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On balance of payments and the volatility of exchange rate in Nigeria

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Abstract
This paper investigates the effect of exchange rate volatility on balance of payments (BOPs) in Nigeria, using annual time series data from 1980 to 2018. The study employs the Autoregressive Distributed Lag (ARDL) co-integration testing technique and the ARDL error correction representation to assess the long-run and short-run dynamic relationship between nominal exchange rate volatility and Nigeria's balance of payments. The regressors included in the ARDL model are: real interest rate, real GDP growth rate, terms of trade, and volatility of nominal effective exchange rate while balance of payments (BOPs) served as the dependent variable. The key results are as follows: (i) GDP growth rate, exchange rate volatility, terms of trade and real interest rate were found to be key determinants of Nigeria's balance of payments position; (ii) volatility of nominal effective exchnage rate is found to exert a second order negative effect on Nigeria's Balance of payments postion-suggesting that uncertainty in the Nigerian exchnage rate market has long memory; and (iii) although improvement in terms of trade is found to exert a postive nock-on effect on the balance of payments, the potential adverse consequence of a negative terms of trade does not quickly die away. Iin view of the potential negative effect of adverse terms-of-trade, a policy of economic diversification that is annexed with an incentive-based export programme is recommended as a core way of improving Nigeria's balance of payments position.

Keywords: exchange rate volatility, auto-regressive distributed lag (ARDL) model, balance of payments (BOPS), Nigeria

Introduction

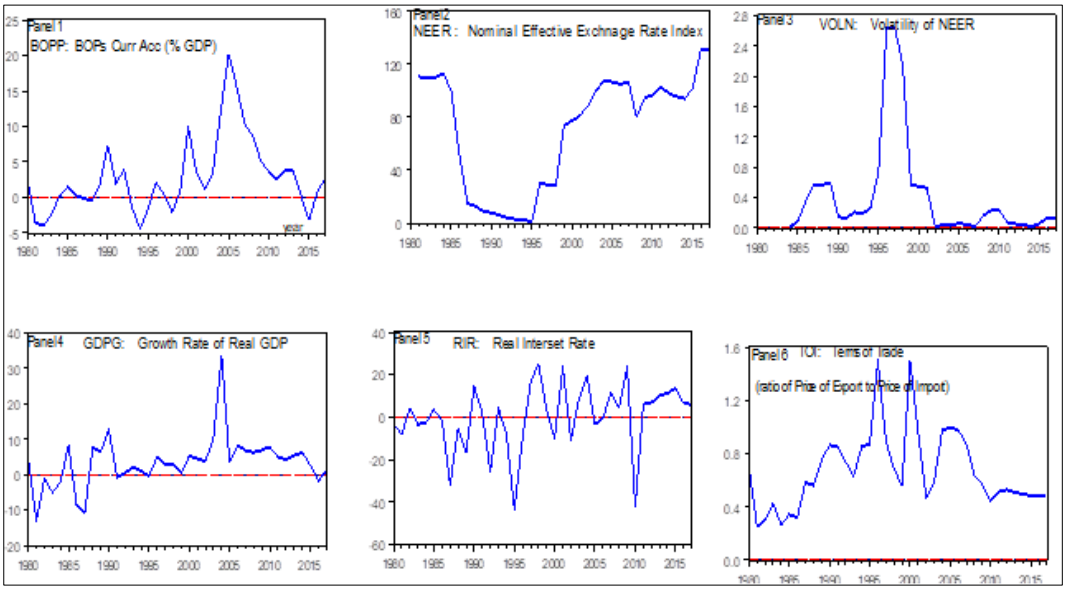
Exchange rate is a fundamental macroeconomic variable that guides investors on the best way to strike a balance between their trading partners (Odili, 2007) [24]. It is an important monetary policy tool used in the pursuit of certain macroeconomic objectives such as healthy balance of payments. It also plays a key role in the determination of relative price of domestic and foreign goods and services as well as a key factor in any nation's competitiveness in the international market. Thus, 'nations' in the pursuit of macro-economic goals of healthy external balances generally find it imperative to enunciate exchange rate policy (Oladipupo and Onotaniyohuwo, 2011) [25]. The objectives of exchange rate policies are often tailored towards the achievement of the overall macro-economic goal of internal and external balances in the medium and long term.

Over the years, many nations including Nigeria have witnessed volatility in their exchange rate with potential adverse implication for their balance of payments. (Umor *et al*, 2013) [28]. Many of these countries have resorted to different exchange rate management policy. In Nigeria, exchange rate management has undergone changes over the past four decades. In the 1960s, Nigeria operated a fixed exchange regime which was fixed at par with the British pound and later the American dollar. This is in addition to restrictions on import via strict administrative controls on foreign exchange (Adelowokan *et al*, 2015). In 1978, the monetary authorities pegged the naira to a basket of 12 currencies of her major trading partners. The sharp fall in international oil price and the consequent decline in foreign exchange receipts in the early 1980s were such that the economy could not meet its international financial commitments. To mitigate the challenges, the stabilization act of 1982 was implemented which led to accelerated depreciation of the naira.

The trend of the naira (using the naira-dollar bilateral exchange rate) depreciation since 1973 has basically been from N0.60 to $1, N4.00 to $1 in 1984, N84 to $1 in 1995, N160 to $1 in 2014 and N199 to $1 in 2015 (Central Bank of Nigeria 2017). The trend of depreciation in the nominal effective exchange rate index (see Figure 1) closely mimics that of the bilateral exchange rate. The continued depreciation of the naira in the foreign exchange market has been closely associated with exchange rate volatility and has resulted in declines in the level of investment, fall in standard of living of the populace, and increased cost of production, among others. It has also tended to undermine the international competitiveness of non-oil exports and have created uncertainty/risk that have in turn made planning and projections difficult at both the micro and macro levels of the economy. This explains the central role according exchange rate and its management at the foreign sector, private individual and government levels in Nigeria.

As Panel 2 of Figure 1 clearly shows, following the adoption of the world bank designed structural adjustment programme in 1986 and the and the subsequent deregulation of the foreign exchange market, the nominal effective exchange rate index have generally maintained a bullish trend. This indicates a general depreciation of the domestic currency (naira) over bulk of post-SAP era in Nigeria. Looking at the volatility in NEER, thde trend indicates more variability in recent years. A more perceptive look

at the trend of GDP growth rate show that growth of GDP has been declining since 2014 and by 2016 Nigeria has plugged in a negative growth in more than three consecutive quarters, the so-called 2016 economic recession. The performance of terms of trade has not been quick different from that of GDP growth rate particularly in more recent times. Beginning from 2010, the trend of terms of trade has not been increasing. Instead the trend has been flat.



***Source*:** WDI (2018), Market Data (2018), CBN Bulletin (2017).

Fig 1: Stylized Characterization of Nigeria's BOPs and NEER Volatility

Given that the trend analysis is only but a descriptive characterization of the behaviour of Nigeria balance of payments and its hypothesized determinants, we are unable to attach any structural interpretation it. Instead, we leave any structural interpretation to the more robust ARDL estimation and the ARDL Error Correction representation that is employed in this study.

The objective of this paper is to investigate the impact of volatility in exchange rate of Nigeria's balance of payments. A study of this nature is important in many folds. First, the finding from the study will help to inform evidence-based policy on exchange rate management in Nigeria. Second, the result from the study will help to unearth the macroeconomic and structural determinant of exchange balance of payments and its misalignments in Nigeria.

The balance of the paper is structured as follows. Section 2 presents an eclectic review of literature focusing particularly on theoretical foundations of balance of payments approaches, namely; the elasticity, the absorption and monetary approaches. This section also present the review of empirical literature and an evaluation of the literature reviewed. In section 3, we discuss the methodology adopted for the study – namely, the ARDL co-integration testing approach and its Error Correction Representation taking advantage of the 'direct' ARDL estimation method that relies on the microfit quantitative software. In section 4, we present the result of the empirical exercises and discuss them. Section 5 concludes the papers with some lessons for policy.

2. Literature Review

The theoretical basis for this study is provided by a number of recent theories dealing with the instrument for correcting balance of payments deficits. Such theories have been from the mainstream international trade theory that dates back to the 18th century. In 1752 for instance, David Hume in his work on the balance of trade (BOT) made a case for the automatic equilibrating mechanism provided by inflows and outflows of money stock in balance of payments adjustment. Detailed analysis of the theory of policy instruments for correcting balance of payments equilibrium is also, however, clearly spelt out in the work of Meade (1951) [19]. Meade (1951) [19] proposed that a country can offset adverse trends in its balance of payments by a change of financial policies. A policy of price adjustments, which involves changes in money wage and changes in exchange rate may be accompanied with devaluation. The former policy mix is the so-called expenditure – switching policy.

The aim of expenditure reducing policy is to reduce domestic expenditure on consumption and investment and thereby release goods for export, while leaving aggregate output unchanged. On the other hand, the aim of expenditure switching policy is to switch domestic demand from imported to home made goods (Anyanwu, 1995). The extent to which the switching is achieved depends on the elasticity of demand and supply of tradable (Olisadebe 1996). The loss would be minimized if resources can be easily moved to the tradable goods sector. Given the topic at hand, namely a review of the nexus between BOPs and exchange rate and/or it volatility, a former presentation of the Balance of Payments equation and their approaches is in order

However, to express our balance of payments function, we first discuss the various approaches used to analyze the effect of exchange rate and its volatility on balance of payments. These approaches include the elasticity approach, the absorption approach and the monetary approach. Among these three approaches, the monetary approach is at the frontier of knowledge regarding the analysis of exchange rate

fluctuation/effects on balance of payments (Sekkat and Varoudakis, 2000) [30]. We now consider these approaches.

The Elasticity Approach

The elasticity approach focuses on the trade balance. It studies the responsiveness of the variables in the trade and services account, constituting of imports and exports of merchandise and services relative price changes induced by devaluation. The approach to balance of payments is built on the Marshall Lerner condition (Sodersten 1980 [1]. This condition can be expressed mathematically as follows:

$$\Delta B = KX_f \left(e_{1m} + e_{2m-1}\right) \quad (1)$$

Where: K represents devaluation (in %); X_f represents the value of exports expressed in foreign currency; e_{1m} represents first (devaluing) country's '*demand elasticity of imports'*; e_{2m} stands for the second country's '*demand elasticity for exports'* from the devaluing country. Thus, for Marshall Lerner condition to hold, the following must be fulfilled:

$$e_{1m} + e_{2m} > 1 \quad (2)$$

The elasticity approach essentially detects the condition under which changes in exchange rate would restore balance of payments equilibrium. It also focuses on the current account of balance of payments and requires that the demand elasticity be calculated specifically for the conditions under which devaluation would improve the balance of payments [2]. (Marshall, 1923; Lerner, 1944) [1] sees elasticity approach to balance of payments as the most efficient mechanism of balance of payments adjustments and suggests the computation of demand elasticity as the analytical tool by which policies in the exchange field can be chosen, so as to form the equilibrium. In contrast, Lotto (2011) is of the view that most less developed countries who are exporters of raw materials or primary products, and importers of necessities may not successfully apply devaluation as a means of correcting balance of payments disequilibrium. This, he argues, is because of the low values for their '*elasticity of demand*' particularly for export.

The Absorption Approach

This approach summarily postulates that devaluation would only have positive effects on the balance of trade if the propensity to absorb is lower than the rate at which devaluation would induce increases in the national output of goods and services. It therefore advocates the need to achieve deliberate reduction of absorption capacity to accompany the currency devaluation. The basic tenets of this approach is that a favourable computation of price elasticity may not be enough to produce a balance of payments effects resulting from devaluation, if devaluation does not succeed in reducing domestic expenditure. The approach dwells on national income relationship developed by Keynes and it tries to find out its implication on balance of payments (Machlup 1955). It begins with the national income identity as shown below.

$$Y = C + I + G + X - M \quad (3)$$

Where,

Y = National income; C = Private consumption of goods and services; I = Total investment by firms and government; G = Government expenditure on goods and services; X = Export of goods and services; M = Import of goods and services

We can represent *domestic expenditure* with expenditure terms such as: C + I + G = α, and the *net export* as: X – M =β

Putting the two expressions together gives the equation Y = α+β which means that the trade balance equals national income minus total (domestic) expenditure

$$\beta = Y - \alpha \quad (4)$$

The Monetary Approach

The monetary approach focuses on both the current and the capital accounts of balance of payments. This is quite different from the elasticity and absorption approaches, which focus mainly on the current account balance. As pointed out by Crockett (1977), the general view of monetary approach makes it possible to examine the balance of payments not only in terms of the demand for goods and services, but also in terms of the demand for the supply of money. This approach also provides a simplistic explanation to the long run devaluation as a means of improving the balance of payments, since devaluation represents an unnecessary and potentially distorting intervention in the process of equilibrating financial flows.

Dhliwayo (1966) emphasizes that the relationship between the foreign sector and the domestic sector of an economy through the working of the monetary sector can be traced by David Humes's price flow mechanism. The emphasis here is that balance of payments disequilibrium is associated with the disequilibrium between the demand and supply for money, which is determined by variables such as income, monetary approach also sees balance of payments as regards international reserve to be associated with imbalances prevailing in the money market. This is because in a fixed exchange rate system, an increase in money supply would lead to an increase in expenditure in the form of an increased purchase of foreign goods and services by domestic residents. To finance such purchases, much of the foreign reserves would be used up, thereby worsening the balance of payments. As the foreign reserve flows out, money supply will continue to diminish until it equals money demand, at which point, money equilibrium is restored and outflow of foreign exchange reserve is stopped.

Conversely, excess demand for money would cause foreign exchange reserve inflows, domestic monetary expansion and eventually balance of payments equilibrium position is restored. The monetary approach is specifically geared towards an explanation of the overall settlement of a balance of payments surplus or deficit. If the supply of money increases through an

[1] The Marshall–Lerner condition states that depreciation would lead to expansion in output if the sum of price elasticity of demand for export and the price elasticity of demand for imports is greater than unity.

[2] Our baseline dependent variable in the ARDL model is the Balance of Payment measured as annual Current Account (in % GDP) (see WDI, 2018)

expansion of domestic credit, it will cause a deficit in the balance of payments, an increase in the demand for goods and various assets and decrease in the aggregate in the economy. In what follows, we examine the empirical literature before evaluating the literature reviewed.

In terms of *empirical literature*, a number of studies have examined the empirical relationship between balance of payments and exchange rate and/or exchange rate volatility. Pentti (1976), for instance, investigated the relationship between exchange rate and balance of payments in the short and long run using the monetary approach. His findings showed a significant departure from the traditional analysis by establishing a link between monetary policy and the inflow or outflow of capital through the effect of interest rate and exchange rate on aggregate demand and output and thereby on the current account, which determines the capital account balance.

Miller (2004) [20] investigated the impact of exchange rate depreciation on exports for Singapore, using the bivariate GARCH-M model. Real exports as dependent variable were tested against real foreign income (y), real risk. Using monthly data over the period of 1975 to 1992, and reported that the effect of exchange rate depreciation on exports was positive but insignificant. Second, time varying real exchange rate risk exhibited a significant negative effect on exports of substantial magnitude. Third, the exchange rate risk effect dominated the depreciation effect, leading to a negative net effect of exchange rate charges on export revenue.

Frenkel (2004) [12] examined aggregate employment behaviour in response to real exchange rate movements in Argentina, Brazil, Chile and Mexico between 1980 and 2003. He found that real exchange rate has an expected negative effect on the change in the national unemployment rates in the period covered with long-run negative impact on current account section of the balance of payments, the implication of which is that in order to achieve higher rate of employment, growth in output and balance of payment equilibrium, stable and competitive real exchange rate should be pursued

Amaghionyeodiwe and Osinubi (2005) investigated what determined the choice of the exchange rate regimes in Nigeria. The multinomial qualitative response model was used. The variables used were Monetary Stock (MS), Real Stocks (RS), Inflation Differential (ID), Foreign Reserve Constraints (FR) and Openness (OPEN) The result indicated that different variables from characteristics of the economy (degree of openness) and macro-economic performance (inflation differential, charge in foreign reserves) to real monetary shock helped to explain the choice of exchange rate regimes at different periods of time. Also, the empirical results indicated that domestic monetary disturbance appreciated the real exchange rate and favoured a more flexible arrangement.

Fang, *et al* (2005) [11] investigated the net effect for eight Asian countries using a dynamic conditional correlation bivariate GARCH -M model that simultaneously estimates time varying correlation and exchange rate risk. Depreciation displayed the normal positive estimates for all countries except Singapore. Exports reacted, slowly to depreciation as compared to US income. Real Exchange Rate Risk produced significant estimates on exports for seven of the eight countries studied. For some countries, the Marshall - Learner condition holds and did not in some. Exchange rate depreciation acts positively on exports but exchange rate risk acted negatively and as such some countries experienced crowding out.

Aliyu (2008) [3] assessed the impact of exchange rate volatility on non-oil export flow in Nigeria. Using quarterly observation for twenty years, he used the vector error correction (VEC) methodology between 1986 Q1 and 2006 Q4. The variables used were terms of trade, nominal effective exchange rate, and lagged real exchange rate. The results of the findings indicated that naira exchange rate volatility decreased non-oil exports while the same estimates for US dollar volatility increased non-oil exports in Nigeria in the year 2003.

Patricia and Osi (2010) examined the BOPs equilibrium in the West African Monetary Zone. Using panel data analysis, the results of within-country effects indicate that interest rate and growth in output play a significant role in achieving a favourable balance of payments, while the cross-country effects show similar results. They therefore consider a tight reign on domestic credit creation as a necessary condition for maintaining stability in the balance of payment.

Loto (2011) [18] investigated the effect of devaluation/depreciation of the Nigerian Naira on the country's trade balance for the period 1986 to 2008. He adopted the elasticity approach, and the ordinary least square (OLS) method was used to estimate import and export demand functions. The variables entered into the regression line were: Export, import, foreign trade and GNP. It was however found that devaluation/ depreciation does not improve the trade balance; since the sum of demand elasticity for imports and exports was less than unity, thus the Marshall-Lerner does not hold in Nigerian economy.

Oladipupo (2011) [25] investigated the impact of exchange rate on the Nigeria external sector, using the ordinary least square (OLS) method of estimation for data covering the period between 1970 and 2008 The variables employed were: change in the trade balance, the devaluation in percentage, the value of exports expressed in foreign currency, the first (devaluing) country's demand elasticity for imports and the second country's demand elasticity for exports from the devaluing country. The results of the investigation indicated that exchange rate has significant impact on the balance of payments position. The exchange rate depreciation can actually lead to improved balance of payments position if fiscal discipline is imposed.

Imoisi (2012) examined the trends in Nigeria's BOPs. The results indicate a significant relationship between BOPs, exchange rate and interest rate. The author therefore, recommended an increase in non-oil export through a diversified productive base as a vehicle to correct the deficit in the current account section of the balance of payments. It must be asserted that the analysis of the impact of exchange rate depreciation on the BOPs must necessarily involve its mechanism on output and trade volume, the stimulation of which can improve a country's net exports consequently.

Umoru and Odjegba (2013) [32] investigated the relationship between exchange rate misalignment and balance of payments mal-adjustment in Nigeria from 1973 to 2012, using a vector error correction model technique. The variables used were: balance of payments, exchange rate and the differencing operator. The result from the findings was that exchange rate misalignment exhibited a positive correlation with balance of payments adjustment in Nigeria, thus, exchange rate appreciation is favourable to the Nigeria economy. It helped the country import much needed

machinery and technological know-how cheaply for purpose of industrialisation.

Ekong and Onye (2013) [10] examined whether flexible price monetary model (FPMM) of exchange rate determination is consistent with the variability of the naira-dollar. Variables used were the official exchange rate, money supply (M2), real money income and expected inflation rate from 1986 to 2010. The Modified Ordinary Least Square method (M-OLS) was used, and the Augmented Dickey- Fuller test for co-integration was also carried out. They found out that exchange rate and relative price will apparently drift apart without bounds in the long-run.

Umoru and Oseme (2013) [32] examined the J-curve effect based on Nigerian data by using the vector error correction methodology. The variables were real exchange rate (depreciation) and trade ratio. However, the findings indicated a cyclical feedback between trade balance and the real exchange rate depreciation of the naira, thus, there is no empirical evidence in favour of the short-run deterioration of the trade balances as implied by the J-Curve hypothesis. Rather, what is empirically supported is the cyclical trade effect of exchange rate shock.

Wanjau (2014) [33] investigated the effect of real exchange rate on current account balance and additionally investigated if the rate of import growth in Kenya is consistent to balanced economic growth as stipulated in the law. Based on two main theories, the neoclassical elasticity approach and balance of payments constraint model, the former contended that balance of payment is influenced by the nature of import and export elasticity, while the later theory holds that long run economic growth may be achieved if growth in export is consistent with import growth rate. The significance and signage of real exchange rate co-efficient was used to determine whether Marshall -Lerner condition holds. Annual time series data from 1980 to 2011 was modeled using the (ARDL) model. The data were subjected to ADF test and Philip Perron test, using ordinary least square (OLS) to estimate the model. The variables used were: current account balance, real exchange rate, domestic income, foreign income, imports and exports, the logged imports - logged export. The results in the finding indicated that the Marshall Lerner Condition holds in Kenya and the J-Curve phenomena is supported by data.

Nyeadi *et al* (2014) [22] investigated the impact of exchange rate movement on export growth in Ghana using secondary data. The variables used were gross domestic product, gross national saving, exchange rate of Cedi for the US dollar inflation rate, import of goods and services growth and size of population. The methodology used was the Ordinary Least Square (OLS). The study period spanned from 1990 to 2012. The results of the findings indicated that contrary to many findings, exchange rate movement has no significant impact on export of goods and services in the country. They found exchange rate movement and inflation not having impact on export growth in Ghana.

Danquah *et al* (2014) [9] examined the effects of exchange rates on Ghana's external trade. The study used real exchange rate as a key determinant of imports and exports and annual time series data from 1986 to 2005. The autoregressive distributed lag approach to co-integration was employed to establish long-run relationship between the variables in the three models they used. The variables used were: imports, exports, trade balance, real effective exchange rate, and income proxied by real GDP of Ghana, import price, export price, foreign income, and foreign reserves. The results of the findings indicated that for improved balance of trade in Ghana, coordination between the exchange rate and demand management policies should be strengthened and be based on the long-run fundamentals of the economy.

Kohlar (2014) estimated the effects of movement of exchange rate on economic activity and inflation in Australia. The range of estimates suggested that a temporary 10% depreciation of exchange rate increased the level of GDP temporarily by $^1/_4$ -$^1/_2$% over one to two years. The models used were: structural vector auto regression (SVAR) model and dynamic stochastic general used. The variables employed were: Gross Domestic Product, Exchange Rate, Imports, and Exports. The results indicated that 10% depreciation increased service export volumes by 13% overall, though quite slow, after two years increased by 8%.

An evaluation of the literature so far reviewed indicates some methodological gap particular in the area of estimation technique. First, many of the existing studies employing the ARDL approach to co-integration do not take advantage of recent advancement in the ARDL estimation technique such as the use of the direct ARDL estimation procedure and the ARDL error correction representation that is readily available in the quantitative microfit software (Pesaran, Shin and Smith, 2001). Instead many past studies have tended to rely on the indirect ARDL co-integration approach that entail two step estimation procedure – by first using OLS and secondly testing for the existence of co-integration using the wald test. A major deficiency of the indirect approach is that it is unable to automatically overcome potential multi-collinearity problem due to its inability to isolate lagged regressors that could potentially create multi-collinearity issue. This problem is readily overcome in microfit estimation since the internal routine of the program automatically isolates lags of the regressors that are potentially collinear with other regressors once the modeler makes the choice of appropriate lag order (e.g lag 2) and appropriate ARDL order Selection (e.g Swarz Bayesian criterion). A second estimation issue that has characterized many past studies is poor measurement of exchange rate volatility (see e.g., Odili, 2014) [24]; Ahmed *et al* 2014)). Our study adds value to literature in this area by using a more robust measure of exchange rate volatility that is able to examine the independent effect of volatility in nominal effective exchange rate on Nigeria's balance of payments. We follow standard practice in the economics literature (see e.g., Acemoglu *et al*., 2003) and measure the volatility in exchange rate as the standard deviation of growth rate of nominal effective exchange rate index of the naira. We adopt a 3-year rolling window in computing the standard deviation and measure growth rate of nominal effective exchange rate as the first difference of its log value.

3. Methodology and Data

Given the centrality of volatility of exchange rate in the current paper, a synopsis of volatilty measures that follows the standard practise in economics science is in order. The summary presented here is retrived from Onye *et al* (2018) [10] and serves two main purposes. First, it is needed for the formalization of our empirical estimable model presented in the sequel in this paper. This is particualy important because volatility of nominal effective exchnage rate is a core variable of our model. Second, this synopsis dymistifies and simplifies in more explicit form the process of capturing volatility of economic variables that is apparently dearth in many economic literature including those topics that include 'volatility' in their title.

Economic volatility is generally measured by the second moment (standard deviation) or sometimes a higher moment of the distribution of a variable around its mean or a trend (Cariolle, 2012:8; Rancière *et al*, 2008). This trend or mean value represents the equilibrium value to which the variable tends to return quickly after deviating in response to a shock. Because macroeconomic series (e.g., GDP, investment) are usually 'non-stationary', i.e., tend to fluctuate around a trend value which itself varies over time, calculation of volatility often entails two key issues. These include: (i) the calculation of a reference value (e.g., calculating the cyclical and potential components of GDP) or the choice of stationarisation method (e.g., calculating the growth rate); and (ii) measuring the dispersion or volatility, usually by the standard deviation, along the reference value. Traditionally, therefore, three methods of calculating volatility are rife in economics literature, namely: (i) Economic volatility measured as the standard deviation of the growth rate of a variable. For instance, Acemoglu *et al* (2003) examined the effect of institutional factors on macroeconomic volatility and measure the latter using the standard deviation of the GDP growth rate. Similarly, Di Giovanni and Levchenko (2010) investigate the effect of external shock on macroeconomic volatility and measure volatility using the standard deviation of growth rate of terms-of-trade and the growth rate of GDP; (ii) Economic volatility measured as the standard deviation of the residual of an econometric regression – for instance, the regression of GDP on a mixed deterministic and stochastic trend (see, e.g., Serven 1998); and (iii) Economic volatility measured as the standard deviation of the cycle (e.g cyclical GDP) isolated by a statistical filter such as Hodrick and Prescott (1997) Filter. Hnatkovska and Loayza (2005) isolate the cyclical component of GDP series using the Baxter and King (1999) filter and compute their standard deviation as a measure of output volatility. According to Cariolle (2012), the third technique of calculating volatility is different from the previous two approaches provided it does not formulate the behaviour of the series 'ab initio'.

In fact, the dispersion of cyclical GDP (filtered by any appropriate procedure) also serves as an important measure of macroeconomic synchronization. According to Gayer (2007:5), the dispersion of standard deviation of output gap (cyclical GDP) is probably the most relevant measure of macroeconomic convergence from the short-term macroeconomic policy perspective. If all West African Member States display similar cycle (output gap), the standard deviation of the cyclical GDP (in percent of potential GDP) will be close to zero. Therefore, the closer to zero the measure is, the higher is the degree of macroeconomic synchronization or convergence of relative growth performance across the economies and the more appropriate a common monetary policy would be for each Member States.

3.1 Empirical strategy

The empirical model employed in this study is inspired by Magee (1976) who examined the impact of hypothesized determinants of BOPs such as real output, price level, interest rate, and nominal domestic credit on balance of payments. However, our estimable model differs from Magee (1976) in two major ways. First, we employ a more robust measure of exchange rate volatility. In line will standard practice in the literature, we measure exchange rate volatility as the standard deviation of the growth rate of the nominal effective exchange rate (see e.g., Di Giovanni and Levchenko, 2010; Acemoglu *et al*. 2003). Second, we expand the set of hypothesized determinants of Balance of Payments to include terms of trade (tot) and broad money supply (M2). Other explanatory variables included in the model are real interest rate and real GDP growth rate.

The behavioral equation is specified thus:

$$BOPP = \int (tot, gdpg, vo\ln, rir, m2) \tag{5}$$

Where: BOPP = balance of payments (measure as BOPs' current accounts in % GDP); tot = terms of trade, GDPG = growth rate of real GDP; voln = volatility of nominal effective exchange rate (measured as the StDev of change in log of nominal effective exchange rate using a 3-year rolling window); rir = real interest rate; and m2 = broad money supply.

As earlier pointed out, this study employs the ARDL or bound testing approach to co-integration in examining the relationship (long run and short run dynamics) between BOPs and its hypothesized determinants. Our choice of ARDL is appropriate in many folds: (i) It can be applied irrespective of the order of integration of the variables and, therefore, does not require the pre-testing of the model-variables for unit roots; (ii) the ARDL error correction representation can be applied when the trace or maximum eigenvalue or F-Statistic (wald test) establish that there is a single long run relationship and more so when the sample size is small or finite. In fact, the ARDL error correction mechanism become more efficient here; (iii) However, if there are multiple co-integrating relationships, then a multivariate co-integration test procedure such as Johansen and Juselius (1990) has to be applied; and (iv) As Pesaran, Shin and Smith (2001) notes, when there is a single long-run relationship, the ARDL procedure can distinguish between the dependent and explanatory variables by assuming that only a single reduced form equation relationship exists between dependent and exogenous variables.

Notably, two approaches are discernable when implementing the ARDL model – the direct and indirect approaches. The direct approach entails the 'direct' microfit ARDL estimation of equation 6 and 7 type-models using the microfit quantitative econometric software that was developed by Pesaran and Pesaran (1997) and advanced by Pesaran, Shin and Smith (2001), and distributed by the Oxford University Press. The indirect technique entails, first, the OLS estimation of equation 6 type model, and second, a test of co-integrating relationship among the variables by conducting an F test for the joint significance of the coefficients of the lagged level of the variables (Ekong and Onye, 2015:120) [10].

In line with Sebastian and Schneider (2016:8), the ARDL (p, q, …, q) model is specified thus,

$$y_t = \alpha_0 + \alpha_1 t + \sum_{i=1}^{p} \beta_i y_{t-i} + \sum_{i=0}^{q} \theta_i x_{t-i} + \mu_{t,} \tag{6}$$

Where t = max (p, q), …, T. We assume, for simplicity, that the lag order q of the regressors (x_t) is the same for all variables in the K*1 vector x_t. α_0 and α_1 are the constant and coefficient of liner time trend in the ARDL model, respectively. θ_i represents the coefficient of the lagged explanatory variables which include;

real GDP growth rate, volatility of nominal effective exchange rate index, real interest rate, terms of trade and broad money supply.

Importantly, the variables y_t and x_t could be allowed to be purely *I*(0), purely *I* (1), or co-integrated, i.e., the order of integrating of the variables is inconsequential. In implementing the ARDL (using either the indirect of direct-microfit approach), the optimal lag orders p and q (possibly different across regressors) are chosen by minimizing a model selection criterion, e.g., the Aikike information criterion (AIC) or the Bayesian information criterion (BIC) [3]. However, in the case of direct microfit estimation, the final lag order of individual-specific variables that are eventually used for the estimation are automatically selected by the internal routine of the microfit software once the choice of appropriate minimizing model selection (e.g. AIC, SIC) and lag order (here, lag 2) has been made.

After estimating the ARDL coefficients, there is also the need to account for short-run equilibrium adjustment. Thus, we specify the re-parametization the ARDL error Correction model as follows:

$$\Delta y_t = \alpha_0 + \alpha_1 t - \alpha(y_{t-1} - \delta x_t) + \sum_{i=1}^{p-1} \beta_{yi} \Delta y_{t-i} + \sum_{i=0}^{q-1} \theta_{xi} \Delta x_{t-i} + \mu_{t,} \quad (7)$$

Where α is the speed-of-adjustment coefficient and δ is the long-run coefficient.

The a priori expectations about the signs of the explanatory variables are as follows: voln < 0; rir < 0; rgdp > 0; GDPG > 0; tot > 0

Theoretically, volatility of nominal exchange rate is expected to create exchange rate uncertainty and exchange rate risk with adverse consequences for investment, trade and balance of payments. Hence, 'voln' is expected to be negatively related to balance of payments. Conversely, it is expected that increase in real GDP would increase Nigeria's balance of payments. This is possible because an increase in investment by foreigners would increase capital inflows in the economy. The capital inflows will results in balance of payment surplus if it exceeds any outflows. Also, increase in interest (rir) would worsen balance of payments; hence, a negative nexus is expected. This is so because high interest rate creates dis-incentives for investment.

4. Results

This section presents and discusses the result of our empirical isometric implemented via the ARDL co-integration estimations and the association ARDL error correction representations. Given the topic at hand, the interpretation is carefully focused on the size and significance of the co-integrating parameter and the error correction terms and, importantly, on their implication for the study. We set out with the discussion i=of the ARDL estimates.

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
BOPP(-1)	.63830	.15512	4.1148[.001]
BOPP(-2)	-.40185	.16690	-2.4077[.029]
GDPG	.21781	.084826	2.5678[.021]
GDPG(-1)	.21220	.078507	2.7029[.016]
VOLN	-2.5742	1.6418	-1.5679[.138]
VOLN(-1)	5.5451	2.3588	2.3508[.033]
VOLN(-2)	-3.6488	1.6800	-2.1718[.046]
TOT	9.0444	3.2577	2.7763[.014]
TOT(-1)	-5.7437	2.7569	-2.0834[.055]
M2	.0000	0.00	*NONE*
M2(-1)	-.0000	0.00	*NONE*
RIR	-.058539	.031729	-1.8449[.085]
RIR(-1)	.059982	.034669	1.7301[.104]
RIR(-2)	.10340	.034375	3.0081[.009]

Note: lag order=2; minimizing order= Swarz Bayesian

Fig 1: Result of ARDL Estimates Dep. Var. BOPs

The ARDL estimation of BOP (CA balance % GDP) versus the hypothesized determinants indicates that real GDP growth rate, exchange rate volatility, terms of trade and real interest rate all met the theoretical a priori expectations. In particular, balance of payments is found to exhibit a first order positive persistency effect on contemporaneous current account balance. This implies that contemporaneous BOP depends, in part, on its past behaviours. At the second lag, however, the effect of past BOP on current BOP became rather deliterious. In other words, past balance of payments has a second order negative effect on its contemporaneous value although first oder effect is positive.

Looking at the effect of economic activiteis on Nigeria's BOPs postion, the result indicates that current and past levels of economic activity is a key determiant of balance of payments. Growth rate of real GDP has positive and statistically significant effect on balance of payments. This result is not too surprisely given that the the level of economic activity is a major determinant of any countries export postion and therefore its current account balance.

Turning to the effect of exchange rate volatility on current account balance, it is remarkable to note that exchange rate volatility create uncertainty and potential exchange rate risk. This in turn creates unfavourable investment atmosphere that would potentially reduce export earning with adverse consequences for the balance of payments. As expected, exchange rate volatility has a negative effect of Nigeria BOPs postion. This the effect however only become statistically significant at a second order lag. This result is not so innocuous as it may seem. It implies that the uncertainty associated with volatility in exchange rate could have a long memory than otherwise may be suggested.

[3] The BIC is otherwise called the Schwarz or Schwarz-Bayesian information criterion.

Intuitively, investors are not necessarily naïve as to quickly forget any unfavourable trade/investment deal associated with past uncertainty in exchnage rate.

Looking at the effect of terms of trade, the result appears rather surprising. It is found that although contemporaneous improvement in terms of trade (increase in price of export with respect to price of import) led to improvement in BOPs in current period, the potential adverse effect of a negative terms of trade does not quickly die away. In other words and as with the effect of exchange rate volatility, past terms of trade position may have a relatively long memory. This is clear from its probality value where although improvement in terms exerts a positive and statistically significant effect on BOPs in current period as expected, the deliterious effect of past decline in term of trade is also highly significant. This seems to suggest that exchnage rate policy aimed at balance of paymets adjustment must also consider means improvement in terms of trade. This result is closely related to the finding by Onye *et al* (2018) that terms-of-trade shocks constitutes a major source of macroeconomic dis-synchronization rather than more open trade and financial reform policies.

Finally, looking at the effect of real interest rate on balance of payments, the result indicate that raising level of real interest rate has a negative but insignificant effect on balance of payments as expected. Importantly, the effect became positive at first lag and positive (and significant) at second lag – suggesting that a moderately rising rate of real interest rate might not necessarily crowd out private investment. Instead, this might be needed to drive savings and investment over a short run period. The result of the short-run dynamic effect of exchange rate volatility on Balance of payments represented by the ARDL Error Correction Representation could provide more insights into this.

```
Testing for existence of a level relationship among the variables in the ARDL model
**************************************************************************
 F-statistic  95% Lower Bound  95% Upper Bound  90% Lower Bound  90% Upper Bound
    7.7979          3.7651          5.1866          3.1579          4.3996

 W-statistic  95% Lower Bound  95% Upper Bound  90% Lower Bound  90% Upper Bound
    4.2604         22.5905         31.1196         18.9473         26.3973
**************************************************************************
 If the statistic lies between the bounds, the test is inconclusive. If it is
 above the upper bound, the null hypothesis of no level effect is rejected. If
 it is below the lower bound, the null hypothesis of no level effect can't be
 rejected. The critical value bounds are computed by stochastic simulations
 using 20000 replications.


                            Diagnostic Tests
**************************************************************************
*    Test Statistics  *        LM Version       *         F Version        *
**************************************************************************
*                     *                         *                          *
* A:Serial Correlation*CHSQ(1)  =   1.5090[.219]*F(1,14)      =   .71634[.412]*
*                     *                         *                          *
* B:Functional Form   *CHSQ(1)  =   3.6679[.055]*F(1,14)      =   1.8788[.192]*
*                     *                         *                          *
* C:Normality         *CHSQ(2)  =   .48958[.783]*       Not applicable       *
*                     *                         *                          *
* D:Heteroscedasticity*CHSQ(1)  =  .021520[.883]*F(1,29)      =  .020146[.888]*
**************************************************************************
   A:Lagrange multiplier test of residual serial correlation
   B:Ramsey's RESET test using the square of the fitted values
   C:Based on a test of skewness and kurtosis of residuals
   D:Based on the regression of squared residuals on squared fitted values
```

Fig 2: Result of Level Relationship (Co-integration Test) and Diagnostics

Fig 2 provide result of the test of statistical significance for the existence of level relationship (co-integration relationship) between balance of payments and the regressors in the ARDL model irrespective of the order of integration of the underlying variable. As we see in Pesaran, Shin and Smith (2001), two sets of critical value are provided,: one when all regressors are purely I (0) and the other if they are all purely I (1).

Accordingly, if the test statistics lies between the bounds, the test is inconclusive. However, we reject the null hypothesis of no level relationship (and accept the alternative hypothesis of a level relationship) when the test statistics fall above the upper bound. Finally, when the test statistics fall below the lower bound, we accept the null hypothesis of a no level relationship and conclude that there no level of long-run relationship between the variables. Going by this decision rule and looking at the F statistics of 7.79 in Table 2, it is easily seen that the test statistics lies above the upper bound. This leads us to reject the null of no level relationship and conclude that there is a long-run relationship between Nigeria's balance of payments and its hypothesized determinants used in the model. Next, we try to account for the short-run dynamic interaction by relying on the ARDL error correction representations.

Fig 3 report the result of the ARDL Error correction representation. Our interest here is on the size and significance of the error correction term, ecm(-1). As the result clearly show, the coefficient 0.76 with teh expected negative sign and is highly significant. This implies that short-run disequilibrium in Nigeria's balance of payments would be clearly adjusted towards equilibrium in the medium and long period if appropriate corrective measure are conscientious implemented.

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Error Correction Representation for the Selected ARDL Model
ARDL(2,1,2,1,1,2) selected based on Schwarz Bayesian Criterion

Dependent variable is dBOPP
31 observations used for estimation from 1986 to 2016

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
dBOPP1	.40185	.16690	2.4077[.026]
dGDPG	.21781	.084826	2.5678[.018]
dVOLN	-2.5742	1.6418	-1.5679[.133]
dVOLN1	3.6488	1.6800	2.1718[.042]
dTOT	9.0444	3.2577	2.7763[.012]
dM2	.0000	0.00	*NONE*
dRIR	-.058539	.031729	-1.8449[.080]
dRIR1	-.10340	.034375	-3.0081[.007]
dTREND	-.062956	.17757	-.35454[.727]
ecm(-1)	-.76354	.14504	-5.2644[.000]

Fig 3: ARDL Error Correction Representation

5. Conclusion and Recommendations

In this study, we committed ourselves to an empirical investigation of the impact of exchange rate volatility on balance of payments in Nigeria by taking advantage of recent developments in the Pesaran Shin and Shin (2001) ARDL approach to co-integration, namely, direct microfit 5 estimation. The study employed annual data spanning 1980 to 2017. Departing from the traditional two-step (indirect) ARDL or bound-testing approach to co-integartion that entails first the OLS estimation and second the wald testing of the joint significance of the regressors, our approach provide a more robust estimate of both the ARDL coefficient estimates and the ARDL re-parametized error correction representations, particularly because the internal routine of the microfit 5.5 estimation automatically and optimally choses the individual variable-specific final lag order once the modeler/analysis is able to specify appropriately the lag order and minimization criterion for the model.

The key results are as follows. (i) volatility of nominal effective exchnage rate is found to exert a second order negative effect on Nigeria's Balance of payments postion - suggesting that uncertainty in the Nigerian exchnage rate market has long memory; and (ii) although improvement in terms of trade is found to exert a postive nock-on effect on the balance of payments, the potential adverse consequence of a negative terms of trade does not quickly die away; (iii) other key determinants of Nigeria's BOPs include; GDP growth rate, terms of trade and real interest rate.

In view of the evidence on the potential deleterious effect of exchange rate volatility, we recommend a more conscientious managed-float exchange rate policy for Nigeria. A policy of economic diversification that is annexed with an incentive-based export programme also recommended as key to improving Nigeria's balance of payments position - given the potential negative effect of adverse terms-of-trade.

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