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Computation of the Real Effective Exchange Rate (REER) using the Bank for International Settlement (BIS) Methodology: A Case of Nigeria

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Abstract

The importance of REER and its computation prompted this study to re-estimate the REER for Nigeria, using the Bank for International Settlement (BIS) methodology. The methodology incorporates recent developments in global trade by employing time-varying trade weighting patterns, highlights the effect of third market competitors, and provides a more comprehensive approach to capturing the effects of bilateral exchange rates through the inclusion of double export weights. The method employed the weighing scheme adopted by Turner and Van't dack (1993) which has its theoretical underpinnings in Armington (1969). The data utilised was monthly series from October 2011 to December 2016 with 2010 as the base year. The results revealed that the computation method adopted mimics that of the International Monetary Fund (IMF), except that the IMF defines exchange rates using direct quotation, while Nigeria uses indirect quotation. The paper identified data constraints both in respect to quality and availability as a challenge for the computation of REER index for Nigeria using the BIS methodology. The former methodology has become obsolete given changes in the global economy and in the composition of Nigeria's major trading partners.

Keywords: Real Effective Exchange Rate, Bank for International Settlement (BIS), Trade weights, IMF

JEL Classification: F31, E52, E58, F12

I. Introduction

Globally, Real Effective Exchange Rate (REER) is an index of interest to many policy institutions, especially, central banks. The REER is the weighted average of a country's currency, relative to a group of other major currencies. It describes the strength of a currency relative to a basket of other currencies. The direction of the REER has implications on the current account balance, reserves level and the competitiveness of the external sector. A continued appreciation of the REER makes imports cheaper for consumers,

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and exports relatively costly for producers, and thus, reduces the external competitiveness of a country. Therefore, it creates losses in the areas of domestic production, employment and fiscal revenues (Monga and Lin, 2015), and in the long run, worsens the current account balance. On the other hand, a continued depreciation of REER reduces imports while exports become relatively cheaper, thereby improving the demand for domestic production. In the long run, this improves government earnings via the current account surplus and in turn increases foreign reserves.

The REER index is significant for many reasons. It can be used to analyse country's international trade transactions. The index provides a better indicator of the macroeconomic effects of exchange rates than any single bilateral rate and serves as a measure of international competitiveness, as criteria for the transmission of external shocks, as well as, targets for monetary policy or operational targets where foreign exchange interventions are used to control the exchange rate.

The need to compute a new REER index for Nigeria has become imperative because of the recent changes in the global trade, changes in the international oil prices and composition of Nigeria's total trade, as well as changes in the trading partners. There is also the need to capture the increasing trading activities with other West Africa countries. Although, there are existing studies on Nigeria (Mordi and Audu, 1991; Obadan, 1994; Obaseki, 2001; and Tule and Duke, 2007; amongst others), these studies were carried out prior to rebasing the gross domestic product (GDP) for the Nigerian economy. Moreover, the major weakness from these studies was that they applied a single weight structure to all of the goods traded internationally, and ignored the differences in the degree of substitutability of the differentiated manufactured goods versus that of more homogenous raw commodities. The extent of the complementarity or competition between foreign and locally produced goods, as well as, possible non-market practices in the trade of goods such as agricultural products were neglected. In view of these weaknesses, this study adopted the BIS methodology to compute a new REER index for Nigeria.

The objective of this study, is to re-estimate the REER for Nigeria, using the Bank for International Settlement (BIS) methodology. The BIS methodology incorporates recent developments in global trade, by employing time-varying weighting patterns. It categorically highlights the effect of third market competitors, and provides a more comprehensive approach to capturing the effects of bilateral exchange rates through the inclusion of double export weights. The BIS methodology is a more improved methodology because it

provides a clearer basis for short-term monitoring and analysis. It also provides a comprehensive assessment of the international pressures on domestic firms over the medium term in respect of costs or prices, and helps to give a representative view of the actual economy.

The remainder of the paper is organised as follows; Section 2 examines theoretical and empirical literature concerning the REER methodology. Section 3 discusses the methodology for the computation of REER and NEER, based on the BIS Approach. Section 4 focuses on the analysis and comparison of results with the existing methods and that computed by the International Monetary Fund (IMF), while Section 5 concludes the paper.

II. Review of Theoretical Literature

II.1 Review of the Bank for International Settlement (BIS) Methodology

The Bank for International Settlement (BIS) REER methodology was computed having employed the weighing scheme adopted by Turner and Van't dack (1993). This trade-based weighing methodology has its theoretical underpinnings in Armington (1969) model assumption of imports not being perfect substitutes for domestically produced goods. Comparative advantage yields gain from trade through specialisation. But where does comparative advantage come from? Classical trade theories hold technology and factor endowment as the sources of comparative advantage. The Armington's model advanced these theories with the introduction of product differentiation as the basis for international trade, under the assumption that each country produces a different good, and consumers would like to consume at least some of each country's goods. The model provides a good characterisation of trade flows between many countries and built on the assumptions that:

(i) Labour is the only factor of production;
(ii) Workers have constant elasticity of substitution (CES) preferences; and
(iii) Market for each country/good is perfectly competitive.

Klau and Fung (2006), in computing the new BIS effective exchange rate indices, adopted a trade-based weighting methodology hinged on the Armington's model. The methodology assumes that there is only one type of good differentiated by country of origin, with a constant elasticity of substitution. Given the high degree of international product differentiation, the elasticity of substitution between imports from different economies may vary. Therefore, fluctuations of different foreign currencies may not have the same impact on the variables of interest (relative demand or domestic prices) for given weights.

The most-common weighted or effective measure of real exchange rate is to capture the currencies by trade weights. Thus, the bilateral trade volumes, the sum of imports and exports of each country expressed as a proportion of total imports and exports of all countries is used to compute the currencies by trade weights. This approach, however, does not consider the changing trade flows. To address this limitation, the third-market effect of calculating trade weights is used. The third-market effect is captured as:

$$REER_j = \prod_{K \neq J} \left(\frac{P_J R_j}{P_k R_k}\right)^{W_{jk}} \quad (1)$$

where R_k and R_J are exchange rates; w_{jk} is the trade weight that captures competition in country j (import competition), competition in trading partner country k (export competition) and competition between j and k in all other markets (the third market competition); and P_j and P_k are value-added prices. The third-market weight is equal to the weighted average over all the third-country markets of country j's import share divided by a weighted average of the combined import share of all of country i's competitors, with the weights being the shares of country i's exports to the various markets. The Armington's assumption of product differentiation is a common feature of effective exchange rate indices. The weight in the above equation is expressed as:

$$w_{jk} = \left(\frac{import\ of\ i}{import\ and\ export\ of\ i} * share\ of\ i\ imports\ of\ j\right) + \left(\frac{exports\ of\ i}{imports\ and\ exports\ of\ i} * overall\ export\ weight\right) \quad (2)$$

$$overall\ export\ weight = \beta * \left(\frac{share\ of\ exportof\ i\ to\ j}{total\ i\ export}\right) + (1 - \beta) * third\ market\ weight \quad (3)$$

II.2 Empirical Literature

Various empirical works have been conducted on issues surrounding the computation of the REER. The authors utilised different methodologies at different times but with similar results. Lafrance et al. (1998) examined the pros and cons of the alternative price indices used in constructing REER indices and the effects of different weighting schemes. The study also compared selected measures of the REER in terms of their ability to explain movements in Canadian net exports and real output. It argued that, although different weighting schemes may at times provide useful and complementary information, the choice of a weighting scheme does not, in general, significantly affect measures of Canada's competitiveness. The critical factor is the choice of a price index. Particularly, the REER indices that are computed using unit labour costs explain movements in Canadian net exports and real output significantly better than those based on consumer price indices.

Nilsson (1999) presented alternative measures of the Swedish REER, based on three alternative weighting schemes and three alternative price indices. The advantages and disadvantages of alternative measures are discussed in the context of the REER as an indicator of competitiveness. The results revealed that REERs based on export prices reflect competitiveness, primarily for internationally traded goods and services, while REERs based on consumer prices serve as a broader indicator of competitiveness.

Opoku-Afari (2004) measured the real effective exchange rate for Ghana. The paper sought to find how important the definitions and measurement of the concepts of real exchange rates were in analytical and empirical work. It also discussed methodological issues surrounding the measurement of real exchange rates, including choosing price and cost indices. The study revealed that the choice of trading partners to include, base year and the weighting scheme used are not very important; alternative measures with different trading partners and weights move very closely and share a common trend in the long run. However, the choice of price indices matters. Therefore, the paper concluded that Ghana seemed more highly competitive based on the GDP-deflator index, but much less so, when the CPI index was used in the computation of the real exchange rate.

Santoya and Soutar (2011) estimated the REER for Belise, assessing Belise's external competitiveness primarily through calculating the REER index for the period 2000-2009. The paper expands on earlier works by Brownbridge (1987) and Arana (1997) by estimating a "composite" index that takes into account "third party competition" as well as the traditional approaches based on direct import and export competition. Two more types of competitiveness indicators were also calculated—commodity based REER and a tourism oriented REER. The results for all three REER indices showed that for the period under review, the index was generally falling, meaning that the exchange rate depreciated and the country's external sector gained in competitiveness.

Schmitz et al. (2012) revisited the effective exchange rates of the euro. Building on the work of Buldorini et al. (2002), the authors showed how the ECB's techniques for calculating effective exchange rates have been updated over time and explained the related theoretical foundations. In particular, the paper discussed the use and development of trade weights based on trade in manufactured goods (also considering third market effects), the trading partners selected, and the choice of deflators for constructing the REER indices. In addition, it presented evidence on exchange rate and developments in competitiveness for both the euro area as a whole and individual member

states. While the growing importance of China was reflected in the updated trade weights of euro effective exchange rates, it appeared that the increasing integration of the euro area with other European economies accounted for the largest variation in trade weights. The paper noted that the US dollar, an anchor currency for a number of large emerging markets, continued to play an important role for the effective exchange rate of the euro and euro area competitiveness. Overall, the euro area competitiveness has improved slightly since the introduction of the single currency, despite significant heterogeneity within the area.

A few papers have studied the various methods of computing the REER index for Nigeria. Mordi and Audu (1991) reviewed the major conceptual and methodological issues that confront an index designed with particular emphasis on the construction of the effective exchange rate index. The paper attempted to construct, for the first time, a NEER index for Nigeria covering the period January 1960 to December 1990. The authors chose 1985 as the base year, and calculated the exchange rate indices vis-à-vis each of the ten (10) trading partners used, which were selected based on the G-10 countries, representing over 70.0 per cent of Nigeria's external trade with the outside world, at the time. Each country was assigned a weight based on its relative importance for Nigeria. Cross rates were then computed manually. The selection of countries was biased against African countries and developing countries due to the absence of developed foreign exchange market where rates are determined by market forces. Also, total trade was employed as a choice of a measure of relative importance and weighing scheme. It also utilised the bilateral weighing scheme. Furthermore, the geometric averaging technique was employed. It only captured effects of trade between Nigeria and her major trading partners.

Tule and Duke (2007) computed Nigeria's real and nominal effective exchange rate indices, using a pool of high frequency monthly data for the period 1996 – 2007. Though the paper advocated a basket approach to naira nominal exchange rate determination in which the relative macroeconomic developments in the major trading partner economies are factored into the market exchange rate of the naira, it failed to capture sub-regional effects of Nigeria's trade with its neighbours. The choice of weights included in the basket was based on trade data on all goods and services. This was justified because changes in the real exchange rate influence economic activity primarily through its impact on competitiveness in the tradable goods and services sector. It included twelve (12) trading partners, which accounted for 79.0 per cent of trade with Nigeria and had a base year of May 2003.

In their paper, Ibrahim and Ayodele (2012) provided theoretical extensions to the computation of NEER and REER over time, using data from 1960 to 2011. The paper compared its computations with that of the CBN in an attempt to provide a litmus test on the extensions. Their findings showed that, increasing trading partners resulted in a difference because the extensions perform better, as they reflect more of changes in the exchange rate of the naira.

As highlighted above, several studies exist to establish the relevance of the REER computation for all economies. Though previous computations exist for the Nigerian economy, they had not adequately captured the effects of trade relations with neighbouring African economies, the effect of trade with third market competitors and the effect of the GDP rebasing. Also, major trading partners and the trade weights of major trading partners had considerably changed, while trade data for West African countries are now available, making it possible to be included in the basket. Thus, we adapt the methodology used by the Bank for International Settlement (BIS) and in line with the Armington's Model, as used by Klau and Fung (2006), for the computation of an effective exchange rate index to reflect the dynamics of trade between Nigeria and its major trading partners, particularly African economies.

This current computation highlights 11 major trading partners that make up a total of 83.3 per cent of Nigeria's total trade, as well as, trade between third market and direct competitors. The major partners are the Euro area (27.1%), China (12.4%), India (11.1%), United States (8.2%), Brazil (6.6%), United Kingdom (4.1%), South Africa (3.9%), Japan (2.9%), Republic of Korea (2.5%), Cote d'Ivoire (2.4%) and Indonesia (2.2%). The method was developed to capture the accelerated changes in the global trade pattern while reflecting increased trade with African nations.

III. Data and Computation Method

III.1 Data and Variables

For the computation, monthly data series from October 2011 to December 2016 with 2010 as the base year were utilised. The base year was chosen because Nigeria's gross domestic product was rebased in 2014 with 2010 as its base year, and also the data from the IMF database has the year 2010 as its base year. This will eliminate the challenges that would have resulted where data based on differing base years are utilized, or possible statistical differences associated with computing a different base year using varying methodology. Data on the variables Direction of Trade Statistics, Exchange Rates, and Consumer Prices were sourced from the IFS, IMF statistical database; while that of the harmonized

index of consumer prices (HICP) was obtained from the European Central Bank. The Thomas Reuters platform was utilised to obtain the data from these sources.

In addition to the above, the computation utilises total trade to determine trade flows (trade weights of major trading partners) as against other sectors or goods such as the ones used by various institutions like the BIS, the IMF, the EC and the ECB. Total trade flows were utilised because data on Nigeria's total trade is readily available[1]; manufacturing component of trade is insignificant in Nigeria's trade basket and as a result, the manufacturing sector cannot be used solely in the determination of trade flows; Nigeria's major export products' prices are global markets determined without being influenced by the competitiveness of individual economies, hence cannot be used to capture the competitiveness of individual currencies and oil is a highly subsidised product (Schmitz et al, 2012); agriculture or mining products are often heavily regulated or subsidised and may distort the competitiveness analysis (Schmitz, et al, 2012); and prices of most traded goods are determined in global markets.

For the major trading partners, this computation considered those countries that account for a cumulative score of 83.3 per cent of Nigeria's total trade flows, in line with previous studies (Siregar, (2011), Mordi and Audu (1991)). This was increased from the universally accepted 75.0 per cent to 83.3 per cent for the following reasons; to increase the number of major trading partners from 8 to 11, based on the three year index (2013 – 2015) thereby highlighting the competitiveness of individual country effects; these currencies enjoy similar and moderate rates of inflation (Turner and Van't dack, 1993); and the major trading partners to be included in the computation of the REER indexes may total up to about 2 dozens (Turner and Van't dack, 1993). Consequently, the Euro Area, China, India, USA, Brazil, United Kingdom, South Africa, Japan, South Korea, Cote d'Ivoire and Indonesia were considered as Nigeria's trading partners accounting for 27.1, 12.4, 11.1, 8.2, 6.6, 4.1, 3.9, 2.9, 2.5, 2.4 and 2.2 per cent, respectively.

The "Other countries" captured in the computation were classified into direct competitors and third market competitors. The "Direct competitors" are the sixteen adjudged by the Organisation of Petroleum Exporting Countries (OPEC) and non-OPEC based on the 2014 ranking as the top oil exporting countries. These include Saudi Arabia, UAE, Canada, Iraq, Libya, Kuwait, Angola, Kazakhstan, Venezuela, Norway, Iran, Mexico, Algeria, Indonesia and Ecuador. The "Third market competitors" are countries that both Nigeria and her direct

[1] The major constraint is the inability of the authors to obtain the needed data from the Nigerian National Bureau of Statistics (NBS).

competitors export to. It is clearly stated in the base document that $i \neq k$, that is, major trading partners cannot be equal to third market competitors (Klau and Fung, 2006). This is practical as, if the major trading partners are captured both as major trading partners and third market competitors; the effects of trade would be nullified and thus would remain uncaptured. Third market competitors are thus determined as all countries Nigeria exports to except her major trading partners, that is, $k = N - i$.

Table 1 presents the list of major trading partners, direct competitors and third market competitors for ease of reference.

Table 1: Major Trading Partners, Direct Competitors & Third Market Competitors

S/N	3rd Market Competitors (k)	S/N	Direct Competitors (h)	S/N	Major Trading partners (i)
1	Argentina	1	Algeria	1	Euro Area (WEO)
2	Australia	2	Angola	2	China
3	Canada	3	Canada	3	India
4	Hong Kong	4	Ecuador	4	United States
5	Denmark	5	Indonesia	5	Brazil
6	Ghana	6	Iran	6	United Kingdom
7	Mexico	7	Iraq	7	South Africa
8	Morocco	8	Kazakhstan	8	Japan
9	New Zealand	9	Kuwait	9	South Korea
10	Niger	10	Libya	10	Cote d'Ivoire
11	Norway	11	Mexico	11	Indonesia
12	Peru	12	Norway		
13	Russian Federation	13	Russia		
14	Senegal	14	Saudi Arabia		
15	Singapore	15	United Arab Emirates		
16	Sweden	16	Venezuela		
17	Switzerland				
18	Taiwan				
19	Thailand				
20	Turkey				
21	Ukraine				
22	United Arab Emirates				
23	Uruguay				
24	Venezuela				

Source: Author's compilation

III.2 Method of Estimation

III.2.1 The Supply Structure Matrix

The supply structure matrix was used in the determination of the double-export weights as shown in Table 2. Each element of the panel($S_{i,j}$), excluding those on the main diagonal, represents the percentage of trading partner's exports to other trading partners and/or third market competitors. It is the percentage of total trade of N competitor countries (across the rows) that is exported abroad (that is, exports) to one or more H foreign markets (across the columns) (that is, other than trading partners and third market competitors). The elements on the main diagonal of the supply structure matrix($S_{i,i}$), represent the percentage of total exports that are accounted for by domestic production in each of the competitor countries. Hence, the main diagonal of the supply-structure matrix relates to the domestic production of the specific country or competitor. Domestic production is defined as GDP less exports (European Central Bank, 2014), which captures total production consumed by the citizens themselves.

To obtain the double-export weights, each row of the supply structure matrix is multiplied by the simple share of Nigeria's trade. For example, the double-export weight of 32.4 per cent assigned to the United States of America in April 2011 is obtained as the sum-product of Nigeria's exports to major trading partners and rest of the world and exports of major trading partners to other partners. This measures the competition faced by Nigerian exporters from United States producers in both the US market and in all of the other markets. Only 11.4 per cent of America's double-export weight is due to competition encountered by Nigerian exporters in the American market, while the remainder stems from third market competition.

Table 2: Supply-Structure Matrix (2013) Capturing Double-Export Weights $(S_{i,,j})(S_{i,,i})$

Supply Structure Matrix													
	Major Trading Partners											Rest of the World	
	Brazil	China	Cote d'Ivoire	India	Indonesia	Japan	Korea	South Africa	UK	USA	Euro Area	3rd Market	Total
Nigeria's exports	4.22	0.17	0.00	12.11	0.90	0.05	0.01	1.30	0.96	11.37	7.26	61.66	100.00

	Brazil	China	Cote d'Ivoire	India	Indonesia	Japan	Korea	South Africa	UK	USA	Euro Area	3rd Market
Brazil	271.15	(3.82)	(1.91)	(1.20)	(0.46)	(2.23)	(0.77)	(5.33)	(16.58)	(3.80)	(1.22)	5.00
China	(34.87)	152.00	(42.91)	(44.82)	(26.79)	(38.69)	(28.57)	(39.12)	(142.33)	(51.53)	(6.85)	18.82
Cote d'Ivoire	(0.04)	(0.00)	353.00	(0.02)	(0.01)	-	-	(0.18)	(0.11)	(0.00)	(0.01)	0.11
India	(5.98)	(0.90)	(9.98)	248.57	(6.64)	(1.43)	(1.08)	(16.02)	(30.17)	(5.06)	(0.95)	3.78
Indonesia	(2.48)	(1.64)	(1.03)	(10.76)	175.62	(9.67)	(5.19)	(8.04)	(6.01)	(2.78)	(0.46)	1.81
Japan	(6.57)	(12.57)	(1.26)	(9.61)	(13.35)	197.66	(22.37)	(9.25)	(49.85)	(17.06)	(1.70)	5.53
Korea, Republic of	(19.81)	(10.57)	(17.78)	(11.49)	(11.62)	(11.48)	186.67	(5.50)	(27.36)	(10.29)	(1.25)	4.11
South Africa	(0.87)	(1.04)	(4.48)	(3.27)	(0.63)	(1.81)	(0.73)	291.63	(12.94)	(1.47)	(0.47)	0.60
United Kingdom	(3.87)	(1.02)	(11.50)	(8.33)	(1.00)	(1.82)	(1.09)	(12.22)	1,593.01	(9.40)	(5.80)	4.38
United States	(47.36)	(7.82)	(14.78)	(21.24)	(7.22)	(16.65)	(15.08)	(23.23)	(199.97)	249.38	(5.51)	18.70
Euro Area	(49.29)	(12.62)	(147.37)	(37.84)	(7.90)	(13.88)	(11.80)	(72.73)	(1,007.70)	(48.00)	124.22	37.13
Total	100	100	100	100	100	100	100	100	100	100	100	100
Export weights	11.84	(1.23)	0.01	30.47	1.59	1.20	(0.88)	3.45	14.63	32.36	6.55	
Import weights	0.59	8.35	0.00	1.91	0.00	0.75	52.08	1.21	3.03	10.12	21.96	
Overall weights	7.36	2.58	0.00	19.11	0.96	1.02	20.19	2.56	10.01	23.51	12.68	

Source: Author's compilation

The Overall weights are derived by combining the bilateral import weights with the double-export weights, using the relative size of Nigeria's imports and exports to average both sets of weights. These can be denoted as follows:

$$\text{Overall weight } (w_i) = \left(\frac{m_j}{x_j+m_j}\right) w_i^m + \left(\frac{x_j}{x_j+m_j}\right) w_i^x \qquad (4)$$

where $x_j(m_j)$ = economy j's total exports (imports).

w_i^m = import weights

w_i^x = export weights

Four major kinds of weighing methods were used in several papers – model based weights, bilateral trade weights, global trade weights and double-weighing[2] schemes, however, only the last three trade-weighing structures are most common. These three (3) are used because of their reliance on actual

[2] This is as detailed in the BIS methodology as emphasised by Turner and Van't dack (1991).

trade flows in the computation of trade weights, notwithstanding the much weaker economic rationale of trade-based indexes. "Most indexes apply a single weighing structure to all or most of the goods traded internationally, thus ignoring differences in the degree of substitutability of rather differentiated manufactured goods versus that of more homogenous raw commodities, the extent of complementarity or competition between foreign and locally produced goods, as well as, possible non-market practices in the trade of goods such as agricultural products" (Turner and Van't dack, 1993). In a bid to capture the complementarity of currencies, the BIS methodology introduces computations using double weighing schemes after highlighting different trade weights. Trade weights are thus classified into three (3) – import weights, export weights and overall weights.

Import weights: These are single weights, which represent the ratio of total trade imported from a specific trading partner to the total imports in a given period. It is denoted as

$$\textbf{Import weight } (w_i^m) = \frac{m_j^i}{m_j} \tag{5}$$

where m_j^i = Nigeria's imports from specific trading partners (i).

m_j = Nigeria's total imports.

Hence, each trading partner has a specific import weight out of a total of a hundred per cent.

Export weights: These are measured as double-export weights capturing the competition in third markets. Producers in Nigeria face competition from various foreign producers exporting to the domestic market (Nigeria). Similarly, Nigerian exporters can be assumed to face competition in foreign markets from both domestic producers (in these foreign markets) and other exporting countries. These patterns of competition enable economies to apply double-export weights. Export weights may thus be computed by using either the following equation or by developing a supply structure matrix;

$$\textbf{Export weight } (w_i^x) = \left(\frac{x_j^i}{x_j}\right)\left(\frac{y_i}{y_i + \sum_h x_h^i}\right) + \sum_{k \neq i}\left(\frac{x_j^k}{x_j}\right)\left(\frac{x_i^k}{y_k + \sum_h x_h^k}\right) \tag{6}$$

where x_j^i = Nigeria's exports to specific trading partners (i).

x_j = Nigeria's total exports.

y_i = home supply of gross domestic gross product of specific trading partners (i).

$\sum_h x_h^i$ = sum of exports from h (excluding j) to i.

i = 1, 2…, N; and N = number of competitors.

j = 1, 2…, H; and H = number of foreign markets.

Several institutions have utilised different deflators for the calculation of the REER. These deflators measure countries' price and cost competitiveness. The most common choice of deflators includes;

i. The consumer price index (CPI and HICP[3], where available);
ii. The GDP deflator;
iii. Unit labour costs in the total economy (ULCE or ULCT); and
iv. Unit labour costs in the manufacturing sector (ULCM).

The main feature of these deflators is the underlying harmonisation of concepts (Lauro & Schmitz, 2012). In this computation, the CPI is used as the cost/price deflator for Nigeria and all other trading partners. Also, BIS indicators are based on CPI deflators as against those used by the IMF (CPI for the broad group and ULC for the narrow group), ECB (CPI and PPI) and EC (GDP deflator, ULCM, ULCE/ULCT, PX (Price deflator of exports of goods and services)).

III.2.2 Computation of the NEER and REER

NEER: NEER is calculated as the geometric weighted average of a basket of bilateral exchange rates. This is computed by applying overall trade weights to the cross-exchange rates of the Naira against the currencies of the major trading partners and as determined by the trade weights. In formal terms, the NEER of the Naira is calculated thus:

$$\textbf{NEER} = \prod_{i=1}^{N}\left(e_{i,naira}\right) * w_i, \qquad (7)$$

that is NEER = $the\ sum\ of\ all\ (exchange\ rate_i) * overall\ weights_i$

Where:

N =number of major trading partners (i) in the reference group against which the external value of the naira is measured.

$e_{i,naira}$ =an index of the exchange rate of the currency of major trading partners (i) vis-à-vis the naira in each period, here 2015.

w_i = overall trade weight assigned to the currency of the major trading partners (i)

REER: The REER is computed as the NEER adjusted with the corresponding deflator. The REER is the geometric weighted average of a basket of bilateral exchange rates which is aimed at ascertaining Nigeria's international price and

[3] Harmonised Index of Consumer Prices. The HICP is the indicator of inflation for the ECB. It is compiled based on a methodology that has been harmonised across the EU countries.

cost competitiveness. It is computed by multiplying the NEER with the country specific CPI data.

In line with this methodology, the basket of bilateral exchange rates is captured by effective cross rates. Unlike the BIS methodology, where the weights are derived from manufacturing trade flows as defined under the standard international trade classification (SITC) 5-8, the computation of Nigeria's REER is derived from total trade flows as used by the European Commission. The most commonly adopted approach is to base the weights on manufacturing trade alone – on the grounds that: manufacturing trade is typically responsive to changes in competitiveness; and they have relatively good price and cost data available for almost all industrial countries (Turner and Van't dack, 1993).

$$\textbf{REER} = \prod_{i=1}^{N} \left(\frac{\boldsymbol{CPI_i}}{\boldsymbol{CPI_{naira}}} \boldsymbol{e_{i,naira}}\right) * \boldsymbol{w_i}, \quad (8)$$

Where:

CPI_{naira} =deflator for Nigeria

CPI_i = deflator for major trading partners (i)

$e_{i,naira}$ = exchange rate against major trading partners (i) vis-à-vis the naira.

w_i = overall trade weight assigned to the major trading partners (i) $(\sum_{i=1}^{N} w_i = 1 \ or \ 100\%)$.

N = number of major trading partners (i).

IV. Presentation of NEER and REER Estimates and Policy Implications

Table 3 presents the computed NEER and REER indices for Nigeria using the BIS methodology. A positive relationship exists between REER and competitiveness. As the general level of prices in Nigeria rises relative to her major trading partners, Nigeria becomes less competitive as represented by a fall in the REER index. This occurred between October 2011 and July 2012. Although Nigeria became competitive in August 2012, the data revealed that Nigeria lost in competitiveness again between September 2012 and February 2013. Nigeria's REER has been volatile as this trend continued all through 2013 and 2014 until February 2015 when competitiveness improved as indicated by the REER index of 59.49. The increased drive to diversify the economy and the move to a more flexible exchange rate policy, which led to a depreciation of the exchange rate, enabled Nigeria regain competitiveness between May and August 2016. It declined in September 2016, but improved in November 2016 to 107.48.

Comparing the results of the computation using the BIS methodology and the methodology by the IMF as shown in Table 4 and Figure 1, the results reveal that the computation using the BIS methodology mimics that as computed by the

IMF for the period (October 2011 – December 2016); except that the IMF defines exchange rates using the direct quotation where Nigeria defines it using the indirect quotation. This implies that using the IMF methodology, an increase or decrease in the REER would lead to an appreciation or depreciation of the domestic currency, respectively. The indirect method used in Nigeria holds that an increase or decrease in the REER would lead to a depreciation or appreciation of the domestic currency, respectively. It also highlights some worrying qualities in the manner in which the present methodology used in the Bank is carried out. This is because the Bank uses the indirect exchange rate quote and as such a rise in the REER should denote a loss in competitiveness rather than a rise. Hence, a further call for the switch in the methodology for computing the REER indices, using the BIS methodology over that being used by the Bank at the moment.

Table 3: Result of NEER and REER between October 2011 and December 2016

	New BIS Methodology (October 2011 - December 2016)		
S/N	**Period**	**NEER**	**REER**
1	Oct-11	88.92	81.16
2	Nov-11	88.53	80.86
3	Dec-11	85.27	77.21
4	Jan-12	84.33	74.20
5	Feb-12	72.56	63.89
6	Mar-12	73.97	64.40
7	Apr-12	75.61	66.03
8	May-12	81.17	70.39
9	Jun-12	82.43	70.75
10	Jul-12	68.23	58.55
11	Aug-12	86.97	74.48
12	Sep-12	84.72	72.12
13	Oct-12	83.78	70.92
14	Nov-12	82.87	69.81
15	Dec-12	73.10	61.35
16	Jan-13	76.39	63.96
17	Feb-13	76.34	63.79
18	Mar-13	81.03	67.44
19	Apr-13	77.72	64.47
20	May-13	74.07	61.07
21	Jun-13	79.62	65.55

22	Jul-13	78.38	64.54
23	Aug-13	70.32	57.99
24	Sep-13	78.71	64.66
25	Oct-13	64.37	52.57
26	Nov-13	55.25	44.88
27	Dec-13	58.99	47.60
28	Jan-14	61.78	49.59
29	Feb-14	60.86	48.81
30	Mar-14	60.35	48.23
31	Apr-14	62.91	50.17
32	May-14	61.54	48.85
33	Jun-14	62.21	49.10
34	Jul-14	67.49	53.10
35	Aug-14	64.28	50.48
36	Sep-14	60.27	47.11
37	Oct-14	66.24	51.56
38	Nov-14	54.24	41.99
39	Dec-14	69.31	53.35
40	Jan-15	69.00	52.66
41	Feb-15	78.21	59.49
42	Mar-15	95.25	72.17
43	Apr-15	87.00	65.63
44	May-15	74.85	56.05
45	Jun-15	79.58	59.22
46	Jul-15	83.25	61.75
47	Aug-15	78.34	57.89
48	Sep-15	74.26	54.58
49	Oct-15	84.45	61.86
50	Nov-15	63.09	60.57
51	Dec-15	74.97	54.25
52	Jan-16	78.60	56.46
53	Feb-16	81.43	57.42
54	Mar-16	84.27	58.33
55	Apr-16	80.07	54.75
56	May-16	85.19	56.91
57	Jun-16	98.88	65.11
58	Jul-16	122.04	79.49

59	Aug-16	138.29	89.19
60	Sep-16	129.26	82.84
61	Oct-16	135.99	86.65
62	Nov-16	169.79	107.48
63	Dec-16	46.65	91.96

Source: Author's computation

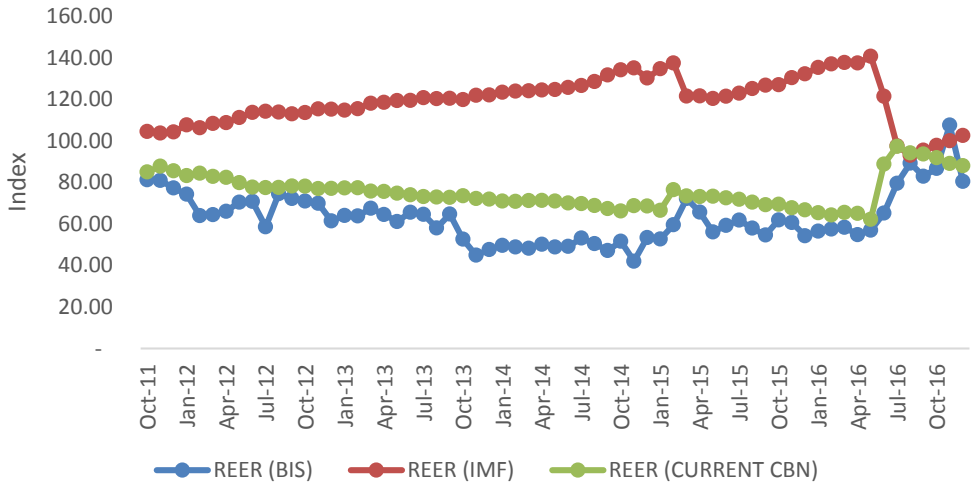
Table 4: Comparing the Computation of the REER INDEX using several methods

Comparing the computation of the REER INDEX using several methods (October 2011 - December 2016)				
S/N	**Period**	**REER (BIS)**	**REER (IMF)**	**REER (CURRENT CBN)**
1	Oct-11	81.16	104.41	84.94
2	Nov-11	80.86	103.63	87.67
3	Dec-11	77.21	104.21	85.49
4	Jan-12	74.20	107.55	83.14
5	Feb-12	63.89	106.15	84.30
6	Mar-12	64.40	108.26	82.77
7	Apr-12	66.03	108.61	82.28
8	May-12	70.39	111.11	79.77
9	Jun-12	70.75	113.60	77.61
10	Jul-12	58.55	114.10	77.38
11	Aug-12	74.48	113.75	77.48
12	Sep-12	72.12	112.91	78.16
13	Oct-12	70.92	113.47	78.09
14	Nov-12	69.81	115.25	76.92
15	Dec-12	61.35	115.12	77.01
16	Jan-13	63.96	114.65	77.26
17	Feb-13	63.79	115.36	77.28
18	Mar-13	67.44	117.96	75.73
19	Apr-13	64.47	118.43	75.54
20	May-13	61.07	119.27	74.73
21	Jun-13	65.55	119.35	73.89
22	Jul-13	64.54	120.68	73.08
23	Aug-13	57.99	120.18	72.81
24	Sep-13	64.66	120.32	72.68
25	Oct-13	52.57	119.73	73.48
26	Nov-13	44.88	121.78	72.16

27	Dec-13	47.60	121.97	71.82
28	Jan-14	49.59	123.28	70.89
29	Feb-14	48.81	123.84	70.76
30	Mar-14	48.23	123.93	71.15
31	Apr-14	50.17	124.34	71.25
32	May-14	48.85	124.56	70.93
33	Jun-14	49.10	125.57	70.01
34	Jul-14	53.10	126.50	69.66
35	Aug-14	50.48	128.44	68.79
36	Sep-14	47.11	131.62	67.30
37	Oct-14	51.56	134.08	66.14
38	Nov-14	41.99	134.98	68.69
39	Dec-14	53.35	130.12	68.54
40	Jan-15	52.66	134.57	66.47
41	Feb-15	59.49	137.34	76.35
42	Mar-15	72.17	121.44	73.37
43	Apr-15	65.63	121.47	73.05
44	May-15	56.05	120.24	73.21
45	Jun-15	59.22	121.33	72.44
46	Jul-15	61.75	122.80	71.77
47	Aug-15	57.89	125.01	70.39
48	Sep-15	54.58	126.64	69.14
49	Oct-15	61.86	126.91	69.35
50	Nov-15	60.57	130.24	67.71
51	Dec-15	54.25	132.15	66.70
52	Jan-16	56.46	135.18	65.30
53	Feb-16	57.42	136.89	64.19
54	Mar-16	58.33	137.56	65.42
55	Apr-16	54.75	137.33	64.96
56	May-16	56.91	140.55	62.15
57	Jun-16	65.11	121.31	88.70
58	Jul-16	79.49	97.50	97.26
59	Aug-16	89.19	92.93	94.08
60	Sep-16	82.84	95.37	93.59
61	Oct-16	86.65	97.69	91.78
62	Nov-16	107.48	99.97	88.98
63	Dec-16	80.36	102.48	87.97

Source: Author's computation

Figure 1: Comparing the Computation of the REER INDEX using several methods (October 2011 - December 2016)



Source: Author's computation

V. Summary and Conclusion

The main focus of this paper was the computation or re-estimation of the REER index for Nigeria using the BIS methodology. It explained the methodology with a few variations (trade basis and computation of the double-export weight using a supply-structure matrix). The paper also highlighted the advantages and challenges in the new methodology for constructing the indexes for Nigeria. There are observable differences in the REER indicators due to their underlying methodologies. The determination of major trading partners and choice of price indexes are paramount. Also, a reference period was highlighted to aid ease of computation and reduce statistical errors, while emphasising the comparison between relevant variables.

The results reveal that the computation using the BIS methodology mimics that of the IMF for the period October 2011 to December 2016. The exception is that the IMF defines exchange rates using the direct quotation, while Nigeria defines it using the indirect quotation. This implies that using the IMF methodology, an increase or decrease in the REER would lead to an appreciation or depreciation of the domestic currency, respectively. The indirect method used in Nigeria holds that an increase or decrease in the REER would lead to a depreciation or appreciation of the domestic currency, respectively.

This paper has, therefore, presented a possible avenue for further enhancing the indexes in the future and provides comparisons with the methodologies applied

by other institutions. It also notes the challenges of the data constraints both in terms of the quality and availability to compute the effective exchange rates. Finding from this paper also serve as an update to the former REER computation for Nigeria, to the extent that the former methodology has become obsolete given the changes in the Nigerian economy and the composition of major trading partners.

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