1999Q1 to 2016Q4. The GARCH and ARDL models establish that exchange rate volatility significantly impacts manufacturing due to its high import content, with a less direct but persistent effect on services. George (2024) examined Uganda's trade balance from 1980--2020 with an ARDL model, revealing that real effective exchange rate volatility negatively impacted the trade balance in the short run but positively affected it in the long run. Inflation, real GDP, and gross capital formation positively influence the trade balance in the long term, whereas foreign direct investment has a negative effect.

The literature has also explored the asymmetric effects of exchange rate volatility on trade flows. Rasaki and Oyedepo (2023) used quarterly data from 1995Q1--2020Q4 to analyze these effects in Nigeria. The ARDL model revealed that exchange rate volatility significantly impacts exports in the short run and imports in both the short and long run, with notable asymmetric effects on imports.

Handoyo et al. (2023) investigated ASEAN-5 manufacturing sector exports from January 2007--March 2019 via the ARCH/GARCH, ARDL, and NARDL models. The study revealed a significant short-term relationship and asymmetrical response of commodity exports to exchange rate volatility. Sohrabji (2024) applied an error correction model (ECM) to study India’s trade from 1994--2002. The results indicated that exports were more sensitive to real exchange rate fluctuations in the short run, whereas imports were more responsive in the long run, with asymmetric effects observed for primary sector imports and exports. Urgessa (2024) analyzed Ethiopia’s trade from 2007Q1--2024Q4 via the ARDL model. The findings indicated that real effective exchange rate appreciation reduced the total exports of meat, vegetables, and oil seeds. Exchange rate volatility also decreased export earnings from these goods, with the NARDL model revealing an asymmetric effect on exports.

Other studies have explored the impact of exchange rate volatility on price elasticity and the trade balance; Bussiere, Gaulier, and Steingress (2020) control for inflation, estimated trade price and quantity elasticities and the trade balance response to exchange rate changes, using a panel of 51 advanced and emerging economies from 1995--2012. The study revealed that quantity elasticities were less than one. Trade balances improved in all economies following currency depreciation due to adjustments in export and import prices. Bosupeng, Naranpanawa, and Su (2024) assessed exchange rate volatility and the trade balance in 5 developed and 5 developing economies via monthly data from 1960M02--2020M12. The VAR model established that exchange rate volatility reduced the positive effect of currency appreciation in developed countries, whereas the opposite was true for developing economies, both in the short and long run.

Another theme examined in the literature is the influence of economic phases and financial crises: Hashmi, Chang, and Shahbaz (2020) examined the volatility of India's cross-border trade during the precrisis (1981--1990), precrisis (1991--2007), and post crisis (2010--2019) periods. The results from the multiple threshold nonlinear ARDL model indicated that the asymmetric response of trade to exchange rate volatility was significantly influenced by the global financial crisis. Muhammad and Aliero (2023) analyzed the impact of exchange rate fluctuations on Nigeria's trade from 1960--2020 via the ARCH, GARCH, and ARDL models. The results revealed that exchange rate fluctuations positively affected exports, whereas the real exchange rate and GDP had a significant negative impact. The negative relationship between inflation and exports was insignificant.

Empirical evidence has also focused on regional and bilateral trade dynamics. Bahmani-Oskooee, Usman, and Ullah (2020) studied the asymmetric effects of rupee-yuan volatility on trade between Pakistan and China from 1980--2018. The models, which included economic activity and exchange rates, revealed short-run asymmetry in 40–50% of industries, with more significant effects in nonlinear models. Sugiharti, Esquivias, and Setyorani (2020) focused on exchange rate volatility and Indonesia's primary commodity exports to China, India, Japan, South Korea, and the US from 2006--2008. Both the ARDL and NARDL models indicated a negative effect of exchange rate fluctuations on exports. Kayani et al. (2023) analyzed the asymmetric effects of exchange rate volatility on trade in Korea, Pakistan, Japan, and Malaysia from 1980Q1 to 2018Q4. The results from the linear and NARDL models indicated that increased volatility negatively impacted trade, whereas decreased volatility had a positive effect.

The empirical literature reveals that most studies have focused on broad categories, such as exports and imports of primary commodities, manufacturing sectors, and services, without considering specific emerging industries within these areas. Sectors such as insurance and financial services, intellectual property, transport services, and ICT may respond differently to exchange rate volatility because of their distinct characteristics and market dynamics. There is a need for research that explores how exchange rate volatility affects different sectors within Nigeria, especially those that are emerging or significant for economic growth.

3. Methodology

Research Design

This study is *ex post facto* research that uses the ARDL model given that the variables are stationary at different levels, I(0) and I(1), as shown in Table 2. The ARDL approach is effective for small sample sizes (Pesaran & Shin, 1999) and estimates both short-run and long-run dynamics, capturing immediate effects and long-term equilibrium (Sarno & Taylor, 1998). It provides unbiased long-run estimates and valid t-statistics, even with endogenous regressors (Phillips & Moon, 1999), and includes an error correction mechanism (ECM) to measure how quickly the dependent variable returns to equilibrium after changes in the independent variables (Banerjee, Dolado, & Mestre, 1998).

On the basis of institutional knowledge of the Nigerian economy, the basic ARDL model for export demand as a function of the exchange rate, volatility, inflation, national GDP, and world GDP is as follows:

$$X_{i,t} = \alpha_0 + \sum_{j=1}^{p} \alpha_j X_{i,t-j} + \sum_{j=0}^{q1} \beta_{1,t-j}\, EXRN + \sum_{j=0}^{q2} \beta_{2,t-j}\, VOLT + \sum_{j=0}^{q3} \beta_{3,t-j}\, INFR + \sum_{j=0}^{q4} \beta_{4,t-j}\, NGDP + \sum_{j=0}^{q5} \beta_{5,t-j}\, WGDP + \mathcal{E}_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots [1]$$

where $X_{i,t}$ is the value of exports of the ith emerging industry at time t, EXRN = exchange rate, VOLT =volatility, INFR= inflation, NGDP= national GDP, and WGDP= world GDP. In terms of the a priori theoretical expectations from [1], β_1 is expected to be positive since a weaker Naira is predicted to increase exports; β_2 (negative), β_3 (positive or negative), and β_4 and β_5 are expected to be positive. On the basis of Pesaran et al. (2001), if cointegration is detected, the basic ARDL model can be transformed into an ECM to analyze short-term dynamics and long-term relationships as follows:

$$X_{i,t} = \alpha_0 + \sum_{j=1}^{P} \alpha j \Delta\, X_{i,t-j} + \sum_{j=0}^{q_1} \beta_1 j \Delta\, EXRN_{t_j} + \sum_{j=0}^{q_2} \beta_2, j \Delta\, VOLT_{t\_j} + \sum_{j=0}^{q_3} \beta_3 j \Delta\, INFR_{t\_j} + \sum_{j=0}^{q_4} \beta_4, j \Delta\, NGDP_{t\_j} + \sum_{j=0}^{q_5} \beta_5 j \Delta\, WGDP_{t\_j} + \Theta_1 X_{t-1} + \Theta_2 EXRN_{t-1} + \Theta_3 VOL_{t-1} + \Theta_4 INFR_{t-1} + \Theta_5 NGDP_{t-1} + \Theta_6 WGDP_{t-1} + \lambda ECM + U_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots [2]$$

where $X_{i,t}$ = the export of a particular emerging industry at time t; α_0 is the constant term; αj are the coefficients of the lagged dependent variable, $X_{i,t-j}$ up to lag p; $\beta_1 j$ -$\beta_5 j$ are the coefficients of the lagged explanatory variables; q_1 -q_5 represents the optimal lags for the explanatory variables; αj; β_1 - β_5 are the short-run coefficients; and Θ_1 - Θ_6 are the long-run coefficients. $\mathcal{E}_t$ is the error term.

On the basis of the Krugman (1979) J-Curve Effect and the Marshall (1920); Lerner (1940) Marshall Lerner Condition, exchange rate fluctuations are expected to influence trade flows in Nigeria's emerging industries. In these industries, which rely on imports for inputs, currency fluctuations can worsen the trade balance. The dynamics of this interaction have been modeled via the ARDL framework.

The Autoregressive Conditional Heteroscedasticity GARCH (1,1) has been utilized to compute exchange rate volatility. Compared with static models, the GARCH model effectively captures and estimates time-varying volatility and clustering effects in exchange rates, providing a more accurate and dynamic measure of volatility.

Data and Variables

This study uses annual data from 1981--2023, a period sufficient to capture the impact of exchange rate volatility on export performance in Nigeria. The data include insurance and financial services exports (IFSX) and transport services exports (TRSX) as percentages of total service exports, intellectual property exports (IPPX) and information and communication technology exports (ICTX) in USD, the nominal exchange rate (EXRN) of Naira to USD, volatility (VOLT) computed from EXRN via GARCH (1, 1), the inflation rate (INFR), the national GDP growth rate (NGDP), and the world GDP growth rate (WGDP), all in percentages. IPPX, ICTX, and EXRN have been converted to natural logarithms. All the data were sourced from the World Bank.

Estimation Procedure

To estimate the ARDL model, unit root/stationarity tests were conducted via the ADF and KPSS tests. The optimal lag length was determined, and bounds tests were performed to check for a long-term relationship between the variables. After confirming cointegration, the short- and long-term ECMs were estimated. Diagnostic tests, including the normality test, Ramsey test, heteroskedasticity test, and serial correlation test, were conducted to ensure model validity. This study analyzed four export demand models, each focusing on different export types—insurance and financial services (IFSX), intellectual property (IPPX), transport services (TRSX), and ICT exports (ICTX)—with distinct explanatory variables and relationships.

4. Results and Discussion

Descriptive Statistics

The descriptive characteristics of the series are presented in Table 1.

Table 1: Descriptive Statistics

	IFSX	IPPX	TRSX	ICTX	EXRN	VOLT	INFR	NGDP	WGDP
Mean	3.26	3.02	15.51	1.08	3.62	0.06	18.87	3.06	2.94
Maximum	23.78	3.69	71.75	1.30	6.45	0.07	72.83	15.32	6.25
Minimum	0.11	1.28	0.63	0.25	-0.60	0.00	5.38	-13.12	-2.93
Std. Dev.	4.98	0.53	14.71	0.21	2.11	0.01	16.14	5.19	1.55
Skewness	2.44	-1.47	1.65	-2.11	-0.76	-2.52	1.90	-0.86	-1.53
J.-Bera	111.48	22.94	41.21	73.94	5.13	100.47	39.14	12.53	50.96
Probability	0.00	0.00	0.00	0.00	0.07	0.00	0.0	0.00	0.00

Source: Authors' computations.

The average values of the series over the period 1981--2023 are as follows: insurance and financial services exports IFSX (3.26), intellectual property exports IPPX (3.02), transport services exports TRSX (15.51), information and communication technology exports ICTX (1.08), exchange rate EXRN (3.62), volatility VOLT (0.06), inflation rate INFR (18.87), national GDP growth rate NGDP (3.06), and world GDP growth rate WGDP (2.94). The maximum values are as follows: IFSX (23.78), IPPX (3.69), TRSX (71.75), ICTX (1.30), EXRN (6.45), VOLT (0.07), INFR (72.83), NGDP (15.32), and WGDP (6.25). The minimum values include IFSX (0.11), IPPX (1.28), TRSX (0.63), ICTX (0.25), EXCR (-0.60), VOLT (0.00), INFR (5.38), NGDP (-13.12, and WGDP (-2.93). INFR shows the highest volatility (standard deviation 16.14), followed by TRSX (14.71). Positive skewness (long right tail) is found in IFSX, TRSX, and INFR, whereas negative skewness (long left tail) is observed in IPPX, ICTX, EXRN, VOLT, NGDP, and WGDP. The Jarque-Bera test indicates that only the EXRN is normally distributed. Sarno and Taylor (2002) noted that variables related to exchange rates and trade flows often deviate from normality due to outliers, volatility clustering, or structural breaks. The ARDL model addresses these problems by focusing on long-term relationships and error correction instead of distributional properties.

Test of Stationarity

This study applied the augmented Dickey Fuller (ADF) and the Kwiatkowski, Phillips, Schmidt and Shin (KPSS) tests to evaluate the stationarity of the series. Unlike the KPSS test, the ADF test has low test power and is prone to reject the null hypothesis. Therefore, the KPSS test has been utilized as a confirmatory test (Akeyede, Danjuma & Bature, 2016). On this basis, the results suggest that, apart from the EXRN, all the series are integrated at level.

Table 2: Results of Stationarity/Unit Root Test

Variable	ADF Test @ level	ADF Test @ 1st Diff.	KPSS Test @ level	KPSS Test @ 1st Diff.	Decision
IFSX	0.446698 [-2.94]	1.48 [-2.94]	0.297** [0.46]		1(0)
IPPX	-4.46** [-2.93]		0.35** [0.46]		1(0)
TRSX	-3.54** [-2.93]		0.20** [0.46]		1(0)
ICTX	-4.67** [-2.93]		0.38** [0.46]		1(0)
EXRN	-1.80 [-2.93]	-5.56** [-2.93]	0.78 [0.46]	0.27** [0.46]	1(1)
VOLT	-4.39** [-2.93]		0.07** [0.14]		1(0)
INFR	-3.16** [-2.93]		0.25** [0.46]		1(0)
NGDP	-2.89 [-2.93]	-12.23** [-2.93]	0.29** [0.46]		1(0)
WGDP	-6.68** [-2.93]		0.10** [0.46]		1(0)

Source: Authors' computations. Critical values @ 5% are in square brackets. ** indicates significance at the 5% level.

Optimal Lag Length Criteria

Optimal lag selection is crucial in ARDL models to accurately capture the relationships between variables and avoid issues such as autocorrelation and overfitting, which can result in biased estimates. Using the Akaike information criterion (AIC), the optimal lag for Model 1 is ARDL (3,3,3,3,3,3), that for Model 2 is ARDL (2,3,1,1,0,1), that for Model 3 is ARDL (1,0,0,0,0,0,0,0), and that for Model 4 is ARDL (2,3,1,0,1).

Bound Cointegration Test for Model 1

The results in Table 3 indicate that since the F- statistic (8.67) is greater than the upper bound critical value at 5%, the null hypothesis is rejected, meaning that there is a long-term relationship (cointegration) between IFSX, EXRN, VOLT, INFR, NGDP, and WGDP in the model.

Table 3: Results of the ARDL bounds test for Model 1

Test Statistic	Value	Significance level	Critical Values I(0)	I(1)
	8.67	1%	3.41	4.68
F-Statistic		5%	2.62	3.79
		10%	2.26	3.35

Source: Authors' computations.

Long-Run and Short-Run Results for Model 1

The results in Table 4 show no statistically significant relationship between the IFSX (the dependent variable) and the explanatory variables in the long run. The short-term results indicate a statistically significant positive effect of EXRN(-1), D(EXRN(-2)), VOLT(-1), D(VOLT(-1)), and D(NGDP(-1)) on the dependent variable (IFSX). The positive effects of EXRN and NGDP conform to the a priori expectations, whereas that of VOLT violates it. A statistically significant negative effect of D(IFSX(-1)) and D(INFR(-1)) on (IFSX) is also revealed. The negative effect of inflation satisfies the a priori theoretical expectations. This result corroborates Kayani et al. (2023), who reported that volatility improves exports, but contradicts Urgessa (2024), who reported that volatility deteriorates exports.

Table 4: Long-term and short-term results for Model 1

Panel A: Long-Run Results				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXRN	-7.685632	4.602092	-1.670030	0.1132
VOLT	-546.0475	428.9040	-1.273123	0.2201
INFR	-0.117944	0.116502	-1.012376	0.3256
NGDP	0.864245	0.725227	1.191689	0.2498
WGDP	-0.781518	2.161671	-0.361534	0.7222
Panel B: Short-Run Results				
C	-17.56	3.98	-4.40	0.00
IFSX(-1)*	0.22	0.12	1.79	0.09
EXRN(-1)	1.74	0.29	5.85	0.00
VOLT(-1)	124.12	44.89	2.76	0.01
INFR(-1)	0.02	0.02	1.13	0.27
NGDP(-1)	-0.19	0.11	-1.72	0.10
WGDP(-1)	0.17	0.49	0.35	0.72
D(IFSX(-1))	-0.78	0.21	-3.64	0.00
D(IFSX(-2))	-0.38	0.20	-1.94	0.06
D(EXRN)	1.71	1.20	1.43	0.17
D(EXRN(-1))	4.84	2.57	1.88	0.07
D(EXRN(-2))	7.72	2.95	2.61	0.01
D(VOLT)	99.87	55.33	1.80	0.08
D(VOLT(-1))	105.12	34.66	3.03	0.00
D(VOLT(-2))	28.29	20.49	1.38	0.18
D(INFR)	0.02	0.02	0.69	0.49
D(INFR(-1))	-0.04	0.02	-2.16	0.04
D(INFR(-2))	-0.04	0.02	-1.90	0.07
D(NGDP)	0.17	0.10	1.72	0.10
D(NGDP(-1))	0.35	0.11	3.25	0.00
D(NGDP(-2))	0.08	0.07	1.10	0.28
D(WGDP)	0.25	0.19	1.32	0.20
D(WGDP(-1))	-0.14	0.30	-0.46	0.64
ECM(-1)	-0.22	-0.027	8.20	0.00
R-Squared =0.84; Prob (F-Statistic) = 0.00; Durbin-Watson Stat =2.38				

Source: Authors' computations.

The error correction term (ECT) is statistically significant and negative, indicating that 22% of the short-run disequilibrium in the IFSX due to shocks from the explanatory variables is corrected each period in the long run. The R-square value indicates that the model explains 84% of the variation in the IFSX. The model is statistically significant as a whole, as shown by the probability of the F-statistic.

Diagnostic tests for Model 1

The results of the diagnostic tests are presented in Table 5. The results reveal the appropriateness of the model. The Ramsey Reset test reveals that the model is well specified. The LM test confirms the absence of autocorrelation, whereas the Breusch–Pagan–Godfrey test suggests no evidence of heteroscedascicity. The Jarque-Bera test shows that the residuals are not normally distributed. However, since ARDL models often focus on long-term relationships between variables rather than precise point estimates, the estimation of long-term coefficients and error correction terms is less sensitive to the normality of residuals.

Table 5: Results of Diagnostic Tests for Model 1

Type of Test	Scaled explained SS		t-Statistic		F-Statistic		Obs*R-squared	
	value	prob	Value	Prob	Value	prob	value	prob
Ramsey RESET	-	-	-	-	2.61	0.08	-	-
Serial Corre Lation	-	-	-	-	1.07	0.36	7.67	0.07
Heteros Cedasti City			-	-	1.45	0.21	27.20	0.99
Jarque-Bera	3.04	Prob (0.21)						

Source: Authors' computations. The dashes (-) indicate that the statistic is not applicable to that particular test.

Bound Cointegration Test for Model 2

The results in Table 6 show that the F statistic is above the upper bound critical value at the 5% significance level. This study rejects the null hypothesis and concludes that there is a long-run relationship (cointegration) between IPPX, EXRN, VOLT, INFR, NGDP, and WGDP in the model.

Table 6: Results of the ARDL bounds test for Model 2

Test Statistic	Value	Significance level	Critical Values I(0)	I(1)
F Statistic	4.03	1%	3.41	4.68
		5%	2.62	3.79
		10%	2.26	3.35

Source: Authors' computations.

Long-Run and Short-Run Results for Model 2

The long-run results in Table 7 indicate that WGDP is the only variable with a significant impact, showing a negative relationship with IPPX (the dependent variable) in the long run. This result violates the a priori theoretical expectations. In the short run, the constant term (c) is statistically significant, indicating a baseline level of the dependent variable. In the short run, a statistically significant negative effect of the dependent variable, IPPX(-1)* alone, is revealed. The results also show that WGDP(-1), D(EXRN(-1)), and D(INFR) have a statistically significant inverse relationship with the dependent variable (IPPX). The negative effect of EXRN contradicts the a priori theoretical expectations. This finding agrees with Kanu and Nwadiubu (2020), who reported that the exchange rate reduces exports, but it contradicts George's (2024) report on the positive effects of the exchange rate on exports.

Table 7: Long-term and short-term results for Model 2

Panel A: Long-Run Results				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXRN	0.05	0.04	1.35	0.18
VOLT	1.80	10.41	0.17	0.86
INFR	-0.00	0.00	-0.32	0.74
NGDP	-0.00	0.02	-0.24	0.80
WGDP	-0.19	0.07	-2.60	0.01
Panel B: Short-Run Results				
C	3.79	1.22	3.10	0.00
IPPX(-1)*	-1.10	0.22	-4.83	0.00
EXRN(-1)	0.06	0.04	1.31	0.19
VOLT(-1)	1.98	11.42	0.17	0.86
INFR(-1)	-0.00	0.0	-0.32	0.75
NGDP**	-0.001	0.02	-0.24	0.80
WGDP(-1)	-0.21	0.09	-2.30	0.02
D(IPPX(-1))	0.27	0.16	1.59	0.12
D(EXRN)	-0.17	0.28	-0.62	0.54
D(EXRN(-1))	-1.58	0.69	-2.27	0.03
D(EXRN(-2))	1.05	0.56	1.88	0.07
D(VOLT)	-31.30	16.11	-1.94	0.06
D(INFR)	-0.01	0.00	-2.42	0.02
D(WGDP)	-0.06	0.05	-1.19	0.24
ECM(-1)	-1.10	0.20	-5.35	0.00
R-Squared = 0.64 ; Prob (F-Statistic= 0.00; Durbin-Watson Stat = 2.20				

Source: Authors' computations.

The ECT is negative and highly significant, indicating a strong adjustment mechanism toward long-term equilibrium. The magnitude suggests that over 100% of the deviation from the long-run equilibrium is corrected within one period. The R-squared value indicates that the model explains 64% of the changes in the dependent variable (IPPX). The probability of the F statistic indicates that the overall model is statistically significant.

Diagnostic tests for Model 2

The results of the diagnostic tests for Model 2 are presented in Table 8. The Ramsey Reset test reveals that the model is well specified. The LM test confirms the absence of autocorrelation, whereas the Breusch–Pagan–Godfrey test suggests no evidence of heteroscedasticity. The Jarque-Bera test shows that the residuals are not normally distributed. ARDL models are often used to test for the existence of cointegration among variables, which indicates a long-term equilibrium relationship. Cointegration tests, such as the bounds test used in ARDL, do not require normally distributed errors.

Table 8: Results of Diagnostic Tests for Model 2

Type of Test	Scaled explained SS		t-Statistic		F-Statistic		Obs*R-squared	
	value	prob	Value	Prob	Value	prob	value	prob
Ramsey RESET	-	-			1.98	0.13	-	-
Serial Corre Lation	-	-	-	-	1.94	0.14	8.03	0.09
Heteros Cedasti City	9.80	0.70	-	-	0.65	0.79	9.78	0.711
Jarque-Bera	16.57 Prob(0.00)							

Source: Authors' computations. The dashes (-) indicate that the statistic is not applicable to that particular test.

Bound Cointegration Test for Model 3

Table 9 reveals that the F statistic is greater than the 5% upper critical value, suggesting a long-run association between the dependent variable, TRSX, and the regressors, EXRN, VOLT, INFR, NGDP, and WGDP, at the 5% level of significance.

Table 9: Results of the ARDL bounds test for Model 3

Test Statistic	**Value**	**Significance level**	**Critical Values I(0)**	**I(1)**
	3. 96	1%	3.15	4.43
F Statistic		5%	2.45	3.61
		10%	2.12	3.23

Source: Authors' computations.

Long-Run and Short-Run Results for Model 3

The results in Table 10 show that INFR has a statistically significant negative long-term effect on TRSX. In the short run, the dependent variable TRSX(-1)* is inversely related to itself. The result is statistically significant. The results also indicate that INFR** has a statistically significant negative effect on TRSX. The negative effect of INFR accords with the a priori theoretical expectations. The ECT has the correct sign, showing 57% speed of adjustment of the TRSX to its long-run equilibrium. This confirms the presence of a stable long-term relationship. The model explains 38% of the variation in TRSX. The probability of the F statistic suggests that the overall model is statistically significant. This result contradicts that of George (2024), who reported a positive response of exports to inflation.

Table 10: Long-term and short-term results for Model 3

Panel A: Long-Run Results				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
ICTX	-9.85	16.61	-0.59	0.55
EXRN	0.12	1.97	0.06	0.95
VOLT	222.75	210.81	1.05	0.29
INFR	-0.50	0.22	-2.25	0.03
NGDP	-1.43	0.78	-1.81	0.07
WGDP	0.54	2.26	0.24	0.81
Panel B: Short-Run Results				
C	14.04	13.97	1.00	0.32
TRSX(-1)*	-0.57	0.13	-4.22	0.00
ICTX**	-5.62	9.66	-0.58	0.56
EXRN**	0.06	1.12	0.06	0.95
VOLT**	127.11	122.36	1.03	0.30
INFR**	-0.29	0.12	-2.33	0.02
NGDP**	-0.81	0.43	-1.86	0.07
WGDP**	0.31	1.28	0.24	0.81
ECM(-1)	-0.57	0.11	-5.05	0.00
R-Squared = 0.38 ; Prob (F-Statistic= 0.00 ; Durbin-Watson Stat =2.0				

Source: Authors' computations.

Diagnostic tests for Model 3

The results of the diagnostic tests for Model 3 are presented in Table 11. The Ramsey Reset test establishes that the model is well specified. The LM test confirms the absence of autocorrelation, whereas the Breusch–Pagan–Godfrey test suggests no evidence of heteroscedasticity. The Jarque-Bera test shows that the residuals are not normally distributed. ARDL models are generally robust to the nonmorality of errors. This robustness stems from the fact that ARDL can handle variables of different orders of integration, both I(0) and I(1)), without requiring the errors to be normally distributed.

Table 11: Results of Diagnostic Tests for Model 3

Type of Test	Scaled explained SS		t-Statistic		F-Statistic		Obs*R-squared	
	value	prob	Value	Prob	Value	Prob	Value	Prob
Ramsey RESET	-	-	0.78	0.43	0.62	0.43	-	-
Serial Corre Lation	-	-	-	-	1.01	0.39	3.75	0.28
Heteros Cedasti City	-	-	-	-	0.90	0.51	6.60	0.47
Jarque-Bera		157.53	Prob(0.00)					

Source: Authors' computations. The dashes (-) indicate that the statistic is not applicable to that particular test.

Bound Cointegration Test for Model 4

The results of the bounds test in Table 12 confirm a long-run relationship between ICTX, EXRN, VOLT, INFR, NGDP, and WGDP.

Table 12: Results of the ARDL bounds test for Model 4

Test Statistic	Value	Significance level	Critical Values I(0)	I(1)
	4.14	3.41	4.68	3.41
F Statistic		5%	2.62	3.79
		10%	2.26	3.35

Source: Authors' computations.

Long-Run and Short-Run Results for Model 4

The results in Table 13 indicate that world GDP has a statistically significant negative effect on ICT exports in the long run. This violates the a priori theoretical expectations. The other results are not statistically significant.

Table 13: Long-term and short-term results for Model 4

Panel A: Long-Run Results				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXRN	0.02	0.01	1.21	0.23
VOLT	-0.43	4.27	-0.10	0.91
INFR	-0.00	0.00	-0.22	0.82
NGDP	-0.00	0.01	-0.39	0.69
WGDP	-0.07	0.03	-2.54	0.01
Panel B: Short-Run Results				
C	1.50	0.48	3.10	0.00
ICTX(-1)*	-1.12	0.22	-4.91	0.00
EXRN(-1)	0.02	0.02	1.19	0.24
VOLT(-1)	-0.49	4.81	-0.10	0.91
INFR(-1)	-0.00	0.00	-0.22	0.82
NGDP**	-0.00	0.01	-0.38	0.70
WGDP(-1)	-0.08	0.03	-2.30	0.02
D(ICTX(-1))	0.25	0.16	1.53	0.13
D(EXRN)	-0.04	0.12	-0.37	0.70
D(EXRN(-1))	-0.63	0.29	-2.19	0.03
D(EXRN(-2))	0.37	0.23	1.58	0.12
D(VOLT)	-12.74	6.71	-1.89	0.06
D(INFR)	-0.01	0.00	-2.24	0.03
D(WGDP)	-0.02	0.02	-1.21	0.23
ECM(-1)	-0.68	0.20	-5.42	0.00
R-Squared = 0.63 ; Prob(F-Statistic)= 0.00; Durbin-Watson Stat = 2.23				

Source: Authors' computations.

In the short run, the constant term is statistically significant, implying that the baseline level of ICT exports, holding all other variables estimated, is significant. The dependent variable, ICTX(-1)* has a significant negative effect on itself. Other significant negative effects on ICT exports are from WGDP(-1), D(EXRN(-1)), and D(INFR). The negative effect of EXRN contradicts the a priori theoretical expectations, whereas that of INF conforms. The coefficient of ECT has the correct sign and suggests a speed of adjustment of 68% of ICTX to long-run equilibrium. The estimated adjusted R-square shows that the model accounts for 63% of the changes in ICT exports. The model is also statistically significant. This result agrees with Urgessa (2024), who reported that the exchange rate deteriorates exports, but contradicts George (2024), who reported a positive effect of inflation on exports.

Diagnostic tests for Model 4

The model diagnostic tests suggest that Model 4 is correctly specified, as shown by the Ramsey test. The LM test indicates the absence of autocorrelation, whereas the Breusch–Pagan–Godfrey test indicates no heteroscedasticity. The Jarque-Bera test suggests that the residuals are not normally distributed. However, the correct specification of the ARDL model, including the selection of appropriate lags and ensuring stationarity conditions, is more critical than the distribution of errors.

Table 14: Results of Diagnostic Tests for Model 4

Type of Test	Scaled explained SS		t-Statistic		F-Statistic		Obs*R-squared	
	value	prob	Value	Prob	Value	prob	Value	Prob
Ramsey RESET	-	-	-	-	1.86	0.15	-	-
Serial Corre Lation	-	-	-	-	2.05	0.13	8.37	0.21
Heteros Cedasti City	14.99	0.30	-	-	0.47	0.91	7.68	0.86
Jarque-Bera	106.77	Prob(0.00)						

Source: Authors' computations. The dashes (-) indicate that the statistic is not applicable to that particular test.

5. Conclusion and Policy recommendations

Conclusion

This study investigated the effects of exchange rate volatility on trade flows in Nigeria’s emerging industries from 1981--2023. Specifically, the study investigated the effects of the exchange rate, volatility, inflation, national GDP, and world GDP on trade flows in Nigeria’s emerging industries, specifically focusing on insurance and financial services exports, intellectual property exports, transport services exports, and information and communication technology exports. This study applied the Krugman (1979) J-Curve Effect and the Marshall (1920); Lerner (1940) the Marshall–Lerner Condition and implemented an ARDL technique on four export demand models. The short-run analysis shows that exchange rate fluctuations and national GDP positively influence insurance and financial services exports, whereas inflation negatively impacts them. Worldwide GDP had a significant negative effect on intellectual property exports in the long run. In the short run, world GDP, exchange rate fluctuations, and inflation negatively impact intellectual property exports. Inflation had a significant negative effect on transport service exports both in the short and long run. World GDP had a significant negative long-term effect on information and communication technology exports. This study concludes that exchange rate volatility, inflation, national GDP, and world GDP significantly impact trade flows in Nigeria's emerging industries, with varying effects in the short and long run across different sectors.

Recommendations

On the basis of the findings of this study, the following recommendations are proposed. First, given the significant impact of exchange rate fluctuations and inflation on trade flows in Nigeria’s emerging industries, policymakers should prioritize exchange rate stability and implement measures to control inflation. These could include monetary policies aimed at maintaining a stable and competitive exchange rate while ensuring price stability.

Second, the positive relationship between national GDP and insurance and financial services exports in the short run highlights the importance of overall economic growth in boosting trade in emerging sectors. Policies aimed at enhancing national GDP, such as infrastructure development, fiscal incentives, and investment in key sectors such as ICT and transport, should be strengthened to sustain and enhance export growth.

Third, the negative long-term effects of world GDP on intellectual property and ICT exports suggest that Nigeria's emerging industries are vulnerable to global economic downturns. Policymakers should focus on diversifying export markets and enhancing the competitiveness of these sectors to reduce dependency on global economic conditions. The development of regional markets and investment in innovation and technology can help mitigate the impact of global economic fluctuations.

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