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# Impact of Exchange Rate on Trade Flow in Nigeria

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*This study examines the impact of exchange rate on trade flow in Nigeria from 1986 to 2021. The study utilises linear and nonlinear autoregressive distributed lag (ARDL and NARDL) models to test the J-Curve hypothesis and the Marshall-Lerner condition in Nigeria. The study found symmetric effects of exchange rate on trade balance, exports, and imports. The findings also show that real exchange rate depreciation has a strong negative influence on trade balance and exports in the short run but positive in the long run, exhibiting the shape typology of the J-curve. Furthermore, the study reveals evidence of the Marshall-Lerner condition since the sum of the elasticities of export and import is greater than unity. Thus, there is room for long run net trade improvement. The study suggests the need for the Nigerian government to grant investment incentives to domestic firms to expand production and improve on the quality of output to reduce import.*

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## 1. Introduction

Every economy wants to achieve vibrant and competitive international trade that could accelerate economic growth and development. However, the realisation of this objective is determined by the capacity to expand and sustain the export of goods and services. As a result of the wave of globalisation, nations rarely operate in an autarky situation, as they trade among themselves aided by the foreign exchange (forex) market.

Nigeria transacts with different countries and uses foreign currencies requiring exchange rates. The exchange rate is seen as the current market price for which one national currency can be exchanged for another (CBN, 2016). The significance of the exchange rate on trade flow is that the price systems of two different countries are

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involved in such a way that the international transactions of goods and services are directly compared. Therefore, exchange rate management is crucial for any developing country mainly because it connects the domestic and global markets for goods and services to a relative price and highlights the competitiveness of the country's exchange power over the rest of the world (Williamson, 1994). Thus, to manage the exchange rate effectively and explore the benefits therein, the monetary authorities make policies that affect the exchange rate. Changes in the exchange rate have a ripple impact on various economic variables, such as trade flows, interest rates, imports, exports, inflation, unemployment, and money supply (Oladipupo & Onotaniyohuwo, 2011).

The J-Curve is a conceptual model that illustrates the relationship between exchange rate and trade flow. In the short run, a decline in currency value leads to a deterioration in trade balance, while in the long run, it results in an improvement. In other words, the country's trade deficit worsens in the initial periods after the depreciation of its currency since higher prices on imports exert a greater influence on the total imports than the reduced volume of imports. However, there is a net improvement in the trade balance if the demand becomes more price elastic in the long run. That explains the fulfilment of the Marshall-Lerner condition that specifies the state in which currency depreciation of any country leads to the net improvement in its trade balance (Abbas-Ali *et al*., 2014; Brown & Hogendorn, 2000). This condition states that depreciation or devaluation in the exchange rate leads to a net improvement in trade balance provided that the sum of the price elasticity of demand for exports and imports is greater than 1 (Abbas-Ali *et al*., 2014; Brown & Hogendorn, 2000).

Different exchange rate regimes are adopted to manage changes in the macroeconomic variables. The fixed exchange rate regime previously implemented in Nigeria is aimed at stabilizing the currency, keeping inflation within the targeted range and making imports more affordable. However, the country's exports were noncompetitive due to the naira's overvaluation, causing massive imports of finished goods with negative consequences on domestic manufacturing and exposing the currency to speculative attacks (Ibrahim *et al*., 2017). Nigeria's monetary authority transited from a fixed exchange regime in the 1960s to a floating regime in 1986, following

the adoption of the Structural Adjustment Programme (SAP) (Kenny, 2019; Sanusi, 2004). However, Nigeria's trade flow has declined recently, with a trade surplus of N2.937 billion in 1986 and trade deficits in 1998, 2015, 2016, and between 2019 and 2020 (Central Bank of Nigeria, 2020). It is unknown whether the downwards spiral witnessed in trade flow in Nigeria, especially in recent times, is caused by exchange rate changes.

Previous studies on the exchange rate and trade flow in Nigeria tracing the evidence of the J-curve phenomenon report divergent views. Few studies have supported the evidence of the J-curve (Apanisile & Oloba, 2020; Okaro, 2017; Adeniyi *et al*., 2011), while contrary views of this effect were provided by Andohol (2020), Onakoya *et al*. (2019), Bawa, *et al*. (2018), Ogbonna (2018), Umoru and Oseme (2013), and Baba and Yazici (2016). Loto (2011) found no evidence of Marshall-Lerner condition in Nigeria. These studies were unable to ascertain the short and long run asymmetry of this relationship and the decomposition of trade flow into exports, imports and trade balance. Linear models often assume that economic variables respond proportionally to changes in other variables. However, in reality, the dynamic responses of these variables can be asymmetric. This study investigates how changes in exchange rate affect trade flow, taking into account these asymmetric effects. To this end, the study employs a NARDL model to determine whether the J-Curve hypothesis holds for Nigeria and whether trade balance satisfies the Marshall-Lerner condition.

This study offers more realistic recommendations for monetary policy that could curtail trade deficits in Nigeria through improved investment in local industries and the adoption of effective exchange rate management to avert possible negative effects of a floating exchange rate regime. It also helps policymakers understand the policies that facilitate favourable trade even in the face of inelastic import demand and boost export capacity. It also helps the monetary authorities forecast the time effects of the changes in the exchange rate and the efficacy of the exchange rate policy on trade flow.

The rest of this paper is structured as follows: Section 2 reviews the literature, while the data and methodology are presented in Section 3. The results and discussion are

presented in Section 4, and Section 5 concludes the study and provides policy recommendations.

## 2. Literature Review

### 2.1 Theoretical Literature

This study hinges on the J-Curve hypothesis. The hypothesis argues that currency devaluation is a tool for increasing a country's balance of trade (Melvin & Norrbin, 2017). The basic assumption underlying the J-Curve model is that exchange rate depreciation or devaluation, in the short run, worsens trade flow but recovers and takes an upwards trajectory after fulfilling the Marshal-Lerner condition. The condition states that depreciation or devaluation of a country's currency leads to a net improvement in trade balance, provided that the sum of demand elasticity for exports and imports is greater than 1 (Abbas-Ali *et al*., 2014; Brown & Hogendorn, 2000). Specifically, exchange rate depreciation leads to a rise in domestic demand and, consequently, a higher real GDP. This is because citizens may find imported goods very expensive and prefer to switch to goods produced domestically. The reverse occurs if the exchange rate appreciates. Consumers switch to imported goods that are relatively inexpensive to domestically produced goods. Thus, it increases the volume of imports, leading to a decline in GDP. After an exchange rate depreciation or devaluation, imports and exports need time to adjust, given the relative price changes. According to Bahmani-Oskooee (2008), the sticky nature of prices prevents the trade balance from responding quickly to the newly devalued exchange rate. As a result of exchange rate depreciation or devaluation, a deteriorating balance of payment lingers until the Marshall-Lerner condition sets in.

The Marshall-Lerner (ML) condition is a further extension of the elasticity approach, and it is satisfied if the absolute sum of a country's export and import demand elasticities is greater than one (Abbas-Ali *et al*., 2014; Brown & Hogendorn, 2000). Conversely, if the sum is less than one, the trade balance deteriorates as the currency depreciates (Lerner, 1944).

### 2.2 Empirical Literature

There are several studies on the relationship between the exchange rate and trade flow. There are previous empirical studies that established evidence of the J-curve and those that refuted the evidence. In each of these categories, the empirical literature ranges from global to those on African countries, particularly Nigeria. Some of the studies that established evidence of the J-curve used panel data whose methodological framework treated countries homogeneously, while others were centered on countries whose economic peculiarities and behaviour of macroeconomic variables differ from those of Nigeria. In a closely related manner, some tested the evidence of the J-curve and the Marshal-Lerner condition.

The panel studies that refuted the evidence of the J-curve include Rose and Yellen (1989), who used the vector autoregressive (VAR) framework for the USA and her trade partners (six countries). They found no evidence of the J-curve phenomenon. Moreover, Hsing (2008) used quarterly data from different start periods (1995, 1992, 1994, and 1995) to the third quarter of 2007 and found no evidence of a J-curve for Brazil, Peru, Argentina, and Colombia. However, improvement in real income increases the level of trade balance for all countries except Brazil. Arruda and Castelar (2019) also assessed the evidence of the J-curve and the validity of the Marshall-Lerner condition for the southern region of Brazil using monthly data from January 1999 to July 2013. They found no evidence of a J-curve but an elastic response of exports to depreciation, especially for manufactured exports.

Other studies that found no evidence of a J-curve include Onakoya *et al.* (2019) and Bawa *et al.* (2018). Sulaiman and Abdul-Rahim (2015) also found a negative impact that supports the assumptions of the J-curve hypothesis and the Marshall-Lerner condition. However, the study revealed that it does not exist in the case of trade in forest products in Nigeria. Umoru and Oseme (2013) used vector error correction methodology to investigate the J-curve effect in Nigeria. They found no empirical evidence to support the J-curve hypothesis regarding short-run trade balance deterioration, but they did support the cyclical trade effect of exchange rate shocks.

Other empirical studies that found no evidence of the J-Curve hypothesis include Arabi and Abdalla (2014), who rejected the J-curve hypothesis for the Sudanese

economy. Khan *et al*. (2016) also found no evidence of a J-curve in Pakistan. Suleman *et al.* (2014) also found no evidence of J-curve phenomena for Pakistan with Saudi Arabia. Adznan and Masih (2018) found inconclusive results on the exchange rate-trade balance relationship in the long run and short run using Malaysian data.

Several scholars have conducted empirical studies of the J-curve hypothesis in Nigeria using different methodologies. Several empirical studies have shown no evidence of the J-curve hypothesis in Nigeria.

In a recent study, Andohol (2020) assessed whether the J-Curve model is affected by structural breaks in Nigeria from 1970 to 2018, and using the 1986 SAP as a criterion to identify break periods as Pre- and Post-SAP. The study employed both linear and nonlinear ARDL models and concluded that the J-Curve hypothesis is not supported for Nigeria. However, the study found an N-shaped pattern during the overall and post-SAP periods, indicating the potential relevance of structural breaks in shaping the J-Curve's typology. In another study, Ogbonna (2018) utilised the cointegration technique to examine the presence of the Marshall-Lerner condition and J-Curve phenomenon in Nigeria's foreign trade activities. The study did not verify the Marshall-Lerner condition for Nigeria or the J-curve effect. Baba and Yazici (2016) also looked at the bilateral J-curve and the Marshall-Lerner (ML) condition between Nigeria and European Union countries between 1999Q1 and 2012Q4. Using the ARDL approach, the study showed no evidence of the J-curve or satisfaction of the Marshall–Lerner condition between Nigeria and the EU15 countries. The study, however, found evidence supporting the J-curve hypothesis in the short run between Nigeria and Austria, Denmark, Germany, and Italy and the existence of the Marshall–Lerner condition only in Luxembourg.

Hsing (2008), using annual data, found evidence of a J-curve for Ecuador, Uruguay, and Chile but no evidence for Colombia, Brazil, Argentina, and Peru. Lal and Lowinger (2002) also used a cointegration test and error correction model to assess the determinants of trade balance for East Asia. The study also found evidence of a J-curve across countries, viz.- Japan, Indonesia, Singapore, Malaysia, Korea, Philippines, and Thailand. The phenomena of the J-curve and Marshal-Lerner condition were also examined by Rehman and Afzal (2003) using ordinary least squares, two-

stage least squares, three-stage least squares and instrumental variables techniques. The study used quarterly data from 1972 to 2002 and found evidence of a J-curve without the favourable long-run effect of real depreciation. In a study on Turkey, Akbostanci (2004) discovered that a real depreciation initially leads to a deterioration in the trade balance. However, over time, the trade balance improves, resulting in a J-shaped pattern.

Jackson *et al*. (2021) examined the J-curve phenomenon in Sierra Leone from 2002Q2 to 2019Q4 using the unrestricted vector autoregressive (VAR) technique. The study showed a long-run positive relationship between the exchange rate and trade balance and that the Marshall-Lerner (ML) condition was also satisfied. Other studies also found evidence of the J-curve in different countries. For instance, Ishtiaq *et al*. (2016) investigated the J-curve phenomenon for Pakistan, utilising quarterly data from the third quarter of 1970 until the fourth quarter of 2012, and employing the cointegration technique and vector error correction models. Caporale *et al*. (2015) used quarterly data for Kenya from 1996q1 to 2011q4 to examine the Marshall-Lerner condition. The study utilised fractional integration and cointegration methods and found evidence of Marshall-Lerner's condition in the long run. Ziramba and Chifamba (2014) studied the response of South Africa's trade balance following a depreciation of the real effective exchange rate in South Africa from 1975 to 2011 using cointegration and found similar results. Siklarey and Kecili (2018) also investigated the Marshall-Lerner condition and the existence of the J-curve for the Turkish economy from 2003 to 2016. They found that the Marshall- Lerner condition holds for the Turkish case, and the J-curve exists. Wanjau (2014) also found evidence of the J-Curve and Marshal-Lerner conditions in Kenya. Rena *et al*. (2011) used annual data from Papua New Guinea from 1980 to 2008. The study found that currency depreciation deteriorates the trade balance in the country. Gupta-Kapoor and Ramakrishnan (1999), using nonlinear ARDL on quarterly data for Japan from 1980Q1 to 2008Q3, confirmed the presence of the J-curve. Bahmani-Oskooee and Faridita-vana (2016), using bilateral trade balance models of U.S. with its six largest trading partners, confirmed the J-curve hypothesis between most of the U.S. trading partners more so that the use of a nonlinear approach has more capability of revealing the true relationship. Bahmani-Oskooee and Ratha (2007) assessed the effects of the

real depreciation of the Swedish krona on its bilateral trade balances. They found the evidence of J-curve in five cases: the trade balance between Sweden and Austria, the Netherlands, Denmark, Italy, and the U.K.

Using African data for 49 countries, Hussain and Haque (2014) found evidence of the J-curve hypothesis. It connotes that developing countries can improve their net trade balance by depreciating their domestic currencies. However, according to them, this kind of policy may trigger retaliation since it is more of a "beggar thy neighbour policy". While checking the possibility of nonlinearity in the relationship, Mwito, Mkenda, and Luvanda (2021) used the linear and nonlinear pooled mean group approaches to assess the evidence of the J-curve phenomenon for the Kenyan economy from 2006q1 to 2018q4. The study found evidence of a J-curve in 7 bilateral trade relations for the symmetric approach and 13 bilateral trade relations for the asymmetric approach. Another study by Usman *et al*. (2017) used an asymmetric approach for Pakistan and the United Kingdom. They also found evidence of a J-curve for nine industries using a linear approach and 15 industries using a nonlinear approach. In a similar approach, Bahmani-Oskooee and Nasir (2019) also found evidence of the J-curve in most industries that trade between U.S. and U.K. However, the study found short-run asymmetric effects in all 68 industries and long-run asymmetric effects in only 25. In another study, Bahmani-Oskooee *et al*. (2021) used Pakistan trade data from 77 industries. The study found short-run positive effects of currency depreciation on the trade balance in 22 industries. Bahmani-Oskooee and Harvey (2017) also found that depreciation improves the net trade balance of Singapore with the United States but decreases that of Malaysia and China.

A study on African countries was also conducted by Bahmani-Oskooee and Arize (2020). They found evidence of a J-curve in Cameroon, Algeria, Ethiopia, Tanzania, Morocco, and Zambia. Mndaka *et al*. (2022) also found evidence of a J-curve for Angola and South Africa. However, the study showed no evidence of a J-curve for Lesotho, Mozambique, Botswana, DR Congo, Malawi, Tanzania, Namibia, and Zambia. This also explains the heterogeneous relationship between exchange rate depreciation and trade flow among countries due to their level of export and import demand elasticities. In a related finding, Amusa and Fadiran (2019) also found evi-

dence of a J-curve for South Africa while utilising the autoregressive distributed lag method.

Other empirical studies have assessed the relationship between the exchange rate and trade flow without necessarily tracing the evidence of the J-curve. For instance, Vieira and MacDonald (2016) investigated the role of REER volatility on export volume using 106 countries from 2000 to 2011. The study found that an increase in REER volatility reduces export volume. Vieira and MacDonald (2020), using data from 58 countries from 1994 to 2014, found that exchange rate misalignment is relevant for current account adjustment, where countries with a more appreciated exchange rate face worse current account performance. Applying the panel fully modified least squares (PFMOLS), panel least squares (PLS), panel dynamic least squares (DOLS), and ARDL approaches, Ekanayake and Dissanayake (2022) found that the real exchange rate reduces exports in all five countries. Mohsen and Abera (2018) also examined the impact of real exchange rate volatility on the trade flows of 12 African countries. They found that exchange rate volatility affects trade flows in many countries in the short run, while the long-run effects were restricted to the exports of 5 countries and the imports of one country. Anjande *et al*. (2019) also examined the relationship between exchange rate movements and African international trade from 1960 to 2017. Using a pooled mean group (PMG) estimator, the study found a negative influence of exchange rate movements on the international trade of African countries.

Without necessarily accounting for the evidence of the J-curve in Nigeria, Olufemi (2019) assessed the asymmetric effects of the real exchange rate on trade balance in Nigeria using quarterly data from 1999 to 2017. Utilising the NARDL approach, the study found asymmetric effects of the real exchange rate on trade balance in Nigeria. The study also showed that positive changes substantially influence trade balance more than negative changes in the real exchange rate. However, it does not indicate the response of exports and imports to changes in the exchange rate. This may limit the understanding of the net improvement in trade as the result of changes in the exchange rate and the satisfaction of the ML condition. Apanisile and Oloba (2020) also found the asymmetric influence of the exchange rate on trade flow in Nigeria

using a real effective exchange rate. Longe *et al*. (2019) also showed a negative influence of the exchange rate on trade in Nigeria from the symmetric approach. Eke *et al*. (2015) examined the effect of the exchange rate on the balance of trade in Nigeria from 1970 to 2012. The study used the Johansen test and error correction mechanism (ECM) and found a significant negative influence of the exchange rate on the trade balance in Nigeria. Similarly, Yakub *et al*. (2015) investigated the impact of exchange rate volatility on trade flow in Nigeria from 1997 to 2016. The ARDL bounds testing approach was employed, and it found that exchange rate volatility negatively influences trade flow in Nigeria.

The novelty of this study is that it assessed the effects of the exchange rate on trade flow while disaggregating the trade flow into the trade balance, exports and imports to better account for the actual effects of the exchange rate on trade flow in Nigeria. Most previous studies have relied on Pesaran et al. (2001) standard ARDL approach, which assumes that the adjustment of economic variables occurs along a linear path. However, this study acknowledges the possibility of a nonlinear adjustment process and thus employs the nonlinear ARDL approach developed by Shin et al. (2013). In addition, recent studies have shown that trade balance asymmetrically reacts to exchange rate (Apanisile & Oloba, 2020; Adznan & Masih, 2018; Bahmani-Oskooee & Fariditavana, 2016). Therefore, the study has also employed the ARDL approach in instances with a symmetric or linear relationship for more reliable results.

Furthermore, a few studies that have tested the asymmetric effects of the exchange rate on trade flow have focused on trade balance only. Most of them have neglected the conditions that need to be attained for beneficial trade due to changes in the exchange rate. However, the elasticity of imports and exports is crucial to accruing the benefits of foreign trade in the event of changes in the exchange rate. This study filled the gap in the literature, as it examined whether the J-curve hypothesis holds for Nigeria after ascertaining whether trade satisfies the ML condition using an asymmetric approach. The study used the real effective exchange rate for data analysis. In addition, it has also used another indicator of the exchange rate (changes in the nominal exchange rate) for a robustness check. The study period coincides with the Structural Adjustment Programme of 1986, when the naira started depreciating, and

the period when the floating exchange rate policy was introduced.

## 3. Data and Methodology

### 3.1 Data Description

The study utilises data from the Central Bank of Nigeria (CBN) Statistical Bulletin and World Development Indicators. These include annual time series data on real effective exchange rates, nominal exchange rates, gross fixed capital formation, foreign direct investment, trade balance, exports, and imports of goods and services. The data description of the variables incorporated in the models and sources are presented in Table 1. All the variables were transformed by taking a natural logarithm to measure their elasticities.

**Table 1:** Data Description and Sources

| Var Name | Definition | Measurement | Source |
|---|---|---|---|
| TBAL | Trade balance | Billions of Naira | CBN Statistical Bulletin |
| EXR | Nominal exchange rate | Indices | World Development Indicators |
| REER | Real effective exchange rate | Indices | World Development Indicators |
| GFCF | Gross fixed capital formation | Trillions of Naira | World Development Indicators |
| FDI | Foreign direct investment, net inflows | Billions of Naira | World Development Indicators |
| EXPT | Exports of goods and services | Billions of Naira | CBN Statistical Bulletin |
| IMPT | Imports of goods and services | Billions of Naira | CBN Statistical Bulletin |
| WRGDP | World gross domestic product | Billions of U.S. Dollars | World Development Indicators |
| RGDP | Real gross domestic product in Nigeria | Trillions of Naira | CBN Statistical Bulletin |
| POP | Population | Millions of People | CBN Statistical Bulletin |

### 3.2 Model Specification

In modelling the influence of the exchange rate on trade flow, the study adopts the model used by Mwito *et al.* (2021) and Mndaka *et al.* (2022). Mwito *et al.* (2021) stated that the trade balance of a country depends on the real effective exchange rate

and the world's real GDP, while Mndaka *et al*. (2022) noted that the real effective exchange rate, domestic income and foreign income influence the trade balance of a country. The J-curve theory also states that due to rising import prices, domestic demand shifts from foreign to domestic production of goods (Abbas-Ali *et al*., 2014). This depends on the country's investment level (whether domestic or foreign direct investment). This study incorporates some macroeconomic variables, such as the investment components that are capable of accruing the benefits from the exchange rate movement. This is because the expansion in domestic investment coupled with the elasticity of import demand and export supply could attract positive benefits (favourable trade balance) of currency depreciation. Thus, to specify the functional relations to account for the influence of the exchange rate on the trade balance in symmetric and asymmetric forms (expressed in natural logarithm), they can be stated as:

$$\ln TBAL_t = f(\ln REER_t,\ \ln \mathrm{R}GDP_t,\ \ln \mathrm{WRGDP}_t,\ \ln GFCF_t,\ \ln FDI_t) \quad (1)$$

$$\ln TBAL_t = f(\ln REER\_POS_t,\ \ln REER\_NEG_t,\ \ln \mathrm{R}GDP_t,\ \ln \mathrm{WGDP}_t,\ lnGFCF_t,\ \ln FDI_t) \quad (2)$$

where ln is the natural logarithm, $TBAL$ is a log of trade balance, $REER$ is the real effective exchange rate, $REER\_POS$ is positive changes in the real effective exchange rate, $REER\_NEG$ is negative changes in the real effective exchange rate, R$GDP$ is Real Gross Domestic Product (domestic income), WRGDP is world real gross domestic product, $FDI$ is foreign direct investment, and $GFCF$ is a gross fixed capital formation used to proxy domestic investment.

Investment (foreign direct or domestic investment) helps the country that has depreciated its currency to maintain a favourable trade balance by improving its exports. Prior expectations of the explanatory variables suggest that a real effective exchange rate will have a net positive impact on trade balance if the sum of the elasticity of exports and imports to changes in the exchange rate is greater than 1 (elastic). However, if the sum of the elasticity of exports and imports to changes in the exchange rate is less than 1 (inelastic), the net effect of the real effective exchange rate on trade balance may be negative. An increase in world real gross domestic product, gross fixed capital formation, and foreign direct investment would have a positive impact

on the trade balance. The stochastic form of the symmetric model and the asymmetric model for equation (1) and equation (2) gives:

$$\ln TBAL_t = \alpha_0 + \alpha_1 \ln REER_t + \alpha_2 \ln RGDP_t + \alpha_3 \ln WRGDP_t + \alpha_4 \ln GFCF + \alpha_5 \ln FDI_t + u_t \quad (3)$$

$$\ln TBAL_t = \alpha_0 + \alpha_1 \ln REER\_POS_t + \alpha_2 \ln REER\_NEG_t + \alpha_3 \ln RGDP_t + \alpha_4 \ln WRGDP_t + \alpha_5 \ln GFCF + \alpha_6 \ln FDI_t + u_t \quad (4)$$

where $\alpha_0$ is the intercept, while $\alpha_1 - \alpha_5$ are parameters to be estimated for equation (3) and $\alpha_1 - \alpha_6$are parameters to be estimated for equation (4).

In assessing the influence of the exchange rate on exports, the study adopts the model used by Nguyen *et al*. (2021) to assess the influence of exchange rate on imports and exports from Vietnam. The study also incorporates investment components such as domestic investment and foreign investment that grease exports. Thus, the symmetric and asymmetric forms of the model to account for the influence of the exchange rate on exports can be stated in a functional form and expressed in natural forms as follows:

$$\ln EXPT_t = f(\ln REER_t,\ \ln \mathrm{WR}GDP_t,\ \ln GFCF_t,\ \ln FDI_t) \quad (5)$$

$$\ln EXPT_t = f(\ln REER\_POS_t,\ \ln REER\_NEG_t,\ \ln \mathrm{WR}GDP_t,\ \ln GFCF_t,\ \ln FDI_t) \quad (6)$$

where $EXPT$is exports of goods and services, and other variables are as defined under Equations (1-2). Investment (whether foreign direct or domestic investment) helps the country that has depreciated its currency respond in terms of increasing exports. The a priori expectation of the explanatory variables shows that a real effective exchange rate is expected to exert a positive impact on exports if the elasticity of exports to changes in the exchange rate is elastic; however, if the elasticity of exports to changes in the exchange rate is inelastic, the effect of the real effective exchange rate on exports may be negative. An increase in world real gross domestic product, gross fixed capital formation, and foreign direct investment would positively influence exports. The stochastic form of the symmetric model and the asymmetric model for equations (5) and (6) gives:

$$\ln EXPT_t = \beta_0 + \beta_1 \ln REER_t + \beta_2 \ln WRGDP_t + \beta_3 \ln GFCF + \beta_4 \ln FDI_t + u_t \quad (7)$$

$$\ln EXPT_t = \beta_0 + \beta_1 \ln REER\_POS_t + \beta_2 \ln REER\_NEG_t + \beta_3 \ln WRGDP_t + \beta_4 \ln GFCF + \beta_5 \ln FDI_t + u_t \quad (8)$$

where $\beta_0$ is the intercept, $\beta_1 - \beta_4$ are parameters to be estimated for equation (7) and $\beta_1 - \beta_5$are parameters to be estimated for equation (8).

In assessing the influence of the exchange rate on imports, the study also adopts the model used by Nguyen *et al.* (2021) in assessing the influence of exchange rate on imports and exports from Vietnam. The study also incorporates investment components (foreign direct investment and domestic investment) that are capable of substituting for the demand for foreign goods. Additionally, population serves as a market size for demand, especially in terms of the importation of goods and services. Thus, the symmetric and asymmetric forms of the model to account for the influence of the exchange rate on imports can be stated in a functional form and expressed in natural forms as follows:

$$\ln IMPT_t = f(\ln REER_t,\ \ln RGDP_t,\ \ln GFCF_t,\ \ln FDI_t,\ \ln POP_t) \quad (9)$$

$$\ln IMPT_t = f(\ln REER\_POS_t, \ln REER\_NEG_t,\ \ln RGDP_t,\ \ln GFCF_t, \ln FDI_t,\ \ln POP_t) \quad (10)$$

where *IMPT* is imports of goods and services, *POP* is population, and other variables are as defined under Equations (1-2). Investment (whether foreign direct investment or domestic investment) helps the country to substitute demand for imports in the face of currency depreciation, while RGDP and population stimulate import demand. The stochastic form of the symmetric model and the asymmetric model for equations (9) and (10) gives:

$$\ln IMPT_t = \chi_0 + \chi_1 \ln REER_t + \chi_2 \ln RGDP_t + \chi_3 \ln GFCF + \chi_4 \ln FDI_t + \chi_5 \ln POP_t + u_t \quad (11)$$

$$\ln IMPT_t = \chi_0 + \chi_1 \ln REER\_POS_t + \chi_2 \ln REER\_NEG_t + \chi_3 \ln RGDP_t + \chi_4 \ln GFCF + \chi_5 \ln FDI_t + \chi_6 \ln POP_t + u_t \quad (12)$$

where $\chi_0$ is the intercept, $\chi_1 - \chi_5$ are parameters to be estimated for equation (11) and $\chi_1 - \chi_6$ are parameters to be estimated for equation (12).

Given that some series may be nonstationary but integrated at first difference while others may be stationary at level, the study used ARDL and NARDL. Thus, the sym-

metric ARDL models for equations (3), (7) and (11) can be specified as:

$$\ln TBAL_t = \alpha_0 + \alpha_1 \ln TBAL_{t-1} + \alpha_2 \ln REER_{t-1} + \alpha_3 \ln RGDP_{t-1} + \alpha_4 \ln WRGDP_{t-1} + \alpha_5 \ln GFCF_{t-1} + \alpha_6 \ln FDI_{t-1} + \sum_{j=1}^{k} \gamma_{1,j} \Delta \ln TBAL_{t-j} + \sum_{j=0}^{k} \gamma_{2,j} \Delta \ln REER_{t-j} + \sum_{j=0}^{k} \gamma_{3,j} \Delta \ln RGDP_{t-j} + \sum_{j=0}^{k} \gamma_{4,j} \Delta \ln WRGDP_{t-j} + \sum_{j=0}^{k} \gamma_{5,j} \Delta \ln GFCF_{t-j} + \sum_{j=0}^{k} \gamma_{6,j} \Delta \ln FDI_{t-j} + \varepsilon_t \quad (13)$$

$$\ln EXPT_t = \beta_0 + \beta_1 \ln EXPT_{t-1} + \beta_2 \ln REER_{t-1} + \beta_3 \ln WRGDP_{t-1} + \beta_4 \ln GFCF_{t-1} + \beta_5 \ln FDI_{t-1} + \sum_{j=1}^{k} \varphi_{1,j} \Delta \ln EXPT_{t-j} + \sum_{j=0}^{k} \varphi_{2,j} \Delta \ln REER_{t-j} + \sum_{j=0}^{k} \varphi_{3,j} \Delta \ln WRGDP_{t-j} + \sum_{j=0}^{k} \varphi_{4,j} \Delta \ln GFCF_{t-j} + \sum_{j=0}^{k} \varphi_{5,j} \Delta \ln FDI_{t-j} + \varepsilon_t \quad (14)$$

$$\ln IMPT_t = \chi_0 + \chi_1 \ln IMPT_{t-1} + \chi_2 \ln REER_{t-1} + \chi_3 \ln RGDP_{t-1} + \chi_4 \ln GFCF_{t-1} + \chi_5 \ln FDI_{t-1} + \chi_6 \ln POP_{t-1} + \sum_{j=1}^{k} \phi_{1,j} \Delta IMPT_{t-j} + \sum_{j=0}^{k} \phi_{2,j} \Delta \ln REER_{t-j} + \sum_{j=0}^{k} \phi_{3,j} \Delta \ln RGDP_{t-j} + \sum_{j=0}^{k} \phi_{4,j} \Delta \ln GFCF_{t-j} + \sum_{j=0}^{k} \phi_{5,j} \Delta \ln FDI_{t-j} + \sum_{j=0}^{k} \phi_{6,j} \Delta \ln POP_{t-j} + \varepsilon_t \quad (15)$$

Pesaran, Shin and Smith (2001) offer five alternative interpretations of the conditional error correction (CEC) forms distinguished by whether deterministic terms integrate into the error correction term. The symmetric ARDL model of equations (13) to (15) can be specified in the error correction form as:

$$\Delta \ln TBAL_t = \gamma_0 + \sum_{j=1}^{p} \gamma_{1,j} \Delta \ln TBAL_{t-j} + \sum_{j=1}^{q} \gamma_{2,j} \Delta \ln REER_{t-j} + \sum_{j=1}^{q} \gamma_{3,j} \Delta \ln RGDP_{t-j} + \sum_{j=1}^{k} \gamma_{4,j} \Delta \ln WRGDP_{t-j} + \sum_{j=1}^{k} \gamma_{5,j} \Delta \ln GFCF_{t-j} + \sum_{j=1}^{k} \gamma_{6,j} \Delta \ln FDI_{t-j} + \lambda_1 EC + \varepsilon_t \quad (16)$$

$$\Delta \ln EXPT_t = \varphi_0 + \sum_{j=1}^{p} \varphi_{1,j} \Delta \ln EXPT_{t-j} + \sum_{j=0}^{q} \varphi_{2,j} \Delta \ln REER_{t-j} + \sum_{j=0}^{q} \varphi_{3,j} \Delta \ln WRGDP_{t-j} + \sum_{j=0}^{k} \varphi_{4,j} \Delta \ln GFCF_{t-j} + \sum_{j=0}^{k} \varphi_{5,j} \Delta \ln FDI_{t-j} + \lambda_1 EC + \varepsilon_t \quad (17)$$

$$\Delta \ln IMPT_t = \phi_0 + \sum_{j=1}^{p} \phi_{1,j} \Delta \ln IMPT_{t-j} + \sum_{j=0}^{q} \phi_{2,j} \Delta \ln REER_{t-j} + \sum_{j=0}^{q} \phi_{3,j} \Delta \ln RGDP_{t-j} + \sum_{j=0}^{k} \phi_{4,j} \Delta \ln GFCF_{t-j} + \sum_{j=0}^{k} \phi_{5,j} \Delta \ln FDI_{t-j} + \sum_{j=0}^{k} \phi_{6,j} \Delta \ln POP_{t-j} + \lambda_1 EC + \varepsilon_t \quad (18)$$

The asymmetric ARDL models of equations (4), (8) and (12) can be specified as:

$$\ln TBAL_t = \alpha_0 + \alpha_1 \ln TBAL_{t-1} + \alpha_2 \ln REER\_POS_{t-1} + \alpha_3 \ln REER\_NEG_{t-1} + \alpha_4 \ln RGDP_{t-1} + \alpha_5 \ln WRGDP_{t-1} + \alpha_6 \ln GFCF_{t-1} + \alpha_7 \ln FDI_{t-1} + \sum_{j=1}^{k} \gamma_{1,j} \Delta \ln TBAL_{t-j} + \sum_{j=0}^{k} \gamma_{2,j} \Delta \ln REER\_POS_{t-j} + \sum_{j=0}^{k} \gamma_{3,j} \Delta \ln REER\_NEG_{t-j} + \sum_{j=0}^{k} \gamma_{4,j} \Delta \ln RGDP_{t-j} + \sum_{j=0}^{k} \gamma_{5,j} \Delta \ln WRGDP_{t-j} + \sum_{j=0}^{k} \gamma_{6,j} \Delta \ln GFCF_{t-j} + \sum_{j=0}^{k} \gamma_{7,j} \Delta \ln FDI_{t-j} + \varepsilon_t \quad (19)$$

$$\ln EXPT_t = \beta_0 + \beta_1 \ln EXPT_{t-1} + \beta_2 \ln REER\_POS_{t-1} + \beta_3 \ln REER\_NEG_{t-1} + \beta_4 \ln WRGDP_{t-1} + \beta_5 \ln GFCF_{t-1} + \beta_6 FDI_{t-1} + \sum_{j=1}^{k} \varphi_{1,j} \Delta EXPT_{t-j} + \sum_{j=0}^{k} \varphi_{2,j} \Delta \ln REER\_POS_{t-j} + \sum_{j=0}^{k} \varphi_{3,j} \Delta \ln REER\_NEG_{t-j} + \sum_{j=0}^{k} \varphi_{4,j} \Delta \ln WRGDP_{t-j} + \sum_{j=0}^{k} \varphi_{5,j} \Delta GFCF_{t-j} + \sum_{j=0}^{k} \varphi_{6,j} \Delta FDI_{t-j} + \varepsilon_t \quad (20)$$

$$\ln IMPT_t = \chi_0 + \chi_1 \ln IMPT_{t-1} + \chi_2 \ln REER\_POS_{t-1} + \chi_3 \ln REER\_NEG_{t-1} + \chi_4 \ln RGDP_{t-1} + \chi_5 \ln GFCF_{t-1} + \chi_6 \ln FDI_{t-1} + \chi_7 \ln POP_{t-1} + \sum_{j=1}^{k} \phi_{1,j} \Delta \ln IMPT_{t-j} + \sum_{j=0}^{k} \phi_{2,j} \Delta \ln REER\_POS_{t-j} + \sum_{j=0}^{k} \phi_{3,j} \Delta \ln REER\_NEG_{t-j} + \sum_{j=0}^{k} \phi_{4,j} \Delta \ln RGDP_{t-j} + \sum_{j=0}^{k} \phi_{5,j} \Delta \ln GFCF_{t-j} + \sum_{j=0}^{k} \phi_{6,j} \Delta \ln FDI_{t-j} + \sum_{j=0}^{k} \phi_{7,j} \Delta \ln POP_{t-j} + \varepsilon_t \quad (21)$$

The asymmetric ARDL model of equations (19) to (21) can be specified in the error correction form as:

$$\Delta \ln TBAL_t = \gamma_0 + \sum_{j=1}^{p} \gamma_{1,j} \Delta \ln TBAL_{t-j} + \sum_{j=0}^{p} \gamma_{2,j} \Delta \ln REER\_POS_{t-j} + \sum_{j=0}^{q} \gamma_{3,j} \Delta \ln REER\_NEG_{t-j} + \sum_{j=0}^{q} \gamma_{4,j} \Delta \ln RGDP_{t-j} + \sum_{j=0}^{k} \gamma_{5,j} \Delta \ln WRGDP_{t-j} + \sum_{j=0}^{k} \gamma_{6,j} \Delta \ln GFCF_{t-j} + \sum_{j=0}^{k} \gamma_{7,j} \Delta \ln FDI_{t-j} + \lambda_1 EC + \varepsilon_t \quad (22)$$

$$\Delta \ln EXPT_t = \varphi_0 + \sum_{j=1}^{p} \varphi_{1,j} \Delta \ln EXPT_{t-j} + \sum_{j=0}^{q} \varphi_{2,j} \Delta \ln REER\_POS_{t-j} + \sum_{j=0}^{q} \varphi_{3,j} \Delta \ln REER\_NEG_{t-j} + \sum_{j=0}^{k} \varphi_{5,j} \Delta \ln GFCF_{t-j} + \sum_{j=0}^{k} \varphi_{6,j} \Delta \ln FDI_{t-j} + \lambda_1 EC + \varepsilon_t \quad (23)$$

$$\Delta \ln IMPT_t = \phi_0 + \sum_{j=1}^{p} \phi_{1,j} \Delta \ln IMPT_{t-j} + \sum_{j=0}^{q} \phi_{2,j} \Delta \ln REER\_POS_{t-j} + \sum_{j=0}^{q} \phi_{3,j} \Delta \ln REER\_NEG_{t-j} + \sum_{j=0}^{q} \phi_{4,j} \Delta \ln RGDP_{t-j} + \sum_{j=0}^{k} \phi_{5,j} \Delta \ln GFCF_{t-j} + \sum_{j=0}^{k} \phi_{6,j} \Delta \ln FDI_{t-j} + \sum_{j=0}^{k} \phi_{7,j} \Delta \ln POP_{t-j} + \lambda_1 EC + \varepsilon_t \quad (24)$$

### 3.2 Estimation Techniques

The study examines the descriptive statistics of the data for the variables, after which the series were tested for the presence of the unit root using the ADF unit root test. Optimal lag selection was also employed based on the Akaike information criterion (AIC). To ascertain whether there is a long-run relationship among the variables of the three models, NARDL bounds tests were conducted. The bounds tests require that the F-statistic values be greater than the upper bound values at the chosen significance level (here, a 5 percent level of significance). Otherwise, there is no long-run relationship. The ARDL and NARDL bounds tests were examined to test for the presence or absence of cointegration among variables. The error correction test is also performed to account for the short-run relationship among the variables and the speed of adjustment towards long-run equilibrium. The Wald test was used to examine the joint significance of the coefficients. The study also examines residual diagnostic tests such as normality for the normality of the residuals using histograms, the Breusch-Godfrey serial correlation Lagrange multiplier (L.M.) test for testing the serial independence of residuals, and the Breusch–Pagan-Godfrey heteroskedasticity test for testing whether the variances of residuals are constant. The study also examines the stability diagnostics of CUSUM and CUSUMSQ for the stability of the residuals, while the cumulative dynamic multipliers were used to depict the adjustment patterns following the positive and negative shocks to explanatory variables.

## 4. RESULTS AND DISCUSSION

### 4.1 Descriptive Analysis

**Table 2:** Descriptive Statistics

| | Mean | Max. | Min. | S.D. | Skew. | Kurt. | J.B. | Prob. | Obs. |
|---|---|---|---|---|---|---|---|---|---|
| TBAL | 1217.59 | 5822.59 | -7905.60 | 2745.68 | -0.67 | 4.72 | 7.15 | 0.028 | 36 |
| EXPT | 6507.57 | 19910.53 | 8.92 | 6574.47 | 0.604 | 1.98 | 3.74 | 0.154 | 36 |
| IMPT | 5289.99 | 22394.50 | 5.98 | 6407.95 | 1.265 | 3.68 | 10.30 | 0.006 | 36 |
| REER | 110.27 | 273 | 49.74 | 53.89 | 1.846 | 5.74 | 31.68 | 0.000 | 36 |
| EXR | 122.32 | 376.67 | 1.75 | 107.58 | 0.801 | 2.83 | 3.89 | 0.143 | 36 |
| RGDP | 40.53 | 72.39 | 17.01 | 20.10 | 0.401 | 1.53 | 4.20 | 0.122 | 36 |
| WRGDP | 55.62 | 86.65 | 30.97 | 17.25 | 0.271 | 1.78 | 2.66 | 0.264 | 36 |
| GFCF | 8.39 | 11.45 | 5.67 | 1.45 | 0.165 | 2.26 | 0.98 | 0.612 | 36 |
| FDI | 439.09 | 1360.31 | 0.34 | 450.16 | 0.559 | 1.92 | 3.62 | 0.164 | 36 |
| POP | 139.18 | 211.40 | 85.77 | 37.65 | 0.346 | 1.92 | 2.46 | 0.292 | 36 |

This study examines the descriptive statistics of the variables included in the models. This is to provide basic information about variables and understand the behaviour and pattern of the data distribution used in the analysis. Means, maximum, minimum, standard deviation, skewness, kurtosis, and Jarque-Bera are used to understand the basic properties of the data.

From the descriptive statistics in Table 2, the trade balance in Nigeria averaged N1,217.59 billion, with exports and imports of goods and services averaging N6,507.57 billion and N5,289.99 billion, respectively. The maximum favourable trade balance was recorded in 2013 (N5,822.59 billion), given the remarkable growth in manufactured goods. Both the exports of goods and services and the imports of goods and services recorded minimum values of N8.92 billion and N5.98 billion in 1986. Even though the country had higher average exports over average imports within the period of the study, the maximum value of imports (N22,390.5) in 2021 exceeded that of imports (N19,910.53) in 2019. The trade deficit in Nigeria widened the most in 2020 (-N7,905.6 billion). This may be attributed to the effect of COVID-19 that restricted the movement of people across the country, hurting the production of goods and services for a reasonable period.

The nominal exchange rate in Nigeria averaged N122.32 during the period. The Nigerian currency experienced the worst depreciation in 2021, while the real effec-

tive exchange rate depreciated to N273 in 1998. Moreover, the exchange rate appreciation recorded its highest level in 1986 at N1.75 and real appreciation in the real effective exchange rate of N49.74 in 1992. This coincides with the period in which Nigeria experienced a very high level of inflation, ranging from 44.59% in 1992 to 72.84% in 1995. According to Tule and Duke (2007), the REER index rose in most of the periods due to Nigerian inflationary pressures, implying a loss in Nigeria's competitiveness relative to its major trading partners. The divergence of the nominal exchange rate from the real effective exchange rate narrowed substantially between 1999 and 2014. Real gross domestic product, world real gross domestic product, gross fixed capital formation and foreign direct investment averaged N40.53 trillion, US$55.62 trillion, N8.39 trillion, and N439.09 billion, respectively. There are wide variations in the data set due to the relatively high standard deviations from their mean values, except for gross fixed capital formation. The skewness for trade balance is negative, implying that the data distribution is skewed towards small values, while the skewness for other variables is positive, implying that the data distribution is skewed towards large values. The Jarque-Bera statistics show a normal distribution for some variables. However, the parameter estimates are not greatly affected by the outliers. Thus, the study relies on the normality results of the residuals from the robust regression technique employed as a basis for the test.

### 4.2 Unit Root Test Results

The ADF results for stationary test of the series are presented in Table 3.

**Table 3:** Unit Root Test Results

| | **ADF Results With Constant** | | | **ADF Results With Constant & Trend** | | |
|---|---|---|---|---|---|---|
| **Variables** | **At Level** | **First Difference** | **I(d)** | **At Level** | **First Difference** | **I(d)** |
| lnTBAL | -4.654*** | | 1(0) | -4.7342*** | | 1(0) |
| lnEXPT | -3.2107** | -6.2431*** | 1(0) | -2.5029 | -5.7276*** | 1(I) |
| lnIMPT | -3.3687** | -7.8656*** | 1(0) | -2.0436 | -9.0569*** | 1(I) |
| lnEXR | -2.8722* | -6.1084*** | 1(1) | -2.8230 | -6.3040*** | 1(1) |
| lnREER | -3.5417** | -6.3128*** | I(0) | -3.7363** | -6.1015*** | I(0) |
| lnRGDP | -0.5986 | -3.7859*** | 1(1) | -1.4228 | -3.744** | 1(1) |
| lnWRGDP | -0.9934 | -6.0097*** | 1(1) | -2.3578 | -6.0317*** | 1(1) |
| lnGFCF | -1.2520 | -4.3017*** | 1(I) | -1.6738 | -4.3463*** | 1(I) |
| lnFDI | -1.8315 | -8.3535*** | 1(1) | -3.0194 | -8.4335*** | 1(1) |
| lnPOP | 0.0786 | -4.5733*** | 1(1) | -15.7454*** | | 1(0) |

The asterisks *, **, & *** indicate rejection of the null hypothesis at 10 percent, 5 percent, and 1 percent levels of significance. TBAL is trade balance, EXR is nominal exchange rate, REER is real effective exchange rate, OPEN is trade openness, FRES is foreign reserves, GFCF is gross fixed capital formation, FDI is foreign direct investment, net inflows, EXPT is exports of goods and services, IMPT is imports of goods and services, WRGDP is world gross domestic product, RGDP is real gross domestic product in Nigeria, POP is population, ln is natural logarithm and I(d) denotes order of integration.

The results of the unit root test, as presented in Table 3 with constant, indicate that the nominal exchange rate, real gross domestic product, world gross domestic product, gross fixed capital formation, foreign direct investment, and population are not stationary at the level but have become stationary at the first difference, or I(1). On the other hand, the trade balance, exports, imports, and real effective exchange rate are stationary at level I(0). When adding constant and trend, the ADF results reveal that the trade balance, real effective exchange rate, and population are stationary at the level, while all other variables become stationary at the first difference, or I(1). Consequently, the null hypotheses stating that the variables have unit root problems at the first difference are rejected for all series, suggesting that the variables have a mean-reverting ability after the first difference. The results exhibit a mixed order of integration and are thus appropriate for applying the ARDL test.

### 4.3 The NARDL Bounds Test Results

The results of the ARDL/NARDL bounds tests are presented in Table 4.

**Table 4:** ARDL/NARDL bounds test results for the lnTBAL, lnEXPT and lnIMPT models

| **Model** | **Level of significance** | **ARDL Results** | | **NARDL Results** | |
|---|---|---|---|---|---|
| | | I(0) | I(1) | I(0) | I(1) |
| lnTBAL | | F-stat = 5.875 | | F-stat = 9.963 | |
| | 10% | 2.75 | 3.79 | 2.53 | 3.59 |
| | 5% | 3.12 | 4.25 | 2.87 | 4 |
| | 2.5% | 3.49 | 4.67 | 3.19 | 4.38 |
| | 1% | 3.93 | 5.23 | 3.6 | 4.9 |
| lnEXPT | | F-stat = 12.55 | | F-stat = 7.365 | |
| | 10% | 3.03 | 4.06 | 2.75 | 3.79 |
| | 5% | 3.47 | 4.57 | 3.12 | 4.25 |
| | 2.5% | 3.89 | 5.07 | 3.49 | 4.67 |
| | 1% | 4.4 | 5.72 | 3.93 | 5.23 |
| lnIMPT | | F-stat = 11.056 | | F-stat = 11.785 | |
| | 10% | 2.75 | 3.79 | 2.53 | 3.59 |
| | 5% | 3.12 | 4.25 | 2.87 | 4 |
| | 2.5% | 3.49 | 4.67 | 3.19 | 4.38 |
| | 1% | 3.93 | 5.23 | 3.6 | 4.9 |

Note: I(0) and I(1) denotes lower and upper bounds respectively. lnTBAL denotes natural logarithm of trade balance, lnEXPT denotes the natural logarithm of exports and lnIMPT denotes the natural logarithm of imports

Results of Wald test in Table 4 show that the F-statistic values for the trade balance, exports, and imports models are greater than the upper bounds values of 5.23, 5.72, and 5.23, respectively, at a 5 percent level of significance for the ARDL models and the upper bounds values of 4.9, 5.23, and 4.9 for the NARDL models. The symmetric results in testing the evidence of a bounds relationship show a long-run relationship among the variables for the three models.

### 4.4 Long-Run Impact of Exchange Rate on Trade Balance

The study used the Wald test to test for asymmetry in the long-run relationship between the exchange rate and trade balance in Nigeria. The estimates are presented in Table 5.

**Table 5:** Wald test results for long-run asymmetry

| Test Statistics | Values | Df | Probability |
|---|---|---|---|
| t-statistic | 1.5334 | 16 | 0.1447 |
| F-statistic | 2.3514 | (1, 16) | 0.1447 |
| Chi-square | 2.3514 | 1 | 0.1252 |

The findings of the study indicate that there is no evidence of asymmetric long-run relationship between the trade balance and real effective exchange rate in Nigeria, as the F-statistic and Chi-square values for the test of the asymmetric impact of exchange rate on trade balance were not statistically significant. The same result was obtained when nominal exchange rate was tested. However, in the short run, there were significant asymmetric effects of the nominal exchange rate on trade balance in Nigeria at a 10% level of significance. This implies that the trade effects of currency depreciation or appreciation in Nigeria are not significantly different in the long run, and the trade balance reacts similarly to positive and negative exchange rate changes at a 5% level of significance. This indicates that there is no significant discrimination between the trade balance effects of currency depreciation and currency appreciation in Nigeria. To determine the long-run relationships of the model, the symmetric results of the TBAL model were estimated, and the findings are presented in Table 6.

**Table 6:** Symmetric Long-Run Results of the TBAL Model

| Variable | Coefficient | Std. Error | Prob. |
|---|---|---|---|
| lnREER | 0.579 | (0.2582) | 0.0377 |
| lnRGDP | -0.238 | (0.9974) | 0.8142 |
| lnWRGDP | 9.029 | (5.0082) | 0.0882 |
| lnGFCF | -0.329 | (0.3639) | 0.3773 |
| lnFDI | 0.346 | (0.1517) | 0.0351 |

From the results in Table 6, the estimates reveal that the exchange rate exerts a positive and significant influence on the trade balance at a 5% level of significance. This implies that the trade balance responds positively to changes in exchange in the long run. This means that currency depreciation facilitates favourable trade in Nigeria in the long run. This positive relationship implies the country's long-run net positive benefits of currency depreciation.

The result further shows that foreign direct investment exerts a strong positive in-

fluence on the trade balance in Nigeria in the long run at a 5 percent level of significance. This means that FDI can boost exports and discourage the importation of foreign products, thereby encouraging a favourable trade balance. The estimated world GDP accelerates the trade balance in Nigeria in the long run at a 10% significance level. The real GDP and gross fixed capital formation estimates are negative but insignificant.

### 4.4.2 Short-Run Impact of Exchange Rate on Trade Balance

The study used the Wald test to test for asymmetry in the short-run relationship between the exchange rate and trade balance in Nigeria. The estimates are presented in Table 7.

**Table 7:** Wald test for short-run asymmetry

| Test Statistic | Value | Df | Probability |
|---|---|---|---|
| t-statistic | -1.924606 | 16 | 0.0722 |
| F-statistic | 3.704107 | (1, 16) | 0.0722 |
| Chi-square | 3.704107 | 1 | 0.0543 |

The result for the test shows an F-statistic value of 3.704107 and a chi-square value of 3.704107 with probability values of 0.0722 and 0.0543, respectively. Hence, there are no short-run asymmetric effects of the exchange rate on the trade balance in Nigeria at a 5% significance level. However, there is evidence of the asymmetric effects of the exchange rate on the trade balance in the short run at a 10% level of significance. The implication is that the trade balance effects of the positive and negative changes in exchange rate differ in the short run depending on the import and export elasticities to changes in the exchange rate. This explains why the relationship between the real effective exchange rate and trade balance in Nigeria is symmetrical since the evidence of the nonlinear relationship in the short run is not found at a 5% level of significance. The short-run results of the variables are presented in Table 8. The results in Table 8 show that real exchange rate depreciation negatively influences the trade balance in the short run and *vice versa*. The result is statistically significant at a 5 percent level of significance based on the joint effect of the lags of the exchange rate on the trade balance, even with the insignificant positive impact of the estimated first lag of the exchange rate.

**Table 8:** Short-Run Results of lnTBAL Model-Selected Model: ARDL(2, 2, 0, 2, 1, 2)

| Variable | Coefficient | Std. Error | Prob. | Wald Test Null Hypothesis | F-statistic | Chi-square |
|---|---|---|---|---|---|---|
| C | -64.240*** | 9.4746 | 0.0000 | | | |
| @TREND | -0.626*** | 0.0913 | 0.0000 | | | |
| D(lnTBAL(-1)) | 1.404*** | 0.3206 | 0.0004 | | | |
| D(lnREER) | 0.258 | 0.3121 | 0.4185 | | | |
| D(lnREER(-1)) | -0.904*** | 0.2936 | 0.0064 | C(4)+C(5)=0 | 2.126** | 4.521** |
| D(lnWRGDP) | 27.932*** | 4.6252 | 0.0000 | | | |
| D(lnWRGDP(-1)) | -14.035** | 6.2025 | 0.0363 | C(8)+C(9)=0 | -0.892 | 0.795 |
| D(lnGFCF) | 1.207** | 0.5601 | 0.0449 | | | |
| D(lnFDI) | 0.091 | 0.1281 | 0.4853 | | | |
| D(lnFDI(-1)) | 0.587*** | 0.1296 | 0.0003 | C(13)+C(14)=0 | 2.872** | 8.246** |
| CointEq(-1)* | -0.237*** | 0.3332 | 0.0000 | | | |
| R-Squared | 0.9077 | DW=2.344 | | | | |
| R-Squared Adjusted | 0.8676 | | | | | |

Note: The asterisks *, **, & *** indicate statistical significance at 10 percent, 5 percent, and 1 percent respectively.

The joint significance of the lags of REER on the trade balance is impactful at a 5% level of significance based on the results of the F-statistic. This result aligns with the findings of some studies that trade does not maintain a regular structure in the short run following depreciation or devaluation (Bahmani-Oskooee & Kantiapong, 2001; Gupta-Kapoor & Ramakrishnan, 1999). However, it further explains the pattern of trade's response (inelastic nature) to changes in the real effective exchange rate in the short run, as posited by the J-curve theory. The negative influence further explains that the trade balance is not favourable in the event of real depreciation in the short run. The study infers that the J-curve holds in Nigeria since there are net positive benefits of depreciation in the real effective exchange rate on the trade balance long-run after short-run negative effects. This depicts a J-curve phenomenon in Nigeria.

The implication is that the relative cost of imports becomes higher than that of locally produced goods. However, due to a lack of expansion by local firms and quality differentials, among other factors, the demand for imports continues in the short run but

vanishes over time due to relative domestic advantage. The absence of net positive benefits of the exchange rate changes (e.g., depreciation) on trade balance in the short run implies that domestic firms do not upscale the standards of domestic products in terms of quality and quantity, inelastic import demand, and efficiency (inelastic supply) that inhibit the export benefits of a depreciating currency. This may be attributed to the trade composition in Nigeria in terms of exports that are primarily petroleum and other raw materials, such as cocoa, rubber, palm kernels, organic oils, and fats. However, Nigerian trade exhibits a J-curve pattern given the positive net benefits of currency depreciation on the trade balance in Nigeria in the long run.

The study also found that FDI, gross fixed capital formation, and world GDP positively and significantly influence the trade balance in the short run at a 5% level of significance. The results of the Wald test also show a significant net effect of FDI on driving the trade balance. The estimated R-squared and adjusted R-squared are 90.77% and 86.76%, respectively. This means that the variations in trade balance are explained by the identified variables that are calibrated and estimated in the TBAL model. The Durbin-Watson statistic is also approximately 2, indicating the absence of serial correlation in the residuals. The speed of adjustment towards long-run equilibrium in the case of any initial distortions is 23.7%. This implies that the TBAL model corrects itself to long-run equilibrium moderately yearly.

### 4.5 Long-Run Impact of Exchange Rate on Exports and Imports

#### 4.5.1 Long-Run results

The study used the Wald test to examine the long-run asymmetric relationship between the exchange rate and exports of goods and services and between the exchange rate and imports of goods and services in Nigeria. The findings of the study indicate that there is no significant evidence of long-run asymmetric effects of exchange rate on imports and exports of goods and services in Nigeria as the F-statistic is not statistically significant at a 5% level of significance. Therefore, the study suggests that in the long run, the effects of foreign exchange rate depreciation and appreciation on exports and imports do not differ significantly.The estimates are presented in Table 9.

**Table 9:** Wald test for long-run asymmetry

| **EXPT Model** | | | | **IMPT Model** | | | |
|---|---|---|---|---|---|---|---|
| **Test Statistic** | **Value** | **Df** | **Probability** | **Test Statistic** | **Value** | **Df** | **Probability** |
| t-statistic | 0.4809 | 11 | 0.6400 | t-statistic | -0.1459 | 7 | 0.8881 |
| F-statistic | 0.2313 | (1, 11) | 0.6400 | F-statistic | 0.0213 | (1, 7) | 0.8881 |
| Chi-square | 0.2313 | 1 | 0.6306 | Chi-square | 0.0213 | 1 | 0.8840 |

The symmetric models (lnEXPT and lnIMPT models) are reported in Table 10.

**Table 10: Symmetric Long-Run Results for export and import**

| **Export** | | | | **Import** | | | |
|---|---|---|---|---|---|---|---|
| **Variable** | **Coefficient** | **Std.Error** | **Prob.** | **Variable** | **Coefficient** | **Std.Error** | **Prob.** |
| lnREER | 0.579 | (0.2582) | 0.0069 | lnREER | -1.775 | (0.8539) | 0.0643 |
| lnWRGDP | 0.238 | (0.9974) | 0.9608 | lnRGDP | 8.154 | (3.6207) | 0.0480 |
| lnGFCF | 9.029 | (5.0082) | 0.0000 | lnGFCF | -4.630 | (1.2945) | 0.0050 |
| lnFDI | 0.329 | (0.3639) | 0.0000 | lnFDI | 0.127 | (0.2086) | 0.5578 |
| | | | | lnPOP | 9.176* | (2.7117) | 0.0070 |

From the results in Table 10, depreciation of the REER has a positive and significant influence on exports, while depreciation of the REER has a negative and significant influence on imports. The implication is that the export of goods and services in Nigeria (export supply) is elastic to changes in REER, as is the response of import demand to changes in REER. This implies that depreciation in the real effective exchange rate exerts a strong positive influence on exports in Nigeria in the long run, and *vice versa, Ceteris Paribas*, while it has the capacity to discourage imports in the long run. This means that fluctuations in the exchange rate in Nigeria significantly determine the flows of exports and imports in Nigeria, especially in the long run. This explains why imports become relatively expensive for a depreciating economy and thus discourage further importation of goods and services in the country due to the high cost. The study validates the theoretical expectation of the relationship that imports become relatively expensive while exports become relatively cheaper in the global market in the event of currency depreciation. Therefore, the study shows that REER depreciation can discourage imports and encourage exports in the long run.

The study also shows that exports of goods and services in the country are driven by

higher levels of investment by domestic and foreign firms. This is because higher domestic and foreign investment significantly increases the level of exports in Nigeria in the long run. Therefore, both GFCF and FDI enhance the export potential of the Nigerian economy. In addition, the result shows a very strong negative relationship between domestic investment (GFCF) and the import of goods and services in the long run. This means that the volume of domestic investment discourages the flow of imports to the country. However, there is a positive influence of population on imports. This explains the potential demand for foreign products and further explains the role of the population in the country on their import demand. In addition, the study shows that RGDP has a significant influence on imports of goods and services in Nigeria. The negative relationship explains the import dependency of Nigerians as a result of improvement in national income. This is evident by the kind of foreign goods and services consumed by many Nigerians whenever there is an improvement in their income.

### 4.5.2 Short run results

To test for short-run asymmetry for the relationship between the exchange rate and imports and the relationship between the exchange rate and exports, the Wald test was used, and the results are presented in Table 11.

**Table 11: Wald test results for short-run asymmetry**

| **EXPT Model** | | | | **IMPT Model** | | | |
|---|---|---|---|---|---|---|---|
| **Test Statistic** | **Value** | **Df** | **Probability** | **Test Statistic** | **Value** | **Df** | **Probability** |
| t-statistic | -1.6220 | 11 | 0.1331 | t-statistic | 0.6017 | 7 | 0.5663 |
| F-statistic | 2.6307 | (1, 11) | 0.1331 | F-statistic | 0.3621 | (1, 7) | 0.5663 |
| Chi-square | 2.6307 | 1 | 0.1048 | Chi-square | 0.3621 | 1 | 0.5474 |

The outcome of the analysis for short-run asymmetry effects of exchange rate on imports and exports suggests that the F-statistics are not significant, indicating that there is no evidence of short-run asymmetric effects of exchange rate on imports and exports in Nigeria. Therefore, it can be inferred that the effects of foreign exchange rate depreciation and appreciation on exports and imports do not differ significantly in the short run. To provide further insight, the symmetric models for the lnEXPT and lnIMPT models were estimated in the short run, and the findings are presented in Table 12.

**Table 12: Short run results from symmetric model**

| Variable | Coefficient | Std.Error | Prob. | Null Hypothesis | F-statistic | Chi-square |
|---|---|---|---|---|---|---|
| **Export** | | | | | | |
| C | -0.475*** | (0.15492) | 0.0066 | | | |
| @TREND | -0.154*** | (0.01677) | 0.0000 | | | |
| D(lnEXPT(-1)) | 0.356*** | (0.11193) | 0.0052 | | | |
| | | (0.14679) | | | | |
| D(lnREER) | -0.334** | | 0.0352 | | | |
| D(lnREER(-1)) | -0.822*** | (0.20152) | 0.0007 | | | |
| D(lnREER(-2)) | -0.623*** | (0.15502) | 0.0008 | C(4)+C(5)+C(6)=0 | 6.138*** | 18.415*** |
| D(lnWRGDP) | 3.913 | (2.28006) | 0.1033 | | | |
| D(lnFDI) | -0.148** | (0.06327) | 0.0315 | | | |
| D(lnFDI(-1)) | -0.616*** | (0.10728) | 0.0000 | | | |
| D(lnFDI(-2)) | -0.376*** | (0.07609) | 0.0001 | C(11)+C(12)+C(13)=0 | 11.551*** | 34.652*** |
| CointEq(-1)* | -1.198*** | (0.13674) | 0.0000 | | | |
| R-squared | 0.8507 | | | | | |
| R-squared Adj. | 0.7829 | | | | | |
| DW | 2.33 | | | | | |
| **Import** | | | | | | |
| C | -3.565*** | (0.357088) | 0.0000 | | | |
| @TREND | -21.051*** | (2.108474) | 0.0000 | | | |
| D(lnIMPT(-1)) | -0.599*** | (0.089597) | 0.0001 | | | |
| D(lnIMPT(-2)) | -0.487*** | (0.094908) | 0.0004 | C(2)+C(3)=0 | 3.319*** | 11.013*** |
| D(lnREER) | 0.738*** | (0.118448) | 0.0001 | | | |
| D(lnREER(-1)) | 0.407*** | (0.111679) | 0.0045 | C(5)+C(6)=0 | 2.534** | 6.424** |
| D(lnRGDP) | 0.144 | (0.700527) | 0.8413 | | | |
| D(lnRGDP(-1)) | 10.429*** | (1.139714) | 0.0000 | | | |
| D(lnRGDP(-2)) | 2.397** | (0.902969) | 0.0241 | C(8)+C(9)+C(10)=0 | -3.406*** | 11.603*** |
| D(lnGFCF) | 0.215 | (0.196331) | 0.2988 | | | |
| D(lnGFCF(-1)) | -2.388*** | (0.313110) | 0.0000 | | | |
| D(lnGFCF(-2)) | -1.278*** | (0.284711) | 0.0012 | C(12)+C(13)+C(14)=0 | 4.883*** | 23.844*** |
| D(lnFDI) | -0.247*** | (0.047695) | 0.0004 | | | |
| D(lnFDI(-1)) | -0.397*** | (0.058203) | 0.0000 | | | |
| D(LNFDI(-2)) | -0.295*** | (0.040119) | 0.0000 | C(16)+C(17)+C(18)=0 | 2.369** | 5.613** |
| D(lnPOP) | 7.887*** | (0.803861) | 0.0000 | | | |
| D(lnPOP(-1)) | -7.054*** | (0.731279) | 0.0000 | C(20)+C(21)=0 | -3.423*** | 11.707*** |
| CointEq(-1)* | -0.882*** | (0.088398) | 0.0000 | | | |
| R-squared | 0.9456 | | | | | |
| R-squared Adj. | 0.884 | DW | 2.202 | | | |

The estimates in Table 12 show that lagged exports of goods and services (lagged dependent variable) positively affect the exports of goods and services from Nigeria in

the short run. This implies that the previous level of exports leads to more demand for current exports of Nigerian goods and services. The estimated influence of the real effective exchange rate on exports is negative and statistically significant at a 5% level. This shows the net negative influence of currency depreciation on the export of goods and services in the short run at a 5% level of significance and *vice versa*. The significant F-statistic using the results of the Wald test also shows the joint influence of the real effective exchange rate on exports. The inconsistencies in the relationship between the exchange rate and export of goods and services, especially as it relates to long-run and short-run estimates, imply that many consumers from Nigeria depend on imports and tend to be unresponsive to changes in the exchange rate in the short run.

The estimated foreign direct investment (FDI) negatively influences current exports at a 1 percent level of significance. The trend was also statistically significant at the 1% level of significance. The speed of adjustment towards long-run equilibrium in the case of any initial distortions is 97.5% for the exports (lnEXPT) model. This implies that the model speedily corrects itself towards long-run equilibrium. The R-squared and R-squared adjusted explain that approximately 85.07% and 78.29% of the variations in exports of goods and services are accounted for by the variables incorporated in the lnEXPT model.

The results from Table 12 indicate that a change in the REER positively and significantly impacts imports. This is further explained by the joint significance of the REER lags using the Wald test results. The inconsistencies in the relationship between the exchange rate and the import of goods and services, especially regarding long-run and short-run estimates, connote that many consumers from Nigeria depend on imports and tend to be unresponsive to changes in the exchange rate in the short run. The high import dependency syndrome, even in the face of currency depreciation in the country, affects the elasticity of import demand in the short run. This study's findings are consistent with the findings of other studies that trade does not follow any particular pattern in the short run after depreciation or devaluation (Bahmani-Oskooee & Kantiapong, 2001; Gupta-Kapoor & Ramakrishnan, 1999).

The estimated impact of real gross domestic product on imports of goods and services

in Nigeria is positive in the short run. This implies that a higher level of national income in Nigeria encourages the importation of goods and services into the country. This may be attributed to the high dependency on imports. The estimated coefficients of gross fixed capital formation and foreign direct investment negatively and significantly influence imports in Nigeria. This implies that improvement in domestic and foreign investment discourages imports in the country. This explains the potential of domestic and foreign firms (domiciled in Nigeria) to substitute the import demand of many Nigerians for foreign goods and services. The joint significance of the FDI lags using the Wald test results also validated the findings. The speed of adjustment towards long-run equilibrium in the case of any initial distortions is 88.17% for the imports (lnIMPT) model. This implies that the model speedily corrects itself towards long-run equilibrium. The R-squared and R-squared adjusted explain that approximately 94.56% and 88.4% of the variations in imports of goods and services are accounted for by the variables incorporated in the lnIMPT model.

### 4.6 Robustness Check

The study estimated the impact of exchange rate on trade flow in Nigeria by considering two exchange rates (real effective exchange rate and nominal exchange rate) and decomposed trade flow indicators (trade balance, exports and imports models). All these were done in a bid to understand the true relationship between the exchange rate and trade flow in Nigeria while interrogating the significance of the choice of the type of exchange rate used. The study estimated the models using the real effective exchange rate for analysis and statistical inferences, while the nominal exchange rate was also used to determine whether the choice of the type of exchange rate produced significantly different estimates in terms of asymmetric effects and evidence of the J-curve pattern. The estimates from the models using the nominal exchange rate indicated no asymmetric effects of the exchange rate on trade balance, exports and imports in the trade balance model, exports model, and imports model at the 5% level of significance. However, for the two proxies of the exchange rate, there was evidence of asymmetry for the trade balance model in the short run at the 10% level of significance.

Regarding theoretical and statistical significance, the exchange rate has no significant

effect on trade balance and exports in the long run at a 5% level of significance, unlike the behaviour of the REER. The results further reveal that an increase in the level of domestic national income and domestic investment increases the level of imports. This may also be attributed to the import dependency syndrome that characterises Nigerian consumers for the former and domestic firms' tendency to import machinery for the latter. The result also confirms that foreign direct investment and domestic investment improve the level of export of goods and services from Nigeria. The estimates generally indicated evidence of a J-Curve pattern in Nigerian trade flow and satisfied the Marshall-Lerner condition, given that the sum of the export and import elasticities is greater than 1.

The symmetric effects of the exchange rate on the trade balance in Nigeria also exhibited slight differences in the results in terms of the significance of the determinants of exports and imports of goods and services and, most importantly, on the net trade balance. Moreover, the dynamic multipliers show a net positive response to trade balance and imports of goods and services in the event of changes in the nominal exchange rate, unlike that of the real effective exchange rate. This shows slight misalignment in the results. Considering the slight variations in the use of exchange rate measures and the importance of real effective exchange rate (REER) as an indicator of a country's overall alignment in trade, this study employed REER. REER is calculated as the average of bilateral REERs between the country and its trading partners, with each partner's trade share weighted accordingly.

## 5. Conclusion and Policy Recommendations

The paper examines the impact of exchange rate on trade flow using linear and nonlinear autoregressive distributed lag (ARDL and NARDL) models to test the J-Curve hypothesis and the Marshall-Lerner condition in Nigeria. The study infers that real exchange rate depreciation has a negative (positive) impact on trade balance and exports in the short (long) run thus confirming the J-curve hypothesis. The findings connote that real depreciation worsens the Nigerian trade balance in the short run, though, it improves significantly in the long run. Thus, the influence of the exchange rate on the trade balance and exports of goods and services is strong and positive in the long run. It can be deduced from the findings that there is a high level of im-

portation even in the face of real depreciation in the country in the short run, which is attributed to the nature of import demand elasticity, intense competition with foreign products, the inability of local firms to upscale the standards of domestic products in terms of quality and efficiency, and the trade composition, which is primarily petroleum and other raw materials. The study established the Marshall-Lerner condition since the sum of the elasticities of exports and imports is greater than one. Thus, there is room for net improvement in trade. The study further shows that domestic and foreign direct investments discourage imports but encourage exports in the long run. The study recommends that the Nigerian government should strengthen local firms by granting them investment incentives to boost and enhance the quality of output. This will not only ease substitution but also encourage exports and consequently reduce imports.

There is an urgent need for monetary policy intervention to mitigate the short-run negative effects of exchange rate changes, given the pattern of the country's trade flow, even in the face of currency depreciation. Effective exchange rate management in this regard can help avert the negative effects of the floating exchange rate regime. This is because exchange rate depreciation without output expansion and import substitution would exacerbate inflationary tendencies. Consequently, a stable exchange rate should be aggressively pursued through a sound exchange rate management and policies that result in increased domestic production of export commodities and decreased demand for imports.

The Nigerian government should establish a support scheme for domestic firms, especially in value addition that could assist in facilitating the expansion of productive capacities and upscaling in terms of the quality of products relative to the global standards, as it would change the domestic demand for imports in instances when the currency depreciates.

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