



A Causality Test of Exchange Rate and International Trade Volume in Nigeria

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Abstract

The study examined the causal relationship between exchange rate and trade volume in Nigeria from 1995 to 2014 with a major objective of determining the relationship between exchange rate and international trade. Using Annualized time series drawn from the World Bank Databank for covering the period 1995 to 2014, it was established that a unidirectional causality exist between exchange rate and net export. A unidirectional causality was also found running from import to export without feedback. It can therefore be concluded that an effective and efficient exchange rate policy is an essential ingredient for enhancing the trade volume of a country like Nigeria.

Keywords: Exchange rate; Net export; Import; Causality test; Akaike information criterion; Lag selection.

1. Introduction

Following the breakdown of the Breton Woods system of fixed exchange rates, both real and nominal exchange rates have been allowed to follow the movement of market forces while fluctuating freely and widely. Several theoretical studies [Ethier \(1973\)](#), [\(Clark, 1973\)](#), [\(Baron, 1976\)](#), [Cushman \(1986\)](#), [Peree and Steinherr \(1989\)](#), have shown that an increase in exchange rate volatility adversely affects volume of international trade. Other theoretical studies have shown that increased volatility can have unclear even positive effects on trade volume [Viaene and Viaene and de Vries \(1992\)](#), [Franke \(1991\)](#) and [Sercu and Vanhulle \(1992\)](#). Exchange rate movements have been unusually large and most times generate some controversies as to their likely effect especially on exports and imports. Arguments on these are new; they have been around at least since the economist Fritz Machlup coined the phrase 'elasticity pessimism' back in 1950 ([Machlup, 1950](#)).

It is on the basis of this contradictory and unsettled arguments that this study is set to examine the possible existence of causal relations among exchange rate on one hand and net export and net import which are proxies for exchange rate.

Our analytical framework follows two key directions. First, our empirical evidence will make a statement in addressing the lack of clarity between exchange rate and the volume of international trade with particular emphasis on the Nigerian economy. Secondly, our findings will help in establishing the direction of the causal relationships between exchange rate and trade flows with focus on import and export volumes.

In terms of methodology, we will carry out some pre-estimation tests to validate the properties of our variables; this will be followed by the application of the Granger Causality test as popularized by [Granger \(1979\)](#). Other descriptive tools such as graphs and charts are further employed to clearly show the statistical and empirical relationships among the variables under study. This creates novelty in our approach and pattern of estimation. The study covers a twenty-year period of 1995 to 2014; which is considered reasonable enough to allow for conclusions and proper generalization.

Aside the introduction, the rest of the paper has Section 2 as review of previous studies. Sections 3 looks at the methodology of the study and 4 provide the analytical results for trade volume and exchange rate while Section 5 concludes.

2. Literature Review

Trade across the border is the exchange of goods and services by citizens of one country and those of the other countries of the world. It is uncoupled into import and export. Import refers to the total amount of goods and services brought into a country at a particular time and period. While the ones sent out of the country refers to export. Under the period of study in this research, the growth rate of imports has dwindling effects overtime. At the beginning of the period under study, between 1981 and 1982 to be precise, the growth rate of imports was negative. This period marked the adoption of the Structural Adjustment Programme under which Nigeria was still grappling with importation. By 1986, it began to increase and there was dwindling effects up till the period of 1995. In 1995, there

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was a sharp increase up to 1.833%. By 1998 when the regime of Ibrahim Babangida came to an end, the growth rate sharply fell to negative and began to increase in 1999. The dwindling effect continued on and on until the end of the period under study. Export on the other hand has largely been less than importation as the country tends to over depend on imported products and services. The growth rate of exports shows mixed results of increase and decrease over the period under study. The period of 1981 to 1983 initial experienced the lowest growth rate in terms of exports. This can be explained by the drop in the prices of oil in the nation and as such hindering the economy from producing exportable goods. In 1986, the growth rate reduced again and could be accounted for by the adoption of the Structural Adjustment Programme. The dwindling effects continued on and on until 1995 when there was another sharp increase under the regime of Ibrahim Babangida. After then, the growth rate continued to increase and decrease.

Exchange rate volatility explains a fluctuation or oscillation in the relative value of economy's currency. There has been a persistent fluctuation in the exchange rate of Nigeria as a country blamed largely on interest rate, inflation, balance of payment, government intervention. In 1998 there was a major rise in the exchange rate volatility this was due to the return to democracy, there was a major shift from fixed exchange rate to flexible exchange rate. Under the floating exchange rate, the CBN attempted to devalue the naira so as to stabilize the movement of the exchange rates.

The relationship between exchange rate and international trade has been of interest in literature over time. It has been argued that this could be driven by reverse causality; that is, trade flows helps in stabilizing real exchange fluctuations thus reducing exchange rate volatility and also exchange rate acting to stabilize trade volume (Burstein and Gopinath, 2014). This view is shared variously across different economic climes.

Yutaka Kurihara (2013), examined the effects of exchange rate uncertainty and financial development on international trade using Panel data in a dynamic panel model framework and for the period 2009 to 2011. The results were found to be inconclusive as exchange rate volatility did significantly influence the volume of international trade in the developed economies with somewhat stable exchange system but negatively influences international trade in developing countries. This view is corroborated by Orkhan Najafov (2010) who found negatively significant effect of exchange rate volatility on trade in the US though this effect was considered unambiguous.

Christian Broda and John Romalis (2003), found that bilateral real exchange rate volatility shows reverse causality in the impact of real exchange rate volatility on trade in different types of goods. The study departs from the existing literature in several dimensions. First it structurally estimated the relationship between trade and exchange rate volatility and secondly, the effect of exchange rate volatility on the composition of trade.

Piet Sercu and Raman Uppal (1998); Elif Nuroğlu and Robert Kunst (2012) all found no strong negative relation between exchange rate volatility and the volume of international trade. The analysis indicates that exchange rate volatility is not probably a major policy concern and this is because of the increasing availability of financial instruments to hedge against exchange rate risks and to the increase share of intra-industry trade.

This study departs from prior authors it uncouples trade volume into export, imports and also looks at the aggregate causal effect of exchange rate on the above-mentioned variables.

3. Theoretical Consideration and Methodology

3.1. Theoretical Consideration

This study theoretically follows the Marshall-Lerner (M-L) condition depicting a "J curve" effect as cited in Krugman (2006). This is one theoretical approach that underpins the investigation of the impact of devaluation or exchange rate movement on trade balance. This is referred to as the elasticity approach of devaluation on trade balance. The M-L condition takes the trade balance equivalent to the current account. Therefore, according to the M-L condition, "all things being equal, a real currency depreciation improves the current account if export and import volumes are sufficiently elastic with respect to the real exchange rate" This also implies that, an improvement in the current account due to real devaluation is subject to the sum of the elasticity of demand for export and import exceeding (Krugman, 2006). The M-L analysis is a partial equilibrium analysis of the response of tradables to relative price changes. In specific terms, tradables are dependent on exchange rate movements implying that trade volumes can be a function exchange rate if this M-L analyses holds true.

3.2. Data and Method

This study examines the causal relationship between exchange rate and trade volumes in Nigeria using annualized data from the *World Development Indicators*; a data repository of the World Bank. The scope covers the period 1995 to 2014.

The Base relationship is expressed thus:

$$Tv = f(exr)$$

Where: Tv= Trade Volume

Exr = Exchange Rate

The estimation is to be done using the Granger causality test which is a statistical concept of causality that is based on prediction. Its mathematical formulation is based on linear regression modeling of stochastic processes (Granger, 1979). It determines the direction of causality between variables. This test would be carried out to show the causal relationship between exchange rate and international trade volume.

Following the Granger Causality tests, the model is presented thus:

$$Y_t = \sum_{i=1}^m \alpha_i X_{t-1} + \sum_{j=1}^n \beta_j \mu_{t-1} + \varepsilon_t$$

Where Y= Trade Volume and X= Exchange Rate.

The test largely determines the possible existence of a unidirectional or bidirectional causation between exchange rate and trade volumes within the studied period. Essentially, trade volume is uncoupled into import volume and export volume.

3.3. Basic Descriptive Statistics

As a part of the pre-estimation test, the basic statistical properties of the variables under study are shown. These includes the measures of central tendency and measures of dispersion.

3.4. Lag Selection

Given that the Granger Causality Test is a lag-based test, there is the need to select the optimal lag selection. In an attempt to choose the optimal lag for the granger causality tests, the series are put into a Vector Autoregression (VAR) system and the lag length criteria following the Akaike Information Criterion employed. This follows the form of the equation stated below:

$$AIC = -2 \log L(\theta, \mathbf{x}_o) + 2p$$

With the optimal lag b maximum being the lag with the least information criterion and maximum log likelihood.

4. Presentation and Interpretation of Data

Table-4.1. Nigeria’s Real Exchange Rate and International Trade Volume Related Variables

YEAR	REXR	MP	NXP	XP
1995	70.8	5439688000.000	5431170000.000	10870857728.00
1996	207.6	8905283000.000	2374332000.00	11279614976.00
1997	235.9	12568410000.00	2396229000.000	14964638720.00
1998	272.4	11675835392.00	2173179000.000	9502657000.000
1999	70.2	7883274000.000	4265996288.000	12149270000.00
2000	69.9	9114927000.000	14880715776.00	23995643904.00
2001	77.8	16050691072.00	4009185000.000	20059875328.00
2002	78.1	16208631808.00	5053158400.000	21261790000.00
2003	73.2	23971143680.00	2947695000.000	26918838272.00
2004	74.9	16064621568.00	10430213120.00	26494834688.00
2005	85.5	21429764096.00	14104655872.00	35534420000.00
2006	91.5	31264470000.00	31432237056.00	62696706048.00
2007	89.7	51157760000.00	4983771000.000	56141530000.00
2008	99.1	52203120000.00	30779610000.00	82982730000.00
2009	92.1	52597235712.00	450179500.0000	52147056640.00
2010	100.0	64169885696.00	29070483456.00	93240370000.00
2011	100.3	88377930000.00	40620610000.00	128998531072.0
2012	111.4	59653830000.00	85264290000.00	144918118400.0
2013	118.8	66940014592.00	26010624000.00	92950630000.00
2014	127.1	71275840000.00	33554160000.00	104830000000.0

Source: World Bank Databank for Development Indicators

REXR = Real Exchange rate (Nominal exchange Rate divided by GDP)

MP = Total Volume of Import

XP = Total Volume of Export

NXP = Net Export volume (Export minus Import)

Table-4.2. Basic Descriptive Statistics

	REXR	MP	NXP	XP
Mean	112.3150000000	34347617780.80	17249288873.40	51596905638.80
Median	91.8000000000	22700453888.00	7930691560.000	31226629136.00
Maximum	272.4000000000	88377930000.00	85264290000.00	144918118400.0
Minimum	69.9000000000	5439688000.000	-2173179000.000	9502657000.000
Std. Dev.	57.75276047173	26056561792.54	20800396249.44	42448098566.71

Table 4.2 contains basic descriptive averages of the series. Measures of central tendency like mean and median are shown there as well as measures of dispersion like maximum, minimum and standard deviation. The measures of central shows the aggregative tendencies of exchange rate and trade volumes with those of dispersion showing how far apart the distributions are to themselves. In addition, the range of the distribution is evidenced by the difference between the

In an attempt to choose the optimal lag for the granger causality tests which is the key method of estimation for this study, the series were put into a Vector Autoregression (VAR) system and the lag length criteria used as reported in Table 4.3 below. From the result, a greater majority of the lag selection criteria favored lag 4 as the optimal lag under a 5% level of significance. It is on this premise that the granger Causality test below was done using a lag of 4.

Table-4.3. Results of Lag Selection Using AIC

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-861.3072	NA	1.67e+43	108.0384	108.1833	108.0458
1	-840.2144	31.63911	3.81e+42	106.5268	107.1062	106.5565
2	-821.2467	21.33871*	1.28e+42*	105.2808	106.2949	105.3328
3	-809.0312	9.161644	1.36e+42	104.8789	106.3275	104.9531
4	-793.1061	5.971904	2.06e+42	104.0133*	105.8964*	104.1097*
* indicates lag order selected by the criterion						
LR: sequential modified LR test statistic (each test at 5% level)						
FPE: Final prediction error						
AIC: Akaike information criterion						
SC: Schwarz information criterion						
HQ: Hannan-Quinn information criterion						

Source: Author's Computation

The results of the primary estimation technique are presented in table 4.4 following the form specified in the model in section three above:

Table-4.4. Granger Causality Tests

Null Hypothesis:	Obs	F-Statistic	Prob.
LNXP does not Granger Cause LREXR	16	24.6923	0.0003
LREXR does not Granger Cause LNXP		0.59749	0.6763
LNMP does not Granger Cause LREXR	16	19.9157	0.0006
LREXR does not Granger Cause LNMP		0.99889	0.4677
LNMP does not Granger Cause LNXP	16	0.73437	0.5968
LNXP does not Granger Cause LNMP		0.96111	0.4842

Source: Author's Computation

From the Granger Causality test results, it can be established that a unidirectional causality exists between exchange rate and net export. This causality runs from net export to exchange rate and there is no feedback. A unidirectional causality was also found running from import to export without feedback. There is however no causal relationship between export and import volumes respectively. This means that as trade volume increases, a certain degree of influence is exerted on the exchange rate of the country whose volume of trade has risen.

5. Conclusion

The study looks at the causal relationship between exchange rate and trade volume in Nigeria from 1995 to 2014. The major objective was to determine the relationship between exchange rate and international trade. From the major test that is the Granger Causality test results, it can be established that a unidirectional causality exists between exchange rate and net export. This causality runs from net export to exchange rate and there is no feedback. A unidirectional causality was also found running from import to export without feedback.

Contrary to our theoretical underpinning, it was found that trade volumes drive exchange rate instead of exchange rate driving trade volume. It is evident that as countries engage more in trade activities following its direction of importation and exportation, the exchange value of their currencies can either be strengthened or weakened depending on the direction of trade flows. It can therefore be concluded that an effective and efficient exchange rate policy are crucial in not only enhancing trade volumes but also stabilizing any country's trade activities. This is with the aim of managing trade relationships in a manner that enhances competitiveness and trade gains while minimizing trade losses precipitated by overdependence on foreign goods.

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