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RESEARCH PAPER

Bilateral Real Exchange Rate Volatility and Trade: The Nigerian Case

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Abstract
Real exchange rate volatility can inhibit or enhance trade. The volatility of Nigerian currency concerning Yuan, Yen, Pounds, and the US dollar exists but is not homogenous. This situation will affect trade flows between Nigeria and China, Japan, the UK, and the US. Therefore, this study unravels the nature and possible result of real exchange rate volatility on trade at the bilateral level from 2008:M1 to 2019:M3. Results obtained from the ARDL model in the context of risk aversion theory are as follows: (1) In the short run, real exchange rate volatility differs across country partners but more persistent in the case of Nigeria-UK trade; (2) in the long run, naira-dollar exchange rate shows detrimental effect on exports to the US, albeit insignificant; (3) real exchange rate volatility is trade enhancing with Japan, inhibiting with the UK and indifference with China and US. Following these results, issues surrounding real exchange rate volatility and trade must be better studied at the bilateral level to provide easy and implementable policy recommendations. Going by the results, it is recommended that trade with Japan should be strengthened. The monetary authorities should also consider Yen and Yuan as part of foreign currencies for international transactions. More hedging instruments should be encouraged to absorb volatility, particularly in the case of Nigeria-UK trade. The potential traders will possibly do well by looking inward instead of facing exchange rate risk in the UK.

Keywords: Autoregressive Distributed Lag, Real Exchange Rate, Trade.
JEL Classification: F14, F31, F41.

1. Introduction
Trade between two countries depends on a range of factors (Rassoulinezhad and Popova, 2017). From the theoretical front, the economic conditions of the country and that of the trading partners are used as major factors driving imports and exports respectively (Helpman et al., 2008). However, trade is also exposed to some risks such as commodity price fluctuations, financial crises, and exchange rate uncertainty (Yu, 2016). Of all these, exchange rate volatility appears to be the most recurring and most difficult to control. Exchange rate volatility can inhibit or

enhance trade, depending on the risk attitudes of the participants. Risk-averse traders will possibly avoid or reduce trade if the exchange rate is volatile. Risk lovers will increase trade while risk-neutral traders will be indifferent to the exchange rates (Bahmani-Oskooee and Nouira, 2019).

The empirical evidence in this regard is voluminous and still attracting interest, albeit, it follows three methodological paths, namely, aggregate trade (export and imports) between a country and the rest of the world; aggregate trade flows between two countries (bilateral trade) and bilateral trade flows on a commodity basis. Of these three, the first one is most prominent in the literature. However, this approach suffers from aggregation bias because trade flow between two trading partners reacts to bilateral exchange rate volatility differently compared to the case of a country and the rest of the world (Bahmani-Oskooee and Nouira, 2019). The reason is that exchange rate volatility exists through changes in nominal exchange rates and prices of trading partners. Consequently, real exchange rate volatility will persist irrespective of the exchange rate regime a country is operating. However, it will be more pervasive as the country moves from a fixed exchange rate to a floating exchange rate. Hence, studying the effect of real exchange rate volatility on trade at the bilateral level provides richer, more reliable, and policy-friendly information than the aggregation approach (Bajo-Rabio et al., 2020).

The literature on the effects of exchange rate volatility on trade in Nigeria is voluminous and still counting. However, results are diverse owing to methodological issues. First is the aggregation bias (see Onafowora and Owoeye, 2008; Musibau and Hamed, 2017; Ojeyinka, 2019; Fofanah, 2020; Aderemi et al., 2020, and Njoroge, 2020 among others). The study of Onafowora and Owoeye (2008) is an exemption in this regard but the authors focus on one major partner, namely, China.

The second one is the issue surrounding the choice of exchange rate and data frequency. While some of these studies chose a naira-dollar bilateral exchange rate for the whole trading partners, very few employed an effective exchange rate. Since the US is not the only major trading partner, it may be incorrect to employ naira-dollar alone. In the last 10 years, available data suggest that China is Nigeria's leading importing country while countries such as the United Kingdom, Spain, France, and Japan have emerged as major trading partners (Central Bank of Nigeria data online)[1]. Consequence upon this, Pounds, and Euro are also major foreign currencies for transactions in Nigeria while the Chinese Yuan and Japanese Yen are gaining strong access. Available data suggests that there exists notable bilateral volatility of naira about these currencies and that the percentage change

[1]. This information was based on data availability as at the time of conducting this research.

is not similar. For example, naira-dollar real exchange rate volatility hovered around 4.7 and 4.9 between December 2009 and March 2019 while that of naira-Yen was between 5.1 and 5.4 and naira-Yuan was between 2.9 and 3.1 in the same period[1]. In addition, the percentage change indicates that naira-yuan volatility changes faster than naira-dollar or naira-yen. By implication, it is unclear whether Nigeria could have exchange rate stability based on these major currencies and whether such could be beneficial to the country.

Further, employing an effective exchange rate not only reduces data to yearly observation, thereby casting doubt on the nature of volatility but also makes it difficult to identify the currency that largely contributes to real exchange rate volatility in Nigeria. In the case of data frequency, at best, the highest data frequency considered in the existing studies is quarterly. However, to get the best result from volatility, it makes sense to utilize high-frequency data such as monthly or weekly data because the information that produces volatility gets lost with time. Although the study of Yakubu et al. (2019) appears to be an exemption in this regard, the method utilized will remove the stochastic tendency of the data because the monthly data generated is a reflection of and depends on the annual data provided. Consequently, the method casts doubt on the authenticity of the volatility outcome of the data.

The importance of this study stems from improving the efficacy of exchange rate volatility on Nigeria's trade at the bilateral level and this could assist the monetary authorities in making adequate foreign exchange decisions. What distinguishes this paper from the existing works are as follows: (i) instead of aggregating all countries, four major trading partners are selected because the currencies of these trading partners strongly influence trade outcomes in Nigeria. These countries are China, the United Kingdom, Japan, and the United States[2]; (ii) data on the bilateral real exchange rate of naira concerning each of these countries' currencies is computed using appropriate methods. It must be noted that the available bilateral data are domestic currency about the dollar. This information is employed to compute the exchange rate of naira concerning each currency. Further, real exchange rate volatility at the bilateral level is also computed. To the best of the researchers' knowledge, this is the first paper that will carry out such tasks in the case of Nigeria. This approach will unravel how persistent or otherwise exchange rate volatility is in driving Nigerian trade with each of these countries. (iii) understanding whether country-pair exchange rate volatility affects trade a short-run or long-run phenomenon is also important. Once this is established, the monetary authorities may find it reasonable to revisit its foreign exchange policy bearing in mind its short-run or long-run implication on trade. It also allows the

[1]. The volatility figures quoted are computed with underlying data from CBN and IFS.
[2]. These countries are selected based on the availability of monthly bilateral data.

monetary authorities to have an understanding of which foreign currency among the major trading partners is more volatile and at what period (either short run or long run). Further, some countries that share the same economic characteristics as Nigeria can benefit from the research outcome findings from this study indicate the following: (a) Bilateral real exchange rate is more of short run than long-run phenomenon. Only naira-dollar negatively affects exports in the long run, and (b) Bilateral real exchange rate volatility affects trade differently both across structure (export and imports) and countries. For instance, it enhances Nigeria-Japan trade; it inhibits Nigeria-UK trade and it does not affect Nigeria-US and Nigeria-China trade.

2. Literature Review

2.1 Theoretical Review

The theoretical underpinning of exchange rate volatility and trade is traced to the theory of firms' behavior in the presence of uncertainty. This theory, which was well articulated by Clark (1973), argued the effect of exchange rate volatility on trade is inconclusive. On the one hand, exchange rate volatility can strangulate trade. On the other hand, it may be inconsequential or even enhances trade. The outcome strictly depends on the state of the economy and how firms respond to the uncertainty. Under the assumption of the perfectly competitive market, zero import input, and absence (or limited) hedging markets, firms' expected utility is driven, in part by the value and variance of profit influenced by exchange rate uncertainty. Consequently, a risk-averse firm will reduce exports when there is high exchange rate volatility to prevent the utility from falling (Clark, 1973; Baron, 1976; Hooper and Kohlhagon, 1978). Even if part of the input is sourced from abroad, exchange rate volatility can still inhibit trade. Specifically, although firms lose foreign currency from depreciation, part of the losses can be offset by lowering input costs. In addition, firms that are risk-averse may decide to diversify sales by concentrating more on selling at home.

However, De Grawe (1988) argues that the action of risk-averse firms to exchange rate uncertainty produces both income and substitution effects. The substitution effect holds if the risk-averse firms care about expected utility and hence, reduce exports to prevent expected utility from falling. The income effect holds if the agents care about the revenue derivable from exporting so that exports increase even when exchange rate volatility is rising provided the profit is worthwhile. Exchange rate volatility can also enhance trade if firms are risk-neutral or if they can adjust factor inputs with minimum or zero cost. This is possible because, during high exchange rate volatility, firms will increase input cost adjustment thereby creating additional gain from exporting (Cazonen et al., 1984). Even if the cost of adjustment is high, exchange rate volatility can still enhance

trade under a favorable economic environment (high labor productivity, low inflation rate, and high income). Exchange rate volatility may not have any significant effect on trade if there is an effective hedging market. To the extent that the hedging market can be accessed at a low cost, firms will hedge any risk associated with the exchange rate (Ethier, 1973; Baron, 1976). In the absence of a hedging facility[1], if the exporting/importing firms are composed of multinationals, exchange rate volatility can be weathered off through other exchange rates or interest rates (Nguyen and Thuy, 2019).

The brief theoretical review suggests that the effect of exchange rate volatility on trade is open and debatable. The lesson therein is if firms in a country are composed of risk-averse agents and if they care about the expected utility of their income then exports will fall following rising exchange rate volatility. However, if they care about revenue to be derived from exports, then an increase in exchange rate volatility will lead to an increase in exports.

2.2 Empirical Review

There is a large empirical study testing this theory but unfortunately, the results are diverse. Most of the empirical studies specify export and import demand functions and investigate the effect both in the short- and long-run (Table 1).

[1]. In developing countries, hedging market is either not available or very expensive for firms to access due to time lag between order and delivery, time zone and transaction cost.

Table 1. Summary of the Empirical Review

S/N	Author(s)	Study area	Methodology and data	Structure of trade	result of the effect of exchange rate volatility on trade
1	Clark et al. (2004)	Developed and Developing countries	Panel data controlling for time-fixed effect	Aggregate exports	Negative
2	Hall et al. (2010)	10 emerging economies (EME) and 11 other developing countries (LDCs)	GMM and time-varying coefficient. 1980:-2000:4	Aggregate export	Negative and significant in the LDCs but insignificant in EME. Capital flows may have reduced the effect on EME
3	Situ (2015)	Developed and export-oriented countries (Canada, Japan, Switzerland, and Sweden) and LDC (Mexico, South Korea, Malaysia, Thailand and Indonesia) to the US	Monthly data 1994:1-2007:12; 2008:1-2014:10.	Aggregate export	
4	Bajo-Rabio et al. (2020)	The 4 largest Eurozone countries (France, Germany, Spain, and Italy	Export demand functions with several measures of exchange rate volatility. 1994:1-2014:4	Aggregate export	Non-notable effect. Meaning that financial markets have developed to stem the volatility effect
5	Arize et al. (2000)	13 developing countries	Quarterly data from 1973:1 to 1996:4	ARDL	Negative and significant effect in the short run but insignificant in the long run
6	Njoroye (2020)	19 COMESA members	Panel gravity model (1992-2017)	Aggregate export	Negative
7	Akpokodje and Omojimite (2009)	ECOWAS	Import demand function (1986-2006	Aggregate import	Negative for the whole sample and CFA but positive for nonCFA
8	Seriadza and Daiaba (2017)	11 SSA countries	Panel ARDL Pooled-mean group (1993-2014)	Aggregate trade (export and import)	Insignificant for import and negative for export in the short run. Positive in the long run
9	Osei-Abbey (2019)	3 SSA countries (Ghana, Tanzania, and Mozambique)	Panel ARDL pooled-mean group (1993-2014)	Aggregate trade (exports and imports)	Negative on export in the short run and positive in the long run. Negative on import in the short run, insignificant in the long run
10	Bahmani-Oskooee and Gelan (2018)	12 African countries (including Nigeria)	ARDL (1971:1-2015:4	Aggregate export	In the short run, it is negative for Burundi, Egypt, and Mauritania but Positive in Lesotho and insignificant in others. In the long run, positive in Egypt, Mauritania, Lesotho, and South Africa but negative in Nigeria, Sierra Leone, and Morocco.
11	Dada (2020)	17 SSA countries	Panel fixed effect (1991-2017)	Aggregate trade (export and import)	Negative on both export and import. The exchange rate movement is also negative.
12	Fofanah (2020)	14 ECOWAS countries	Pooled OLS (1992-2017	Trade balance	Insignificant on trade balance. Depreciation of the exchange rate also reduces exports.
13	Devita and Abbort (2004)	UK to EU 14	ARDL bounds tests (1993:1-2001:6).	Exports at both aggregate and sectoral	Insignificant both in the short and long run and across the sector
14	Asterious et al. (2016)	MINT (Mexico, Indonesia, Nigeria, and Turkey) countries	ARDL	Aggregate export	Insignificant in the long run in all the countries except Turkey
15	Serenis and Tsounis (2014)	Croatia and Cyprus	1990:1-2012:1	Aggregate export	Negative
16	Nguyen and Thuy (2019)	Vietnam	ARDL Bounds Test (2008:1-2014:4	Aggregate Export	Significant negative effect of exchange rate volatility on exports in the long run. Also, exchange rate movement negatively affects exports in the short run.
18	Bahmani-Oskoee and Noura (2019)	Tunisia with 16 trading partners	Annual data1987-2016	Testing for symmetric and asymmetric effects on each of the trading partners (the use of NARDL).	Exports are affected asymmetrically by real exchange rate volatility in the short run but not in the long run
19	Khanand Syed (2014)	Pakistan with selected countries from Developed and Developing Countries	Export and Import demand functions. Monthly data from 1970:1 to 2009:12	Panel fixe effects	Exports and Imports are affected negatively by exchange rate volatility when each country's currency is in terms of US dollars. But when a bilateral exchange rate is employed, the volatility is insignificant
20	Musila (2002)	Malawi	Export and import demand function. Annual data from 1968 to 1998	ECM	Devaluation reduces trade balance in the short run but improves it in the long run (follows the famous J-curve

21	Onafowora and Owoye (2008)	Nigeria-US	Quarterly data 1980:4-2001:4	VECM	Exchange rate volatility affects exports both in the short run and in the long run.
22	Shehu (2010)	Nigeria-Rest of the World	Non-oil export. Quarterly data from 1986:1 to 2006:4. Employed naira-dollar exchange rate to measure volatility		Exchange rate volatility has a negative effect on non-oil export.
23	Aliyu (2010)	Nigeria	Quarterly data from 1986:1 to 2006:4	VEC	Negative effect
24	Joseph (2011)	Nigeria	Annual data from 1970 to 2009	ECM	Show negative but insignificant
25	Essien et al. (2011)	Nigeria	Cocoa Export.	Least Square	Positive effect
26	Dickson and Ukwe (2013)	Nigeria	Export and import demand functions. Annual data from 1970 to 2010	ECM	Positive and significant effect on export but insignificant on imports
27	Musibau, B and Halimah Hamed (2017)	Nigeria	Non-oil export. Quarterly data from 1986:1 to 2001:4	ECM	Negative effect
28	Urendus et al. (2017)	Nigeria	Quarterly data from 1987:1 to 2011:4	ARDL	Insignificant in the short run but negative and significant in the long run
29	Yakub et al. (2019)	Nigeria	Export demand function. Monthly data from 1997:1 to 2016:12	VECM	Negative and significant effect in the short run and insignificant in the long run.
30	Aderemi et al. (2020)	Nigeria	Annual data from 1981-2016)	ARDL	Negative effect on export and positive effect on imports
31	Ikechi and Nwadiubu (2020)	Nigeria	Annual data from 1996 to 2018	VAR	Inverse relationship
32	Wang and Barrett (2007)	Taiwan-US	Monthly sectoral data from 1989:1 to 1999:12	GARCH-type with variance-covariance analyses	Negative effect on agriculture export but insignificant for other sector
33	Nishimura (2013)	Japan-China	Monthly data from 2002:1 to 2011:12	ARDL	Negative but insignificant effect. Exchange rate movement is also not significant.
34	Chi and Cheng (2016)	Australia-selected Asian Countries (China, Japan, S/Korea, Taiwan, India, Indonesia and Malaysia)	Maritime Export	ARDL	The effect varies across country pairs. Positive with China, India, Indonesia, and Malaysia; negative with S/Korea. In the long run, negative with S/Korea and India and positive in Malaysia.
35	Ariani (2010)	Indonesia-Japan and US	Monthly data from 1998:1 to 2005:10	ARDL (ECM)	Negative in the short and long run with Japan and positive with the US in the short run and insignificant in the long run
36	Sugihart et al. (2020)	Indonesia-top 5 exporting countries (China, India, Japan, S/Korea, and the US	Monthly data from 2006:1 to 2018:12	ARDL	When all countries are aggregated, the result shows a positive effect. At the country pair level, there is a negative effect on exports to China, S/Korea, and the US and a positive effect on exports to Japan in the short run. In the long run, there is a negative effect on exports to all the countries except China which reported a positive effect.
37	Bahmani-Oskoee, and Afrab (2017)	Malaysia-US	Monthly data for 54 exporting firms to the US and 63 importing firms from the US; 2001:4-2015:12	NARDL	One-third of the sectors support short-run and long-term asymmetry.
38	Turasenko (2021)	Russia with 70 trading partners	2004-2018	IV approach	Negative effect on exports and positive effects on imports
39	Ekanayake and Dissanayake (2022)	US with BRICS	Quarterly data from 1913:Q1-2021:Q2	Panel FMOLS and Panel; DOLS alongside ARDL	Negative effect on exports in the long run. Mixed result in the short run.

While the measure of exchange rate volatility is also not uniform, most of the empirical works contend with the use of the ARCH-type method owing to the argument that the volatility tends to be time-dependent, may be symmetric or asymmetric, and the fact that the news inherent in the volatility could be negative or positive.

Observably, the study of the subject matter is still ongoing. Second, most empirical works focus on the country or regional trade with the rest of the world. Most of the analyses concentrated on exports. Lastly, a handful of results are available in the case of Nigeria, albeit, most of them are either based on aggregate or sectoral trade but not on bilateral bases (Table 1). In terms of methodology, very many authors employ an ARCH-type approach to compute exchange rate volatility but use the result in different techniques of estimation, with ARDL being the most employed.

Expectedly, results are diverse but more information is needed, especially at the bilateral level.

The empirical gap that this study seeks to fill is clear. Instead of employing a naira-dollar exchange rate, which is common in the existing studies, a bilateral exchange rate is utilized. Second, instead of considering Nigeria's trade with the world, four major trading partners for which their currencies are internationally traded are employed. This is to examine how Nigeria's trade with each of these trading partners fared well with the corresponding exchange rate. To capture more information about the nature of volatility, monthly data (rather than annual/quarterly data) are compiled and utilized. It is hoped that filling these gaps will provide dipper understanding of the dynamics of exchange rates and how Nigeria's trade responds to such dynamics, particularly with its major trading partners.

3. Research Method

3.1 Model Specification

Exchange rate volatility is one of the risks faced by the participants in the foreign exchange market. Merchandize exporters and importers *(aka* traders) are also participants in this market. If a large proportion of traders care about the expected utility of their income, then exchange rate volatility will inhibit exports but enhance imports. If they care about future revenue, then exchange rate volatility will facilitate exports and discourage imports. Volatility may not affect trade if hedging instruments are available and accessible.

Based on this theoretical background and some standard empirical papers such as Nguyen and Thuy (2019) and Bahmani-Oskooee (2019), the model for the determinants of trade with reference to exchange rate volatility at the bilateral level is shown in Equation 1.

$$TRADE_{i,jt} = f(VOL_{i,jt}, Z) \quad (1)$$

where TRADE is the bilateral trade (export or import) between the reporter (*i*) and the major partners (*j*), VOL is the real exchange rate volatility and Z represents catchall variables affecting trade. Such variables, as captured by standard literature include GDP of reporter and partners, real exchange rate, and international reserves. Incorporating these variables for Z in Equation 1 and specifying a model for export and import separately the estimable model of Equation 1 for Nigeria is shown in Equations 2 and 3:

$$XPORT_{N,ft} = \gamma_0 + \gamma_1 REXR_t^{N,f} + \gamma_2 REXR\_VOL_t^{N,f} + \gamma_3 GDP_t^N + \gamma_4 GDP_t^f + \gamma_5 RES_t + \mu_t \quad (2)$$

$$MPORT_{N,ft} = \gamma_0 + \gamma_1 REXR_t^{N,f} + \gamma_2 REXR\_VOL_t^{N,f} + \gamma_3 GDP_t^N + \gamma_4 GDP_t^f + \gamma_5 RES_t + \mu_t \quad (3)$$

$XPORT_{N,ft}$= export of Nigeria to country *j* at time *t*; $MPORT_{N,ft}$ represents import of Nigeria form country *j*; $REXR_t^{N,f}$ is the bilateral real exchange rate movement of Nigeria currency viz-a-viz each of the partners' currencies, $REXR\_VOL_t^{N,f}$ is the bilateral real exchange rate volatility between Nigeria currency and the currency of country *j*, and RES is international reserves of Nigeria. Other terms are the parameters of the model and the error term.

Following the *J-curve* phenomenon, exchange rate depreciation is expected to dwarf trade in the short run but enhance it in the long run (Jackson et al., 2021). There is no decisive effect of exchange rate volatility on either export or import. Following the Keynesian national income theory, export is an increasing function of partners' income while import is an increasing function of Nigeria's income (Lawal et al., 2022; Ekanayake and Dissanayake, 2022). However, exports may decrease following an increase in foreign income if export products are abnormal. Import may also respond negatively to an increase in Nigeria's GDP if there is an economic sanction that prevents Nigeria from importing as much as expected (Rasoulinezhad and Popova, 2017; Rasoulinezhad and Kang, 2016). International reserves are expected to enhance imports and reduce exports (Sugiharti et al., 2020).

3.2 Estimation Issue and the Preferred Technique

There are at least three estimation issues in Equations 2 and 3. First, exchange rate volatility is not observable, and hence, it has to be computed. Although there are several measures of volatility, the one that is commonly utilized is that which is generated through the Autoregressive Conditional Heteroskedasticity (ARCH)-type. Usually, the best model among the ARCH-type is chosen by applying model selection criteria such as the Schwartz Information Criteria (SIC). Thus, with the aid of SIC, the appropriate nature of ARCH-type is selected and incorporated in

the export and import models. Second, the bilateral exchange rate is not before the computation of the bilateral real exchange rate between Nigeria and each of the trading partners is not readily available, and so it is computed[1].

The third is the issues surrounding the series. These series are obtained at the secondary level and hence, prone to be nonstationary. The implication of this is that the usual linear regression estimation cannot be carried out. To establish this and to choose the appropriate estimation method, unit root tests are performed. Several techniques abound for testing unit root or the existence of non-stationarity but for the scarcity of space and the fact that all these tests, more often than none yield similar results, the Augmented Dickey-Fuller (ADF) and Phillip Perom (PP) are employed.

The appropriate technique of estimation for this paper is the autoregressive distributed lag (ARDL) owing to the stationarity outcome of the series. Specifically, the series exhibits a combination of I(0) and I(1). The advantages of ARDL over others are that it has built-in bound testing for investigating cointegrating relationships, it is capable of dealing with endogeneity problems, and can test the long-run estimates (Sezgin and Yildrim, 2002).

After loglinearizing Equations 2 and 3, the short-run dynamics cointegrating equation alongside the long-run form are specified in Equations 4 to 7 for exports and imports respectively.

$$\begin{aligned}\Delta lnXPORT_{N,ft} = \gamma_0 + \sum_{i=1}^{L} \pi_i \Delta lnXPORT_{N,ft-i} + \vartheta_i \sum_{i=0}^{q1} \Delta lnREXR_{t-i}^{N,f} \\ + \emptyset_i \sum_{i=0}^{q2} \Delta REXR\_VOL_{t-i}^{N,f} + \tau_i \sum_{i=0}^{q3} \Delta lnGDP_{t-i}^{N} \\ + \beta_i \sum_{i=0}^{q4} \Delta lnGDP_{t-i}^{f} + \varphi_i \sum_{i=5}^{q5} RES_{t-i} + cointeq_{t-1} + \mu_t\end{aligned} \tag{4}$$

$$\begin{aligned}\Delta lnMPORT_{N,ft} = \gamma_0 + \sum_{i=1}^{L} \pi_i \Delta lnMPORT_{N,ft-i} + \vartheta_i \sum_{i=0}^{q1} \Delta lnREXR_{t-i}^{N,f} \\ + \emptyset_i \sum_{i=0}^{q2} \Delta REXR\_VOL_{t-i}^{N,f} + \tau_i \sum_{i=0}^{q3} \Delta lnGDP_{t-i}^{N} \\ + \beta_i \sum_{i=0}^{q4} \Delta lnGDP_{t-i}^{f} + \varphi_i \sum_{i=5}^{q5} RES_{t-i} + cointeq_{t-1}\end{aligned} \tag{5}$$

$$\begin{aligned}lnXPORT_{N,ft} = \gamma_0 + \gamma_1 lnREXR_t^{N,f} + \gamma_2 REXR\_VOL_t^{N,f} + \gamma_3 lnGDP_t^{N} \\ + \gamma_4 lnGDP_t^{f} + \gamma_5 lnRES_t + \mu_t\end{aligned} \tag{6}$$

[1]. Data are only available for local currency per unit of US dollars. Suppose we have two countries, i and j and the US. The nominal exchange rate of each country with respect to US dollar will be C_i/S and C_j/\$ respectively. This is what is reported in the data. To now get C_i/C_j, we divide C_i/\$ by C_j/\$, that is $\frac{C_i}{C_j} = \frac{C_i}{\$} \div \frac{C_j}{\$}$. Multiplying this by the composite relative price level ($\frac{P_j}{P_i}$) we arrive at bilateral real exchange rate. In this regard, country *i* is Nigeria and country *j* is each of the trading partners.

$$lnMPORT_{N,ft} = \gamma_0 + \gamma_1 lnREXR_t^{N,f} + \gamma_2 REXR\_VOL_t^{N,f} + \gamma_3 lnGDP_t^N + \gamma_4 lnGDP_t^f + \gamma_5 RlnES_t + \mu_t \quad (7)$$

3.3 Sources of Data

Data on bilateral exchange rates was computed by utilizing data from International Financial Statistics (IFS) data on bilateral exports and imports were sourced from the Nigerian Bureau of Statistics (NBS). Nigeria's GDP and foreign reserves were obtained from the Central Bank of Nigeria (CBN) statistical bulletin while data on foreign GDP was extracted from the IFS. High-frequency data on GDP are not readily available. However, the quarterly data were converted to monthly data using the *quadratic-match average frequency conversion* method.

All data are obtained from January 2008 to March 2019 and the majority of the consideration of Nigeria to selected major trading collaborates, namely, UK, USA, China, and Japan. The bilateral real exchange rates are obtained by multiplying the nominal exchange rate by the relative price level. This proxy is measured in domestic currency (naira) to foreign currency (yuan, yen, dollar, and euro). Domestic GDP is measured in real domestic currency (naira) and Foreign GDP is measured in their respective foreign currency. Bilateral exports and imports are measured in Naira value and foreign reserves are measured in naira. Real exchange rate volatility is obtained from the best models of the GARCH family.

4. Result and Discussions

4.1 Descriptive Analysis and Estimation Results

Summary statistics alongside the trend of bilateral exchange rate and trade are reported in Table A1 and Figure A1 respectively in the Appendix. The series are subjected to unit root tests employing the ADF and Phillip Perron tests[1]. The unit root test results indicate that while some variables are stationary at levels, others are stationary in the first difference. Following this outcome, the co-integration test is conducted using the ARDL bounds test, to investigate the long-run relationship among the variables. The results of the bounds test suggest the existence of co-integration among variables, indicating that the model converges to equilibrium following any disturbance (Table 2). Consequently, Equations 4 and 5 are estimated for short-run dynamic (and long-run convergence) while Equations 6 and 7 are estimated for long.

[1]. Due to limited space, a comprehensive result of the unit root and stationarity tests are not reported. However, they are available on request.

Table 2. ARDL Bounds Test Result

MODEL		Export Model		Import Model
F statistics for China		5.30		39.38
F statistics for Japan		7.89		9.31
F statistics for the UK		7.82		15.92
F statistics for the US		9.73		28.81
Critical value bounds				
Significance	10%	5%	2.5%	1%
I(0)	2.72	3.23	3.69	4.29
I(1)	3.77	4.35	4.89	5.61

Source: Research finding.

4.2 ARCH-type Test

Table 3 presents the result of the volatility models, that is, GARCH, EGARCH, and T-GARCH alongside respective Schwartz Information Criteria (SIC) values. The model with the lowest value of SIC (shown **in bold)** indicates the best fit and from which the series of volatility is derived (Table 3). Consequence upon this, the appropriate GARCH-type model is the EGRACH or TGARCH.

Table 3. Result of Exchange Rate and Trade Volatiles

Variables	CHINA						JAPAN					
	GARCH		EGARCH		TGARCH		GARCH		EGARCH		TGARCH	
	Coef (prob)	SIC	Coef (prob)	SIC	Coef (prob)	SIC	Coef (prob)	SIC	Coef (prob)	SIC	Coef (prob)	SIC
RER	-0.029 (0.176)	-4.360	-0.639*** (0.00)	**-4.772**	9.409*** (0.001)	-4.664	-0.047 (0.442)	-3.11	-0.050*** (0.00)	**-3.737**	-0.474*** (0.00)	-3.22
Variables	**UK**						**US**					
RER	-0.038 (0.69)	-3.66	-0.603*** (0.00)	-3.74	0.495*** (0.00)	**-3.749**	7.59E-05 (0.97)	-5.46	-1.75*** (0.00)	**-5.77**	27.58*** (0.00)	-5.73

Source: Research finding.

Note: values in the brackets are the probabilities; *, **, and *** indicate significance at 10%, 5%, and 1% critical levels respectively.

Following the result of the volatility model and the outcome of the stationarity tests, Table 4 presents the short-run dynamic of the export model with particular reference to real exchange rate volatility. First, considering the model for Nigeria-China trade, two variables, namely the one-month lag of export and contemporaneous change in Nigeria's GDP have positive and negative effects respectively (Table 4). This implies that a continuous increase in Nigeria's GDP is detrimental to exports to China, while the market for Nigeria's exports to China is thriving. Foreign reserves are rightly signed, posting a negative effect on exports to China. China's GDP also shows a negative effect, albeit insignificant. This could suggest that most products exported to China appear to be inferior or necessities. Consequently, the continuous export of these products may be affected adversely as the level of development increases in China. This result reflects the structure of export products to China, which is more of natural resources and agricultural products.

Exchange rate movement and its volatility show positive effect t. This result implies that real depreciation tends to encourage competitiveness[1], while most exporters exporting to China are risk-neutral or perhaps, they can activate available hedging instruments to dampen the effect. Nigeria's hedging market such as the forward exchange rate is gaining attention and has become an effective hedging instrument among the importer and exporters. It could also be that most products exported to China are inferior since they neither respond to exchange rate changes nor volatility.

[1]. This may be due to increase in nominal exchange rate rather than increase in relative price.

Table 4. Short-Run Dynamic Effect of Bilateral Real Exchange Rate Volatility on Exports

VARIABLES	CHINA	JAPAN	UK	US
ΔLNEXP$_{-1}$	0.25**	-0.32**	-0.18*	-0.32**
	(2.852)	(-2.277)	(-1.252)	(-2.708)
ΔLNNEXP$_{-2}$		-0.41***	-0.13*	-0.19*
		(-3.568)	(-1.731)	(-1.706)
ΔLNEXP$_{-3}$		-0.25**		-0.24**
		(-2.795)		(-2.649)
ΔLNRER	0.19	0.68**	1.12	0.51
	(1.227)	(2.295)	(0.928)	(0.453)
ΔLNGDP_FOREIGN	-0.03	-0.49	0.11***	-0.90
	(-0.991)	(-0.798)	(6.679)	(-1.191)
ΔLNNGDP	-0.04*	-0.16*	0.63	1.02
	(-1.790)	(-1.813)	(1.403)	(-1.292)
ΔLNNGDP$_{-1}$	-0.64	-0.02**	0.36***	
	(-0.685)	(-2.432)	(3.162)	
ΔLNRESERVE	-0.02	-0.32**	0.03**	0.26**
	(-0.302)	(-2.693)	(0.021)	(2.786)
ΔVOL	0.12	0.28**	-0.74**	0.44
	(0.224)	(2.907)	(-2.201)	(0.680)
ΔVOL$_{-1}$			-0.49*	
			(-1.776)	
ΔVOL$_{-2}$			0.05***	
			(4.388)	
ΔVOL$_{-3}$			0.29***	
			(4.899)	
CointEq$_{-1}$	-0.98***	-0.54***	-0.62***	-0.40***
	-8.793	-3.426	-5.899	-3.275

Source: Research finding.

Note: values in parentheses are the t-statistics; *, **, and *** indicate significance at 10%, 5%, and 1% respectively.

In the case of export to Japan, up to a three-month lag of export has a significant effect on contemporaneous exports. Further, Nigeria's GDP, foreign reserves, real exchange rate movement, and exchange rate volatility have a significant effect. Unlike the case of exports to China, exports to Japan are increasing at a decreasing rate. Specifically, an increase in the last month's export to the tune of 1% reduces current export by 0.3 percentage points and reduces next month's export by 0.4%. Nigeria's GDP persistently dwarfs exports to Japan as an increase in GDP reduces exports in the current and succeeding months.

The effect of exchange rate movement on exports to Japan is also positive, significant, and more pronounced than the case of Nigeria-China. The positive effect of the exchange rate movement suggests that real depreciation facilitates

exports to Japan. Specifically, if the real exchange rate depreciates by 1%, exports will rise by 0.7%. The *J-curve phenomenon* cannot hold in this regard. Like exchange rate movement, real exchange rate volatility significantly affects exports to Japan. In this regard, a 1% increase in volatility leads to an approximately 0.3% increase in exports (Table 4). The positive effect suggests that exporters moving goods to Japan are risk neutral, placing more attention on future revenue accruing from export than the utility derived from the process. One more reason for the positive effect is that the exchange rate of Nigeria appears to be more relatively predictable and the risk-neutral exporters tend to capitalize on this to export more.

Generally, exports to selected Asian countries (developing countries) are reduced by an increase in Nigeria's GDP, foreign reserves, and lagged periods of exports but are increased by real exchange rate movement and its volatility. In terms of contribution, the result suggests that volatility from Naira-Yen more influences exports than naira-Yuan.

The results from Europe and America (advanced countries) are relatively different. In particular, exports to the United Kingdom (UK) are affected positively by the real effective exchange rate, GDP, and foreign reserves while exchange rate volatility is negative. An increase in the UK GDP increases exports to the country, suggesting that products exported to the UK are normal. This is not surprising because some bilateral trade arrangements favor non-oil exports to the UK. In addition, UK-based Nigerians are increasing and this could influence more demand for home products. Owing to more demand for Nigerian products, more resources are shifted to producing goods exported to the UK.

In the case of real exchange rate movement and volatility, there is a persistent response of export to these two variables. In the first two months, volatility dwarfs exports while in the last two months, it enhances exports. What this implies is that initially, exports are dominated by risk-averse agents placing more importance on utility rather than revenue derivable from exports but as time passes on, agents tend to pay more attention to revenue and hence, export more in the face of exchange rate volatility due perhaps to ability to predict the direction of volatility (since, according to the nature of the volatility, positive shock responds to good news in the market). The agents can read the market relatively accurately and have taken the opportunity of the volatility bearing in mind that it will eventually increase their revenue. Coming to exports to the US, the previous month’s increase in exports leads to a reduction in the current month’s exports. Nigeria and US GDP are important but insignificant in influencing exports. Exchange rate movement and volatility show positive but insignificant signs. Hence, agents exporting to the US may have been benefitting from effective hedging facilities such as forward exchange rates. It could also be that agents exporting to the US are risk-neutral.

From the export function results, it is clear that real exchange rate volatility affects exports across countries differently depending on how easy to activate hedging instruments and the behavior of agents exporting to these countries. Exports to China and the US (Nigeria's first-class export partners) do not respond significantly to bilateral real exchange rate volatility. Exports to Japan and the UK respond significantly to bilateral exchange rate volatility. Exports to the UK are crucial as the direction of effect changes over time. Further, the magnitude of the effect is more pronounced in the UK than in any other countries under study.

The short-run deviation from the long-run equilibrium (the cointegrating equation) indicates that the adjustment is faster in the case of Nigeria-China than any other country pair. As can be read, 9% of the 10% short-run deviation from the long-run equilibrium will be adjusted for in the current month, while the rest 1% will be accounted for in the succeeding month. Hence, following the distortion in the export to China, an adjustment will be completed in less than five weeks. In the case of Nigeria-Japan, approximately half of the adjustment will happen in the current month. Hence, it will take two months to return to equilibrium if there is any disturbance in the system. Any short-run deviation from the long-run equilibrium of export to the UK will take around 6 weeks for the adjustment to complete. The case of Nigeria-US is somewhat different as it takes more than two months before the full equilibrium is restored after a disturbance. The result from the adjustment process also indicates that the speed of adjustment differs across countries.

The short-run result for the import model is presented in Table 5. Import from China is significantly but negatively affected by the previous month's import and current real exchange rate movement. The contemporaneous GDP of Nigeria and the three-month lag real exchange rate volatility have significant and positive effects. This outcome implies that products imported from China are normal. Depreciation dwarfs imports because it makes imports relatively expensive. However, the magnitude of the effect is weak, posting a 0.8% decrease for a 10% depreciation. This could be attributed to the pattern of imports, of which some products such as intermediate imports and some final goods may likely be imported despite how expensive they become. Contemporaneous as well as asynchronous exchange rate volatility have effects on imports from China. However, only the third lag (third month) significantly affects imports. Overall, exchange rate volatility is import-enhancing in this regard. What this suggests is that agents importing from China can be considered risk-neutral or possess the ability to correctly read exchange rate uncertainty in a way to increase their profit.

Table 5. Short-run Dynamic Effect of Bilateral Real Exchange Rate Volatility on Imports

VARIABLES	CHINA	JAPAN	UK	US
ΔIMP_{-1}	-0.11* (-1.294)	-0.17* (-1.893)	0.08 (1.066)	0.04 (0.39)
ΔIMP_{-2}			0.14** (2.255)	
ΔIMP_{-3}			0.07 (1.483)	
$\Delta LNRER$	-0.089* (-1.778)	0.65 (1.532)	-0.338* (-1.751)	
ΔVOL	0.34 (0.223)	0.11 (0.143)	1.17 (0.334)	-0.12 (-0.252)
ΔVOL_{-1}	0.71 (0.468)	-0.08** (-2.891)	-0.17* (-1.810)	
ΔVOL_{-2}	-0.37 (-0.24)	-0.12* (-1.729)		
ΔVOL_{-3}	0.41*** (4.563)			
$\Delta LNNGDP$	0.11*** (5.922)	-0.09 (-0.291)	0.32 (0.344)	-0.12 (-0.044)
$\Delta LNGDP\_FOREIGN$	0.002 (0.173)	0.06*** (4.026)		
$\Delta LNNGDP_{-1}$			-0.16** (-2.277)	
$\Delta LNNGDP_{-2}$			-0.576 (-0.07)	
$\Delta LNNGDP_{-3}$			0.03** (2.581)	
$\Delta LNRESERVE$	0.03 (1.190)	0.57 (1.536)	0.57** (2.657)	0.20 (0.483)
$CointEq_{-1}$	-0.11 (-7.712)	-0.79*** (-6.608)	-0.01*** (-4.777)	-0.96*** (-10.647)

Source: Research finding.

Note: values in parentheses are the t-statistics; *, **, and *** indicate significance at 10%, 5%, and 1% respectively.

Import from Japan is significantly affected by previous imports, Japanese GDP, and exchange rate volatility, but real exchange rate movement, Nigeria's GDP, and reserves are insignificant. An increase in Japanese GDP could motivate the production of more goods, precipitating relative price, thereby increasing the competitiveness of Japanese products in the Nigerian market.

Exchange rate volatility has a negative and significant effect, albeit, not immediate. This suggests that agents importing from Japan tend to be risk-averse. A cursory look at the result indicates that exchange rate volatility persistently drags imports from Japan.

Turning to the case of the UK, previous imports from the country engenders current imports. In addition, reserves and Nigerian GDP significantly influence imports. Real exchange rate movement and its volatility have a negative and significant impact. An inspection of the result indicates that imports from the UK are weakly sensitive to naira-pound exchange rate movement. In addition, real exchange rate volatility delays for a while before a significant effect surfaces. It turns out that importers of UK goods may likely be risk averse, perhaps because the available hedging facility is too sophisticated to employ and so, agents decide to reduce importation as a result of high volatility.

Imports from the US are driven by previous imports, Nigeria and the US income, real exchange rate volatility, and reserves. However, none of the variables significantly contributes to imports from the country. In the case of exchange rate volatility, the insignificant effect can be because of the ability to access hedging instruments and so, they are protected from naira-dollar exchange rate uncertainty when importing from the US.

Overall, the short-run result suggests that exchange rate volatility affects imports from Nigeria’s major trading partners differently. The effect is more pronounced and persistent in China and Japan but less pronounced in the UK. It is of note that imports from the US are not affected by real exchange rate volatility.

Aside from agents importing from China who appear to be risk-neutral, agents importing from Japan, the UK, and the US can be considered risk averse.

The Effects of foreign reserves on imports from each trading partner are positive. However, it is interesting to observe importing from China responds less to changes in reserves than any other partner country. This is an important discovery that supports the fact that the trade effect of any variable is better and more informative at the bilateral level than mere aggregation.

The convergence parameters indicate that short-run deviation from long-run equilibrium is quickly dealt with in the US compared to other trading partners. In particular, about 96% of the adjustment is accounted for in the current month. Specifically, equilibrium will be restored within 40 days following any distortion in the system. Adjustment to long-run equilibrium imports from the UK and Japan

takes almost 2 months. Adjustment to long-run equilibrium import in the case of China is sticky and by implication takes longer. As can be observed, only 3% of the adjustment will be taken care of in the current month while the rest 97% is spread over future months. In this regard, it takes around 32 months (more than 2 and a half years) for the full adjustment to take place. The summary of how exchange rate volatility influences trade is indicated in Table 7.

Table 6. The Effects of Bilateral Real Exchange Rate on Trade (Long run)

VARIABLES	Exports				Imports			
	CHINA	**JAPAN**	**UK**	**US**	**CHINA**	**JAPAN**	**UK**	**US**
REAL EXCHANGE RATE	-0.19 (-1.275)	-0.12*** (-5.209)	0.77 (0.139)	0.08 (0.835)	-0.08* (-1.782)	0.81 (1.579)	-0.07* (-1.925)	== ==
FOREIGN GDP	-0.03** (-2.287)	-2.76 (-0.582)	-0.22 (-0.352)	-0.81*** (-4.135)	-3.94 (-1.114)	-0.13 (-0.054)	0.47 (0.282)	-0.16 (-0.178)
NIGERIA GDP	0.24*** (4.942)	0.03 (0.107)	0.55 (0.134)	0.28*** (3.565)	0.09*** (6.781)	-0.12 (-0.290)	0.06* (1.936)	0.33 (0.345)
RESERVES	-0.02 (-0.304)	-0.59 (-0.663)	0.07 (0.041)	0.26** (2.120)	0.002 (0.167)	-0.71 (-1.568)	0.57** (2.831)	-0.21 (-0.484)
VOLATILITY	-0.15 (-0.918)	0.65 (1.121)	0.11 (0.167)	-0.13*** (-3.055)	-0.03 (-1.192)	-0.62 (-0.689)	0.89 (0.167)	-0.12 (-0.252)
Constant	0.81 (0.596)	0.37 (0.454)	0.15 (0.627)	0.7005*** (5.428)	1.15** (2.764)	0.14 (0.283)	0.82 (0.681)	0.24 (0.582)
R-squared	0.389	0.534	0.579	0.429	0.432	0.163	0.282	0.084
Adjusted R-squared	0.325	0.481	0.527	0.379	0.383	0.084	0.178	0.032
Durbin-Watson stat	1.921	2.021	1.955	2.070	2.028	1.998	1.901	2.004
B-G S. Corr. LM test (p-value)	0.571	0.751	0.923	0.230	0.676	0.594	0.586	0.728
B-P-G Hetero Test (p-value)	0.296	0.640	0.190	0.847	0.205	0.433	0.950	0.237
J-B (P-value)	0.351	0.558	0.825	0.4891	0.648	0.959	0.839	0.533

Source: Research finding.

Note: values in parentheses are the t-statistics; *, **, and *** indicate significance at 10%, 5%, and 1% respectively.

Table 7. Short and Long Run Effects of Real Exchange Rate Volatility on Trade Short Run

Countries	Exports	Imports
China	No	No (until 3rd lag which is positive)
Japan	Positive*	Negative*
UK	Negative*	Negative*
US	No	No
Long Run		
China	No	No
Japan	No	No
UK	No	No
US	Negative*	No

Source: Research finding.

Note: * indicates significant. No indicates, no significant effects.

5. Conclusion and Policy Recommendation

Exchange rate uncertainty and its effects on trade have been a topical issue in the international economics literature. On the one hand, the uncertainty tends to crowd out trade while on the other hand, it crowds in trade. Under a certain and plausible condition, there may not be any worry about the effect of exchange rate uncertainty on trade. Available empirical evidence also tows these three parts, depending on the country or region and the methodology employed.

However, a closer look at the empirical literature suggests that the results may be marred by inappropriate methodology. Specifically, a large percentage of empirical evidence tends to either aggregate countries or exchange rates. Owing to this aggregation problem, it is difficult to understand the nature and magnitude of country pair exchange rate effect on trade. It also beclouds the country pair exchange rate that may have been responsible for the volatility. The implication of this is that the policymakers may be carrying out policies that are counterproductive just because of the result arising from the aggregation.

The case of Nigeria is not different as a large percentage of studies addressing this issue were carried out at the aggregate level. Our paper seeks to improve this by looking at the same issue but from the bilateral level. In this regard, monthly data spanning January 2000 to March 2019 were obtained for exports and imports between Nigeria and four of its major trading partners, namely China, Japan, the UK, and the US. The study employs autoregressive distributed lag (ARDL) in the context of risk aversion theory to capture both short and long-run effects.

Results from the short-run analysis suggest that first, bilateral real exchange rate volatility exists between Nigeria and all four trading partners. This result is consistent with the work of (Bahmani-Oskooee, 2019). Second, the effect of real exchange rate volatility on trade is more of a short-run phenomenon than a long run. This is in contrast to the work of Ekanayake and Dissanayake (2022), where it is more of a long-run phenomenon. In particular, out of the 4 major trading partners, exchange rate volatility significantly affects trade with 2 (Japan and the US) in the short run while it only affects 1 (export to the US) in the long run. In clear terms, there is no short-run significant effect of exchange rate volatility on trade with China and the US. However, the third lag period of Naira-Yuan exchange rate volatility affected imports from China, positively and significantly.

The general conclusion is that real exchange rate volatility inhibits trade with the UK; it enhances exports to and dampens imports from Japan. A special case is trading with the China and US where bilateral exchange rate volatility is inconsequential in the short run. This outcome supports the claim that not only is exchange rate volatility a short-run phenomenon in Nigeria but also that the volatility differs across the trading partners. This finding is in line with the work

of Bahmani-Oskooee and Gelan (2016). It is also important to say that the trade effect of exchange rate volatility in Nigeria appears to be driven more importantly by the Naira-Yen real exchange rate.

Given the above discoveries, some economic implications and recommendations can be discerned. Since no seeming effect of Naira-Yuan and Naira-Dollar real exchange rate volatility on trade, exporters can consider these countries as save places for their goods. The government should therefore strengthen bilateral trade relations with these countries (China and the US). The naira pound is not only detrimental to trade but also persistent. This means that the higher the naira-pound real exchange rate volatility, the more exports to the country are strangulated and this will persist for a couple of months. Insofar as the UK is one of the major and important trading partners, access to hedging arrangements for easy transactions of naira-pound should be encouraged. In the interim, exporters to these countries can direct their products to China provided there is a relevant trade arrangement in this regard. Alternatively, to avert unnecessary unemployment that this may cause, the potential or intending exporters could look inward by using their resources to produce for domestic consumption. While it is noted that this decision may not work in the short run due to the irreversibility effect, the exporters should bear in mind that trading with the UK might have a negative exchange rate uncertainty effect and build this in their production and market placement decision.

Unlike the case of China, the UK, and the US, the positive effect of the Naira-Yen real exchange rate uncertainty on exports to Japan suggests that the Japanese market is still favorable for Nigeria's exports. Thus, risk-neutral exporters have a promising market in Japan. Since there is no long-run effect of exchange rate volatility on trade with China, Japan, and the UK, there should not be any worry in this regard. However, there is a potentially detrimental effect from virtually all countries, so it is important to prepare for an action that will suppress it. Such action calls for including the currencies of these major countries in the foreign exchange currency basket of Nigeria. Yen and Yuan should be directly exchanged for Naira instead of taking the indirect route of the dollar. By doing so, maybe the fluctuation of the dollar will have been reduced[1].

Observably, other catchall variables also affect exports and imports differently both in magnitude and direction. In the short run, real appreciation is encouraging to exports to all the trading partners in the short run. In the same vein, Nigeria's income dwarfs exports from China. In addition, Japanese, Chinese, and American income has no significant effect on Nigeria's exports. This indicates that

[1]. We are aware that if yuan/dollar fluctuates, it may likely cause naira/yuan to fluctuate as well. But our thinking is that paying for imports (and proceeds from exports) in Yuan will circumvent or reduce the effect of yuan/dollar fluctuations

most products moving to these countries may likely be inferior. However, the case of the UK is different. Our result also shows that external reserves are still important for export, particularly to the UK and the US. Real exchange rate depreciation reduces imports from China and the UK. It is also of interest to note that although external reserves positively affect imports from all the countries, it is only significant in the case of the UK.

Following these findings, the exchange rate volatility's effect on trade is better assessed at the bilateral level because it will provide useful information for policy makers in the quest for appropriate and implementable bilateral trade policy. For example, the exchange rate volatility on export in the case of Nigeria is triggered by Naira-Pound and so, the policy makers should concentrate on the Nigeria-UK trade relations. Having said this, further research is needed at the product level to substantiate the inferiority or otherwise of the products exported and imported.

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Appendix

Table A1. Descriptive Statistics: EXP, IMP, RER, GDP for Nigeria, China and Japan from January 2008 to March 2019

	Mean	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis	Jarque- Bera	(Probabilities)	ARCH effect	Observations
Export to China	23,696.40	440629.6	142	46472.31	6.42	53.14	15071.92	0	0.92	135
Import from China	127345.1	405665.6	1034.3	63324	1.37	6.43	108.34	0	0.00***	135
Naira/Yuan	20.79	26.9	17.62	1.84	0.87	3.53	18.89	0	0.00***	135
GDP (China)	57,081,878	92,989,369	3,157,765	211,792	-0.39	2.84	3.60 (0.16)		0.00***	132
Export to Japan	12531.64	79,525.62	142	14697.37	1.88	6.96	168.02	0	0.083*	135
Import from Japan	12683.74	196869.4	364.5	18482.78	7.71	74.77	30315.43	0	0.91	135
Naira/Yen	1.24	1.76	0.85	0.25	0.07	1.57	11.53	-0.0031	0.00***	135
GDP (Japan)	129,251,008	142,718,600	119,748,300	6,278,273	0.23	2.19	4.84	-0.08	0.00***	135
Export to UK	51139.92	462613.1	341.1	61546.47	3.34	18.56	1613.26	0	0.95	135
Import from UK	28675.23	139620.4	3.2	17085.19	2.97	16.39	1209.71	0	0.806	135
Naira/Pound	202.51	277.72	162.43	25.22	1.06	3.97	30.95	0	0.00***	135
GDP (UK)	449,404.60	541,413	376,446	49854.33	0.3	1.78	10.29	-0.005	0.00***	135
Export to US	185434.7	650722.9	196	160190.9	1.01	3.14	23.19	0	0.001***	135
Import from US	73130.55	575440.4	51.5	62541.41	4.93	35.25	6397.3	0	0.911	135
Naira/Dollar	132.01	169.14	105.65	15.32	0.22	2.22	4.49	-0.11	0.00***	135
GDP (US)	5,639,997	6,886,343	4,784,283	631,620	0.28	1.83	9.02	-0.01	0.00***	132
External Reserves	38882.48	62081.86	23689.87	8961.122	0.634283	2.967169	9.058153	0.01079	0.001**	135
Domestic GDP	80,739,797	134,855,977	38,559,781	27,755,789	0.12	1.99	5.88	-0.052	0.00***	135

Source: Research finding.

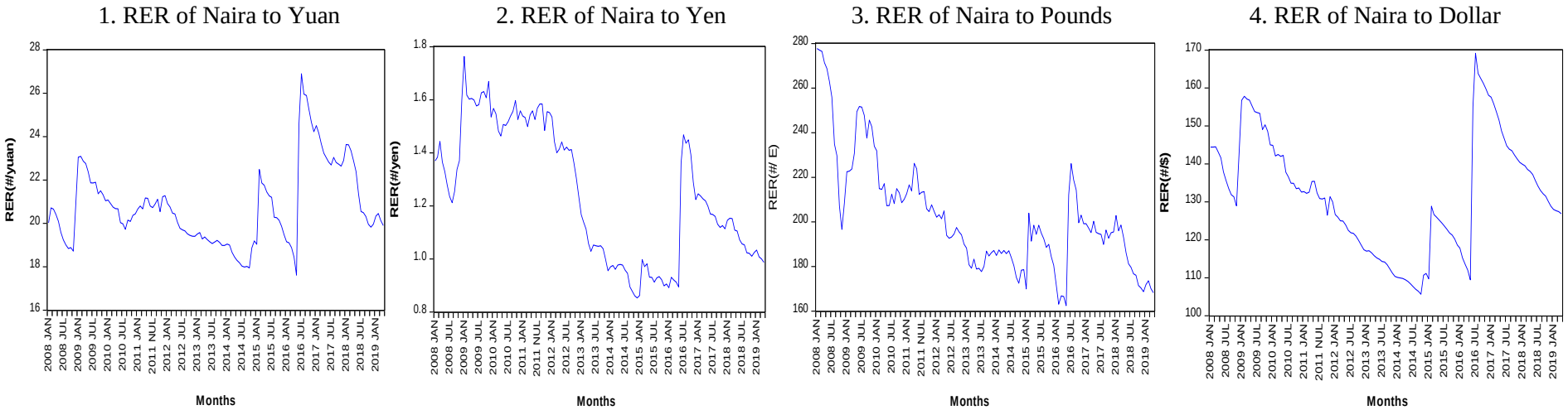

Figure A1. The Trend of Bilateral Real Exchange Rate of Naira per Foreign Currency

Source: Research finding.

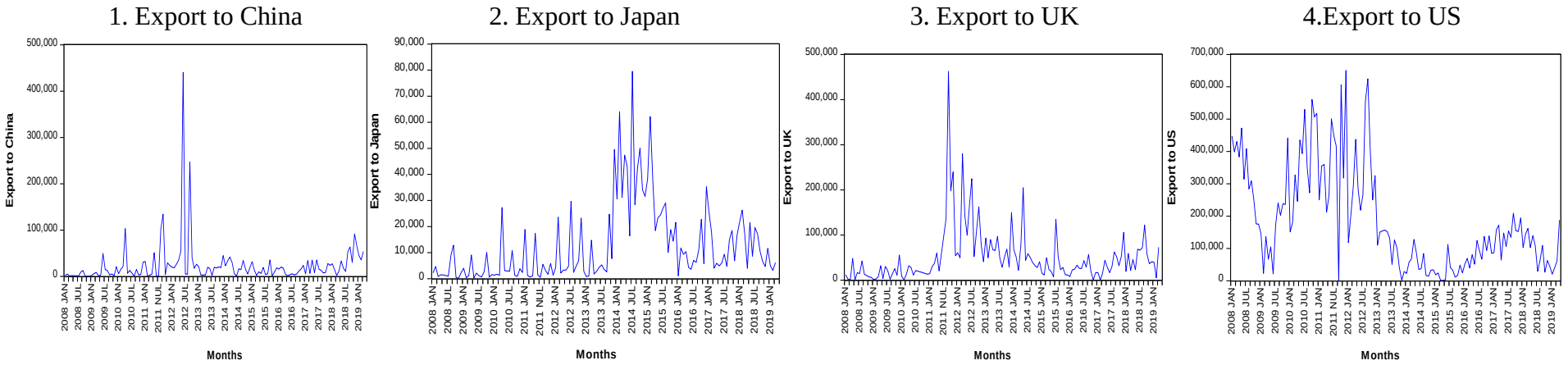

Figure A2. The Trend of Bilateral Export from Nigeria to Trading Partners

Source: Research finding.

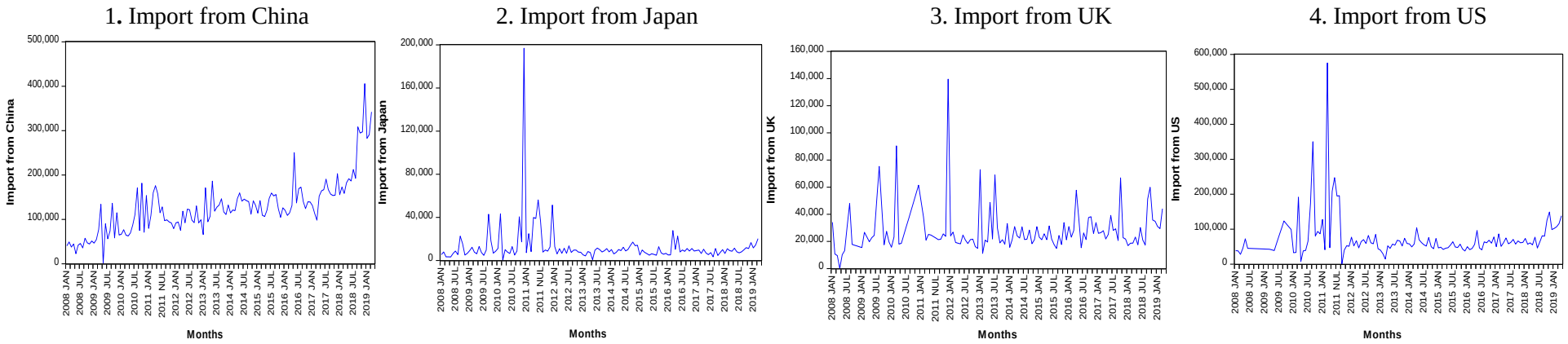

Figure A3. The Trend of Imports to Nigeria from Trading Partners

Source: Research finding.

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