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Exchange Rate Volatility and the Nigerian Oil and Non-Oil Trade: An ARDL Approach

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DECLARATIONS

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results to this work.

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ABSTRACT

This study applies the ARDL Approach to Cointegration and conditional ECM to investigate the long-run and short-run relationships of Naira/dollar exchange rate volatility on the Nigerian oil and non-oil trade over the period of 1981 to 2012. Moving Sample Standard Deviation of the growth rate of the monthly real exchange rate data from 1981:1 to 2012:12 is used as a measure of exchange rate volatility, which is then tested on the real oil and non-oil export and import equations. The study is based on the exchange rate volatility-trade theory developed by Clark (1973), which is later reformulated by Hooper and Kohlhagen (1978). Oil trade and non-oil trade are examined separately because the former dominates the export trade and the latter dominates the import trade in Nigeria. Oil export and non-oil import equations are found to be cointegrated and therefore their long run relationships are estimated, while oil import and non-oil export equations are analysed using short run models. The findings reveal that, based on 5 per cent significance level, the effect of exchange rate volatility is significant only on the real oil import in the short run. The real oil import is found to be positively related with the exchange rate volatility. The right course of action is for government to establish new refineries and renovate the existing ones, and encourage private ownership in the oil sector. Furthermore, the study confirms the presence of Marshall-Lerner Condition in the short run, which suggests that devaluing Nigerian Naira can improve the Nigerian trade balance in the short run.

Key words: ARDL Approach to Cointegration, conditional ECM, exchange rate volatility, Moving Sample Standard Deviation, export equation, import equation.

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LIST OF ABBREVIATIONS

ARDL	Autoregressive Distributed Lag
CBN	Central Bank of Nigeria
ECM	Error Correction Mechanism
GDP	Gross Domestic Product
IMF	International Monetary Fund
LNOE	Log of non-oil export
LNOI	Log of non-oil import
LOE	Log of oil export Log of oil import (LOI)
LP	Log of Price
LREER	Log of REER
LRGDP	Log of real GDP
LURGDP	Log of US real GDP
LV	Log of Volatility

CHAPTER ONE

GENERAL INTRODUCTION

1.1 Introduction

The collapse of Bretton Wood exchange rate system in 1973 ushered in the era of flexible exchange rate system. This development came with it the uncertainty in the international trade due to high volatility in the exchange rate. Exchange rate volatility refers to the unexpected and sudden swing or movement in the rate of currency exchange. The uncertainty in turn affects in one way or the other the flow and profitability of the international trade. As a result, economists and policy makers alike take keen interest in investigating the relationship between the exchange rate volatility and trade. However, the findings from the various studies are diverse due largely to the fact that different studies employed different data set, different sample period, different volatility measures, and so on.

There are two major categories of trade in Nigeria: oil sector and non-oil sector. The former overwhelms the export trade, while the latter dominates the import. Nigerian economy had been agrarian before 1972 as agriculture dominated the export trade. However oil sector has taken lead in the Nigeria's export afterwards. Nigeria's trade was liberialised in 1986. The need for industrialisation has necessitated the adoption of various policies such as National Devlopment Plans, SAP, NEEDS, Vision 2020 and so on.

This research work is based on the appraisal of the impact of exchange rate volatility on Nigeria's oil and non-oil trade. The study employs ARDL approach to cointegration and ECM on annual oil and non-oil trade data from 1981 to 2012.

1.2 Statement of the Research Problem

As a result of constant increase in the rate of exchange rate volatility, various exchange rate policies have been adopted by successive governments in Nigeria to reduce the severity of its negative effect on Nigeria's macroeconomic variables, particularly international trade. Among these policies are development plans, Autonomous Foreign Exchange Market, National Economic Empowerment and Development Strategies (NEEDS), Interbank Foreign Exchange Market, Vision 2020. There is need to carry out

this study for the fact that policies formulated based on empirical evidence prove to be more effective than those formulated based on value judgment.

1.3 Research Questions

- Does the exchange rate volatility have impact on the oil and non-oil trade in Nigeria?
- How can the relationship between exchange rate volatility and oil/non-oil trade be modelled and estimated?
- Does Marshall-Lerner condition hold in Nigerian oil and non-oil trade.
- What are the policy implications of exchange rate volatility in formulating trade policies?

1.4 Aims and Objectives of the Study

The research centres on evaluating the impact of exchange rate volatility on Nigeria's oil and non-oil trade. Other objectives include;

- To evolve an appropriate modelling technique in estimating the relationship between exchange rate volatility and oil/non-oil trade in Nigeria.
- To check for the presence of Marshall-Lerner condition in Nigerian oil and non-oil trade.
- To draw logically the policy implications of the exchange rate volatility and make meaningful recommendations.

1.5 Significance of the Study

This study seeks to explain how exchange rate volatility affects oil and non-oil trade in Nigeria. More so the outcome of this research work is hoped to be of assistance to other student researchers who might be interested in the same or similar subject. Besides, it is also hoped that the research findings will add to the examined literatures and knowledge on the subject matter.

Thus the outcome of this research work will be of tremendous importance to the citizens and government of Nigeria.

1.6 Scope and Limitations of the Study

The scope of this research is based on geographical, time and conceptual scope. Geographically the study area is Nigeria, the Africa's most populous country and is situated in West Africa. Furthermore, this study covers the period of thirty two years (1981 to 2012).

The limitations of the study are concerned with the problems of time constraints, money constraints and lack of some requirements (for example lack of quarterly series of some variables) for in-depth research investigation about the study.

1.7 Organization of the Study

This research is divided into five chapters, each of them covering different aspect of the study. Chapter one deals with the general introduction of the research essay. The second chapter covers the aspects of Nigeria's trade development since independence year 1960. Chapter three will be centred around theoretical framework and literature review on the exchange rate-trade relationship. Chapter four will provide in-depth information on the methodology and empirical results. The last chapter consists of summary and conclusion of the study, policy recommendations, and further research areas.

CHAPTER TWO

DEVELOPMENT OF TRADE AND FOREIGN EXCHANGE MARKET IN NIGERIA

2.1 Trade Balance of Nigeria

To fully understand the nature and structure of Nigeria's foreign trade, it is pertinent to discuss it under two different periods: the period before SAP, and the period after its implementation. SAP is the set of policies of IMF and World Bank implemented in Nigeria in July, 1986. It was adopted to correct the problem of trade imbalances and to stimulate growth and development. The main features of SAP include;

- Restructure and diversify the productive base of the economy in order to lessen the dependence on the oil sector and on imports;
- Achieve fiscal and balance of payments viability over time;
- Lay the basis for sustainable, non-inflationary growth; and
- Lessen the dominance of unproductive investments in the public sector, improve the sector's efficiency and intensify the growth potential of the private sector.

2.1.1 Pre-Sap Trade in Nigeria (Before 1986)

Nigerian foreign trade has been made up of two categories: oil sector and non-oil sector. The former has overwhelmed the export, while the latter has dominated the imports.

A rise in the oil price in not only brought about higher export of crude oil but also increased the receipts of official foreign exchange. Following the boom in the market, management of the foreign exchange resources became necessary in order to avoid shortages. The ever-increasing demand for foreign exchange which coincided with the period of shrinking supply ushered in the era of comprehensive exchange controls in 1982.

Nigeria's economy was rural, backward, and agrarian with insignificant industrial base. So to modernise the economy, various policies were adopted in the form of National Development Plans. Development plans involve deliberate efforts on the part of Nigerian government to speed up the process of social and economic development of Nigeria. The main purpose was for the country to be able to locally produce some consumables so that the dependence on import of such items would be reduced.

Marketing Boards were established in order to encourage the farmers to increase the production of crops, which were the main sources of foreign exchange earnings. The desire to quicken the pace of industrialisation brought about huge demand for import. Therefore, the trade policies were directed towards moderating the import demand pressures. Exchange rate control was used to adjust the demand for foreign exchange; essential imports were given higher priority in the use of foreign exchange than other imports. In order to support import substitution industrialisation policy and to protect infant industries, trade barriers such as import licensing and custom tariffs were used to put limit on importation of some commodities.

The pre-SAP development plans include the Third National Development Plan (1975 to 1980), the Fourth National Development Plan (1981 to 1985), Austerity Measure (1984-1985).

2.1.2 Post-Sap Trade

Adoption of SAP was tantamount to dismantling all forms of administrative controls. Both external trade and foreign exchange market were liberalised. Exchange rate policy and manipulation of customs tariffs were the tools utilised to control imports.

SAP had a positive impact on the performance of Nigerian economy during the early years of its introduction. The GDP grew at 9.9 per cent in 1988, and at average rate of 5.8 per cent between 1989 and 1992. Despite the favourable trade balance, the structure of the domestic output did not differ from that of the pre-SAP period because the share of agriculture in GDP continued to be greater than that of other sectors till 1988. The trend of its output continued to rise between 1985 and 1998. Production of consumer goods overwhelmed the manufacturing sector. Except in 1986, the production rate rose continuously till 1992, but the growth rate fell down between 1993 and 1996. The average share of manufacturing output in GDP fell from 9 per cent in 1980-1985 to 6.3 per cent in 1986 to 1992 period. The decline of its contribution to GDP was due to slow rate of responsiveness by the manufacturing sub-sector to the industrialisation strategy. Capacity utilisation of industries that were able to get their raw materials locally boosted and ranged from 57 to 70 per cent. Some of these industries involved in the manufacture of beer, textile and tyre/tube with production capacity of 67 per cent, 57 per cent, and 56.5 per cent respectively. Other industries which relied on imported

inputs like paints plant and auto assembly plants had production capacities of 21.7 per cent and 22.1 per cent respectively.

Despite the fact that one of the aims of SAP was to reduce import, there was increased import of producer goods, raw materials and durable consumer goods. The growth of the importation of producer goods was ascribed to the country's desire to industrialise. However, export of manufactured commodities recorded significant growth of 39 per cent in 1988 to1990 period.

2.1.3 External Trade Direction

Nigeria's major trade partners include Europe (EU), the United States of America (USA), the United Kingdom (UK) and Japan. The bulk of the exports consist of agricultural commodities, petroleum and other mineral resources. We can see from the following tables that most of the Nigeria's import come from Europe, and most of its exports go to the USA.

Table 2.1 Export by Major Trade Partners (Naira million)

	AFRICA	ECOWAS	AMERICA	EUROPE	ASIA	TOTAL
1996	69,595.50	50,444.50	323,773.70	328,367.70	73,028.00	801,752.10
1999	155,535.80	104,562.50	661,720.40	325,379.70	411,051.60	1,559,299.50
2000	202,827.40	139,838.30	1,368,399.80	631,781.70	548,820.30	2,752,057.50
2001	127,501.90	90,981.70	1,008,005.70	483,419.30	360,410.80	2,007,127.00
2002	178,782.40	145,671.80	869,444.90	532,245.40	493,430.30	2,167,412.40
2003	259,781.80	141,177.50	1,531,824.70	684,699.90	594,432.80	3,109,288.40
2004	414,849.00	189,776.30	2,831,984.40	880,215.70	973,490.70	5,129,025.60
2008	1,098,003.60	693,918.10	4,933,644.60	2,089,193.30	1,138,257.90	9,568,949.20
2009	1,267,083.30	320,707.20	3,304,644.20	1,750,615.70	1,069,928.00	7,434,543.90
2010	1,547,937.22	307,447.92	6,114,850.68	2,993,789.21	2,188,596.24	13,009,905.70
2012	2,118,676.10	869,569.00	7,196,118.70	8,227,089.70	4,347,382.90	22,446,320.23
2013	807,988.30	396,712.80	1,801,208.80	3,067,804.00	1,326,354.90	7,195,040.71

Source: National Bureau of Statistics

Table 2.2: Share of Export by Trade Partners

YEAR	AFRICA TOTAL	ECOWAS		AMERICA TOTAL	USA		EUROPE TOTAL	ASIA TOTAL	JAPAN	
		Share in total	Share in Africa		Share in total	Share in America			Share in total	Share in Asia
1997	9.37%	7.25%	77.32%	45.45%	41.56%	91.44%	29.81%	9.30%	0.91%	9.77%
1998	11.15%	7.83%	70.15%	50.71%	42.72%	84.24%	29.23%	8.50%	0.77%	9.00%
1999	9.97%	6.71%	67.23%	42.44%	33.69%	79.38%	20.87%	26.36%	1.50%	5.69%
2000	7.37%	5.08%	68.94%	49.72%	42.48%	85.43%	22.96%	19.94%	0.40%	14.26%
2001	6.35%	4.53%	71.36%	50.22%	40.57%	80.77%	24.09%	17.96%	0.96%	5.34%
2002	8.25%	6.72%	81.48%	40.11%	32.35%	80.63%	24.56%	22.77%	3.05%	13.41%
2003	8.36%	4.54%	54.34%	49.27%	38.26%	77.65%	22.02%	19.12%	4.01%	20.98%
2004	8.09%	3.70%	45.75%	55.21%	42.93%	77.75%	17.16%	18.98%	2.92%	15.39%
2005	6.86%	3.99%	58.21%	52.55%	40.82%	77.68%	18.45%	21.83%	3.04%	13.92%
2006	9.98%	6.28%	62.93%	54.07%	45.01%	83.24%	21.17%	14.77%	1.88%	12.73%
2007	11.31%	6.91%	61.13%	57.45%	49.34%	85.89%	20.43%	15.91%	1.91%	11.99%
2008	11.47%	7.25%	63.20%	51.56%	42.34%	82.12%	21.83%	11.90%	0.36%	3.03%
2009	17.04%	4.31%	25.31%	44.45%	27.26%	61.33%	23.55%	14.39%	0.46%	3.22%
2010	11.90%	2.36%	19.86%	47.00%	34.37%	73.12%	23.01%	16.82%	0.45%	2.69%
2011	10.43%	2.85%	27.28%	40.51%	22.54%	55.64%	29.21%	15.89%	0.31%	1.94%
2012	9.44%	3.87%	41.04%	32.06%	17.68%	55.16%	36.65%	19.37%	0.49%	2.52%
2013	11.23%	5.51%	49.10%	25.03%	11.89%	47.49%	42.64%	18.43%	0.33%	1.81%

Source: author's calculation based on the data generated from NBS.

Table 2.3: Imports by Major Trade Partners (N million)

YEAR	AFRICA	ECOWAS	AMERICA	EUROPE	ASIA	TOTAL
1996	13,267.00	7,947.50	86,743.60	196,793.20	74,401.20	375,193.90
1997	73,613.60	9,824.50	99,757.70	201,238.80	131,025.30	447,724.20
1998	14,206.40	8,106.50	85,080.50	206,294.20	98,470.60	405,587.50
1999	19,787.60	8,309.40	80,963.50	209,414.90	93,652.30	406,961.40
2000	25,789.20	13,079.60	94,811.80	326,131.60	142,684.70	591,325.60
2001	80,646.80	45,075.00	124,048.40	436,696.50	241,749.40	885,114.10
2002	50,063.90	13,240.50	174,891.70	445,112.50	379,695.50	1,054,075.60
2003	99,580.70	48,346.00	376,765.30	700,043.50	454,224.30	1,923,098.80
2004	135,893.10	52,662.10	218,381.30	783,207.60	400,454.50	1,575,563.90
2005	158,311.60	104,827.40	421,472.20	655,196.30	528,170.40	1,779,601.60
2006	119,701.00	38,949.70	573,964.70	1,159,502.00	986,213.10	2,922,248.50
2007	232,050.20	97,156.40	858,688.80	1,632,009.30	1,341,045.80	4,127,689.90
2008	218,687.20	111,024.60	654,198.80	1,223,725.90	1,162,073.80	3,299,096.60
2009	360,001.40	10,685.50	1,071,063.50	1,631,803.00	1,896,085.90	5,047,868.60
2010	429,562.43	36,735.09	1,992,692.44	1,618,626.34	2,496,640.88	6,648,525.90
2011	450,077.40	129,526.60	3,359,596.90	2,684,815.80	3,165,933.70	9,892,644.12
2012	245,605.00	33,828.70	1,421,885.00	1,490,398.00	2,319,882.60	5,624,870.44
2013	178,134.70	65,065.50	339,194.30	1,126,988.20	1,192,233.70	3,244,981.98

Source: National Bureau of Statistics

Table 2 4: Share of Import by Major Trade Partners

YEAR	AFRICA TOTAL	ECOWAS		AMERICA (TOTAL)	USA		EUROPE (TOTAL)	ASIA (TOTAL)	JAPAN	
		Share in total	Share in Africa		Share in total	Share in America			Share in total	Share in Asia
1996	3.54%	2.12%	59.90%	23.12%	16.75%	72.44%	52.45%	19.83%	4.96%	25.04%
1997	16.44%	2.19%	13.35%	22.28%	15.65%	70.24%	44.95%	29.26%	5.16%	17.63%
1998	3.50%	2.00%	57.06%	20.98%	14.01%	66.81%	50.86%	24.28%	4.09%	16.85%
1999	4.86%	2.04%	41.99%	19.89%	15.58%	78.30%	51.46%	23.01%	3.10%	13.48%
2000	4.36%	2.21%	50.72%	16.03%	11.12%	69.35%	55.15%	24.13%	4.89%	20.27%
2001	9.11%	5.09%	55.89%	14.01%	10.25%	73.13%	49.34%	27.31%	4.53%	16.57%
2002	4.75%	1.26%	26.45%	16.59%	12.81%	77.18%	42.23%	36.02%	4.94%	13.71%
2003	5.18%	2.51%	48.55%	19.59%	15.52%	79.20%	36.40%	23.62%	2.45%	10.35%
2004	8.63%	3.34%	38.75%	13.86%	11.06%	79.77%	49.71%	25.42%	2.48%	9.75%
2005	8.90%	5.89%	66.22%	23.68%	20.29%	85.66%	36.82%	29.68%	3.54%	11.92%
2006	4.10%	1.33%	32.54%	19.64%	15.58%	79.30%	39.68%	33.75%	3.31%	9.80%
2007	5.62%	2.35%	41.87%	20.80%	15.11%	72.63%	39.54%	32.49%	2.31%	7.12%
2008	6.63%	3.37%	50.77%	19.83%	8.12%	40.92%	37.09%	35.22%	2.69%	7.64%
2009	7.13%	0.21%	2.97%	21.22%	6.02%	28.36%	32.33%	37.56%	2.85%	7.60%
2010	6.46%	0.55%	8.55%	29.97%	17.94%	59.86%	24.35%	37.55%	2.58%	6.88%
2011	4.55%	1.31%	28.78%	33.96%	18.00%	53.01%	27.14%	32.00%	4.52%	14.12%
2012	4.37%	0.60%	13.77%	25.28%	13.62%	53.89%	26.50%	41.24%	2.74%	6.63%
2013	5.49%	2.01%	36.53%	10.45%	7.36%	70.44%	34.73%	36.74%	1.03%	2.79%

Source: author's calculation based on the data generated from NBS.

2.1.4 Oil and Non-Oil trade in Nigeria

The analysis of Nigeria's oil and non-oil trade will be made by using Figure 2.1. The figure shows that all trade flows had been insignificant untill 1996. Non-oil export has been insignificant throughout the study period, possibly because Nigeria monoculturally relies on oil for its exports. Oil export has been increasing except in 1998 due to transition from military dictatorship to democracy, and 2009 due to global financial crisis. Oil and non-oil imports also show increasing trend. We can also see from the figure that oil export has dominated the export trade, and non-oil import has overwhelmed the import trade. Another important observation is that Nigeria gains trade surplus in oil sector, but it incurs trade deficits in the non-oil sector.

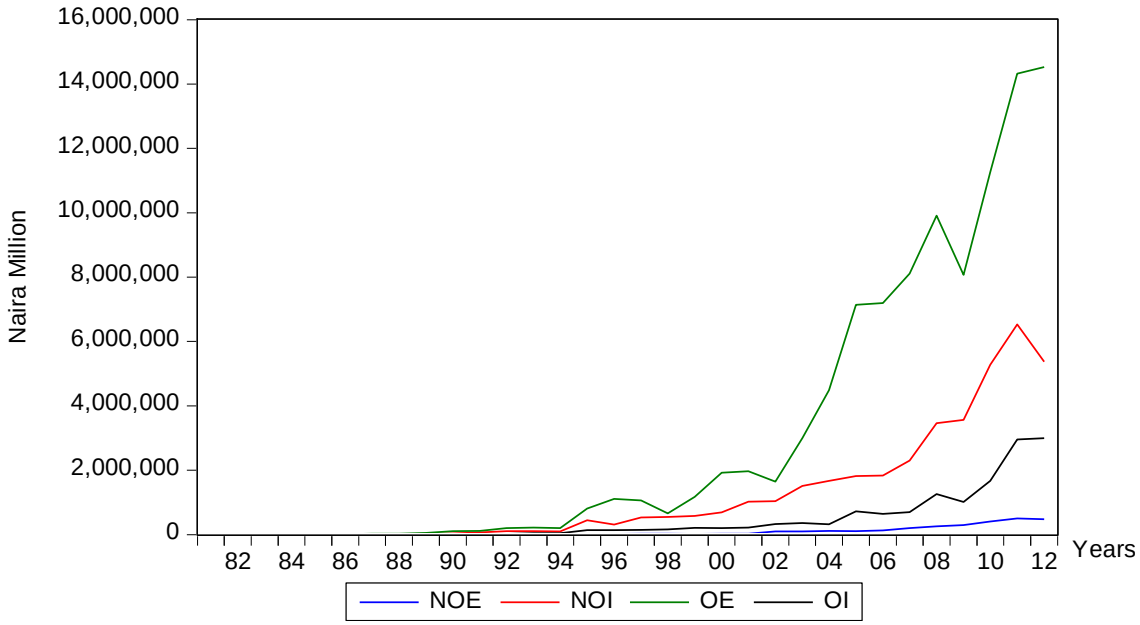

Figure 2.1: Oil and Non-Oil Trade in Naira Million (1981-2012)

2.2 Foreign Exchange Market in Nigeria

International Monetary Fund (IMF) defines Foreign Exchange as "the monetary authorities' claims on foreigners in the form of bank deposits, treasury bills, short-term and long-term government securities and other claims usable in the events of balance of payment deficits, including non-marketable claims arising from inter-central banks and inter-government arrangements, without regard to whether the claim is denominated in the currency of the debtor or creditor".

The Central Bank of Nigeria (CBN) defines it as "any currency other than the Nigerian currency and includes coins or notes which are, or have at a anytime been legal tender in any territory outside Nigeria: poster orders, money orders, bills of exchange, promissory notes; drafts, letters of credit and traveller's cheques payable or expressed in a non-Nigerian currency".

Simply put, foreign exchange market "can be defined as foreign currency or any other financial instruments acceptable as a means of payment or exchange for international transactions (Odusola, 2006). The important thing in the definitions is the convertibility of the currencies.

Nigeria's foreign exchange market is influenced by variety of factors which include international trade, production structure and institutional changes in the economy. Prior to the **establishment of CBN in 1958**, foreign exchange was in the hands of private sector and commercial banks acted as agents for local exporters. However, centralisation of foreign exchange authority in the CBN led to the emergence and development of local foreign exchange market.

2.3 Structure of the Nigeria's Foreign Exchange Market

Nigeria's foreign exchange market comprises of three major structural markets: The Second-tier Foreign Exchange Market (SFEM), the Autonomous Foreign Exchange Market (AFEM), and the Inter-bank Foreign Exchange Market (IFEM)

The Second-tier Foreign Exchange Market (SFEM) was introduced in September, 1986 with a view to evolving an appropriate mechanism of foreign exchange allocation that would suit the goal of internal balance. Market forces determined the allocation of foreign exchange and the Naira exchange rate under SFEM. In other words SFEM ushered in the era of Nigeria's foreign exchange deregulation or simply the era of floating exchange rate. The year 1989 witnessed the introduction of Bureaux de Change in order to widen the horizon of Foreign Exchange Market. Bureau de Change deals in privately sourced foreign exchange (see CBN website)[1]. SFEM began as a "dual

[1]More information at http://www.cenbank.org/IntOps/FXMarket.asp

exchange rate system which produced official first tier exchange rate and the SFEM or the "free" market exchange rate" (Campbell O.A, 2010)

The Foreign Exchange Market was further de-regularised in 1995 with the introduction of an Autonomous Foreign Exchange Market (AFEM) for the sale of foreign exchange to end-users by the CBN through selected authorised dealers at market determined exchange rate. Furthermore, Bureaux de Change operators were again given the status of authorised sellers and buyers of foreign exchange.

The introduction of an Inter-bank Foreign Exchange Market (IFEM) in October, 1999 took the liberalisation of the Foreign Exchange Market to a higher level.

2.4 Objectives of Foreign Exchange in Nigeria

Exchange rate policy is one of the most important policies as it influences the price of imported goods, or goods whose production is dependent on the imported inputs. It is not only a tool used to correct trade imbalances but also an instrument for efficient resource allocation. Exchange rate can also be used as stabilization policy. Currency can be devalued or re-valued (re-dominated) in order to achieve target macroeconomic objectives.

There are basically two categories of objectives: traditional and non-traditional. The traditional objectives as outlined by the Central Bank of Nigeria are as follows:

- Conservation of available foreign exchange resources so as to check expenditure and undue depletion of external reserves.
- Ensuring adequacy of reserves consistent with current and future international commitment
- Preserving the values of external reserves through appropriate portfolio diversification and optimal deployment into strong currencies.

However, the non-traditional objectives cover the following aspects:

- reduction of excessive demand for foreign exchange
- removal of distortions in the economy
- stimulation of non-oil exports
- promotion of efficient allocation of foreign exchange resources (Odusola,2006)

2.5 Exchange Rate Policies in Nigeria

Implementation of Structural Adjustment Program (SAP) in 1986 brought an end to fixed exchange rate regime in Nigeria. Since then, Naira/Dollar exchange rate has been volatile. This development led to the adoption of several exchange rate arrangements. The foreign exchange systems adopted include; the dual exchange rate system (1986-1987), the Dutch Auction System (DAS)[2] (1987), the unified exchange rate system (1987-1992), and the fixed exchange rate system (1994-1998). Others are the re-introduced DAS (1999-2002), the retail Dutch Auction System (2002-2006), and the wholesale Dutch Auction System (2006-date) (Bala A and Asemota O, 2013, p.90)

The following Table 2.5 summarises the events of exchange rate management in Nigeria. The detail started from 1959 because foreign exchange market was institutionalised until 1958 after the establishment of the apex bank.

Table 2.5: Chronology of Exchange Rate Management in Nigeria

	YEAR	EVENT	REMARK
1	1959 to 1967	Fixed parity solely with the British Pound Sterling	Suspended in 1972
2	1968 to 1972	Included US dollar in the parity exchange	Aftermath of the 1967 devaluation of the Pound and the emergence of a strong US dollar.
3	1973	Revert to fixed parity with the British pound	Devaluation of the US dollar.
4	1974	Parity to both British pound and US dollar	To minimise the effect of devaluation of the individual currency
5	1978	Trade (import)-weighted basket of currency approach	Tied to seven currencies: US dollar, British pound, German mark, French franc, Japanese yen, Dutch guilder, Swiss franc.
6	1985	Referenced on the US dollar	To avoid arbitrage prevalent in the basket of currencies.
7	1986	Adoption of the Second Tier Foreign Exchange Market (SFEM)	Deregulation of the economy
8	1987	Merger of the First and Second-tier markets	Merger of rates

[2] DAS entails the payments made by an authorised dealer of foreign exchange rate that bids for foreign currency unlike where all dealers paid a centrally determined rate by the CBN

9	1988	Introduction of the Inter-bank Foreign Exchange Market (IFEM)	Merger between the autonomous and the FEM rates
10	1989	Licensing of Bureaux de Change	To allow access to small users of foreign exchange and enlarge the officially recognised foreign exchange market.
11	1994	Fixed exchange rate	Regulate the economy
12	1995	Introduction of the Autonomous Foreign Exchange Market (AFEM)	Guided deregulation
13	1999	Re-introduction of the Inter-bank Foreign Exchange Market (IFEM)	Merger of the dual exchange rate, following the abolition of official exchange rate from January 1, 1999.
14	2002	Re-introduction of the Dutch Auction System (DAS)	Retail DAS was implemented at first instant with CBN selling to end-users through the authorised users (banks)
15	2006	Introduction of Wholesale Dutch Auction System (WDAS)	Further liberalised the market

Source: Christopher k (2012)[3]

2.6 Exchange Rate Volatility in Nigerian Naira.

Volatility is the measure of the amount of randomness in an asset return at any particular time. There are different types of volatility measures ranging from actual, historical/realized, implied to forward volatility. There is volatility when the values of a given series change rapidly from period to period in an unpredictable manner (Engle, 2003)

Exchange–rate volatility, therefore, is "swings or fluctuation over a period of time in exchange rate" (Asemota, 2013). Oloba O. and Abogan O. define it as "the risk associated with the unexpected movement in the exchange rate". In other words, volatility is the day to day, month to month variability of exchange rate, a variability that may have no trend to it (Oloba O. et al, 2013)

[3] Available online at http://www.cenresinpub.org/pub/Dec2012/JMCG/Page%2014-26%20_2024_.pdf

It is a common belief that increased exchange rate volatility retards the growth of Nigeria's foreign trade. Naira exchange rate against the major currencies has been excessively volatile ever since the introduction of floating exchange rate regime by SAP in 1986. The volatility has many consequences ranging from distortion of production patterns, currency crisis to fluctuations in foreign reserve. Exchange rate volatility could be harmful to Nigeria's international trade because exchange rate uncertainty leads to uncertainty in future price, causing risk–averse traders to trade less.

Another aspect of foreign exchange variability is called misalignment. It signifies long-lasting fluctuations of exchange rate from its long-run equilibrium. Anticipation is what distinguishes "volatility" from "misalignment". Unlike misalignment, volatility occurs unexpectedly. Volatility affects international trade adversely as it poses uncertainty in the business environment. Misalignment, which is mostly anticipated, may undermine economic activity. It can bring about recession, de-industrialisation, protectionism, inflation and so on.

Table 2.6: Average Official Exchange Rate (N/$) (1981-2012)

YEAR	EXCHANGE RATE	YEAR	EXCHANGE RATE	YEAR	EXCHANGE RATE	YEAR	EXCHANGE RATE
1981	0.610025	1991	9.909492	2001	111.9433	2011	153.8616
1982	0.672867	1992	17.29843	2002	120.9702	2012	157.4994
1983	0.724142	1993	22.05106	2003	129.3565		
1984	0.764942	1994	21.8861	2004	133.5004		
1985	0.89375	1995	21.8861	2005	132.147		
1986	2.020575	1996	21.8861	2006	128.6516		
1987	4.017942	1997	21.8861	2007	125.8331		
1988	4.536733	1998	21.8861	2008	118.5669		
1989	7.391558	1999	92.69335	2009	148.8802		
1990	8.037808	2000	102.1052	2010	150.298		

Table 2.6 shows Naira/dollar average official exchange rate over the period of 1981 to 2012. We can see that first devaluation took place in 1986, the year in which SAP was adopted. Another devaluation came about in 1992 and1993. However, Sani Abacha's military regime from 1993 to 1998 adopted a fixed exchange rate regime. Naira/dollar exchange rate had been fixed at 21.8861 throughout the regime. The democratic era which began in 1999 brought back the flexible exchange rate. This explains why the Naira/dollar rate went as high as 92.69335 in 1999 and 157..4994 in 2012.

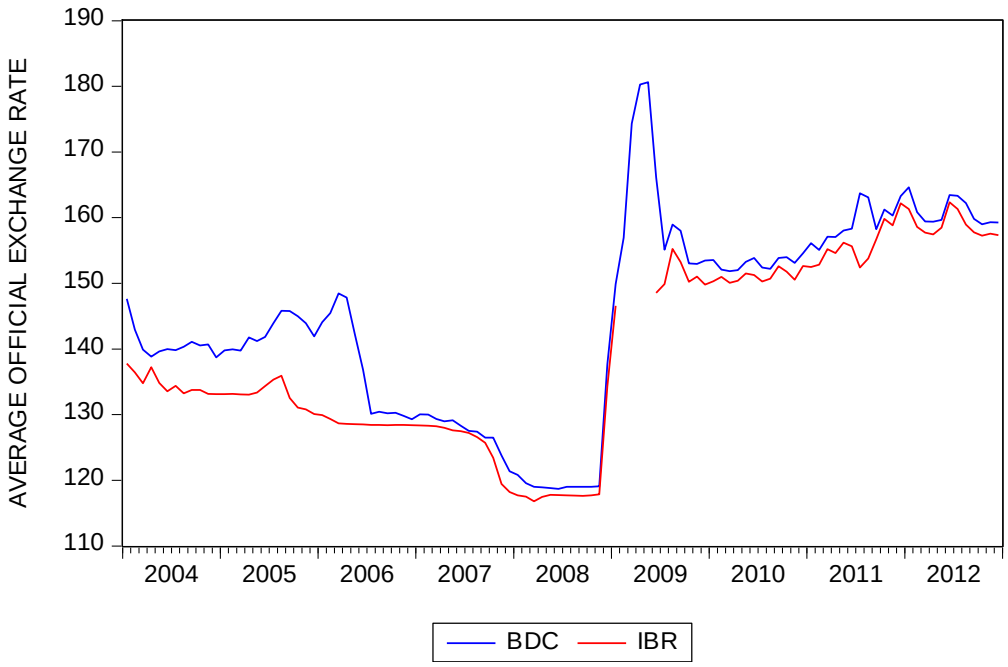

Figure 2.2: Exchange Rate Movement of BDC and IBR (January 2004 to December 2012)

Figure 2.2 is a plot of Average Official Exchange Rate from January, 2004 to December, 2012, depicting the existence of volatility in Nigeria's exchange rate. There was a sharp fall in the N/$ exchange rates of both bureau de change (BDC) and inter-bank rates (IBR) in the year 2006 because of the introduction of WDAS which increased the supply of US dollars in the Nigerian foreign exchange market. Another important observation is the skyrocketing rise in the bureau de change exchange rate in the period between February and June, 2009. The explanation for this is that operations of the Inter-Bank Foreign Exchange Market (IFEM) was stopped from trading mid-February 2009 and reopened for trading in June 2009. The exchange rate appears to be more volatile in the range of 2009 to 2012 than the period before 2009. This is attributable to the new exchange rate policies adopted by the apex bank which made the foreign exchange market highly competitive during the period. Some of the policies include reduction of the amount of foreign exchange sold weekly to bureau de change from $100,000 to $50,000 (or its equivalent of other foreign currencies like Sterling Pounds). In addition, there was a ban on the importation of foreign currencies by the

private dealers, and that recipients of money transfer from abroad must collect their money in Naira, and so on.

2.7 Determinants of Exchange Rate in Nigeria

Although there are various model trying to explain what determines the price of currencies, it can be argued that there are plenty of other factors that cause fluctuations in the rate of currency exchange. These determinants of exchange rate are discussed below;

2.7.1 Demand and Supply

Just like price of goods and services, the rate of exchange among currencies responds to the forces of demand and supply. If for some reason the monetary authorities increase the supply of a specific foreign currency, then the exchange rate between that currency and the domestic currency will fall, provided that the demand remains constant. In other word, the value of domestic currency appreciates, and the reverse is equally true. Excess demand or supply will decrease or increase foreign currency reserves temporarily.

This is explained in Figure 2.2 where the introduction of WDAS in 2006 increased the supply of foreign currency as a result of which Naira became stronger. On the other hand, a gap in the operation of inter-bank foreign exchange market in 2009 weakened the value of Naira in the bureau de change market, with the Naira/dollar exchange rate jumping from $1=156.93 to as high as $1=180.63 (the highest Naira/dollar rate in the period under study).

2.7.2 Differentials in Inflation

Mordi Charles N.O argued that exchange rate instability is a symptom of macro-economic volatility. Analysis of exchange rate fluctuations between 1980 and 2012 reveals that there is positive correlation between the exchange rate movement and inflation. Exchange rate moved along with inflation rate in the 1990s. Exchange rate volatility was high during the period of high inflation rate, and the converse was true. For instance exchange rate moved from $1=N8.04 in 1990m to $1=22.05 in 1993 and $1=81.65 in 1995, in response to inflation rate movement from 7.5 per cent in 1990 to 57.2 and 72.8 per cent in 1993 and 1995 respectively (Mordi Charles, 2006).

2.7.3 High Import Dependency

Nigeria highly relies on the importation of both consumer and producer goods. Almost all the major industrial inputs are imported and intermediate and capital goods are wholly sourced from abroad. This importation leads to high demand for foreign currency, which puts pressure on the exchange rate.

2.7.4 Over-Reliance on Oil Export.

Nigerian economy is a mono-cultural with oil dominating the export sector. Crude oil has been the country's biggest source of foreign exchange earnings as it accounts for about 80 per cent of the exports earnings. The implication is that the economy is highly susceptible to external shocks as a crash in crude oil price may cause a fall in foreign exchange earnings, which has a concomitant impact on foreign exchange stability.

2.7.5 Huge Debt Service Payment

Following the oil glut in the international market which led to the declining foreign exchange in 1980s, Nigeria's government resorted to external borrowing in order to finance domestic production. In 1986, the ratio of debt service payments to export was 30 per cent, and 60 per cent on average in the period of 1987-2005. These payments cause destabilisation in the foreign exchange market and the exchange rate.

2.7.6 Political Instability/Interference

The emergence of rebel and terrorist groups like the Movement for the Survival of the Ogoni People (MOSOP) in Southern Nigeria and the "Boko-Haram" in the north-eastern part scares away foreign investors. This adversely affects both the supply of foreign currency and the exchange rate.

Recent suspension to the CBN Governor Sanusi Lamido Sanusi by the President Goodluck Jonathan on February 20, 2014, has a detrimental effect on the Naira exchange rate. This political move undermined both the credibility and independence of the CBN and sent Naira to "a record low".

2.7.7 Differential in Interest Rates

If for any reason the Nigerian interest rate is higher than the foreign interest rate, the Nigerian currency would appreciate, and vice versa. This is because higher interest rate causes capital inflow into the Nigerian economy, which in turn makes the demand for Nigerian Naira higher.

2.7.8 Current Account Deficits

Current account deficits occur when Nigeria's import is greater than its export, and this situation leads to excess demand for foreign currency and at the same time causes depreciaton of the Nigerian Naira. Nigeria has been using exchange rate policy as a remedy for account deficits. Devaluation of Naira in 1986 was aimed at resolving the balance of payment deficits that characterised the Nigerian external sector in the early 1980's.

2.7.9 Terms of Trade

Terms of trade is a ratio of export prices to import prices. Increase in Nigeria's terms of trade indicate greater demand for its exports. Therefore, the result of higher terms of trade is increased demand for and value of Nigerian Naira. The reverse is often equally true.

CHAPTER THREE

LITERATURE REVIEW

3.1 Theoretical Aspects of the Link between Exchange Rate Volatility and Trade

To explain the relationship between real exchange rate volatility and trade, Clark (1973) pioneered a model that uses a rudimentary exporting firm. He described a model which assumes that there is a competitive firm with no market power producing only one commodity which is sold entirely to one foreign market and does not import any intermediate inputs (Tamirisa N et al, 2004). He further assumes that the firm receives payment in foreign currency and the conversion of its exports' proceeds is based on the current exchange rate, which varies unpredictably due to the fact that there are assumed to be no hedging possibilities. Moreover, the firm cannot alter its production in order to respond immediately to exchange rate movements, which may bring about favourable or unfavourable shifts in the profitability of its exports. In such a situation whereby the firm's profitability is influenced solely by exchange rate, greater exchange rate volatility may induce the firm's decision to reduce its exposure to risk by reducing its output, and hence its exports. Hooper and Kohlhagen (1978) elaborated this basic model and arrived at the same conclusion of a clear negative relationship between exchange rate volatility and trade.

However, this strong conclusion depends on the assumption that there are no hedging possibilities either through offsetting transactions or through the forward exchange market. This assumption holds especially for the currencies of most developing countries like Nigeria where there are no well-developed forward markets, which can allow hedging of specific transactions in order to reduce exposure to unforeseen movements in exchange rates. Moreover, even in advanced economies where well-developed forward markets exist, the trade decision appears to reflect a series of transactions over time where both the amount of foreign currency receipts and payments, as well as the forward rate, are not known with certainty (Tamirisa N et al, 2004).

Let us look at how the theoretical Import Demand developed by Hooper and Kohlhagen (1978) looks like.

The demand for imports is taken to be a derived demand schedule in the sense that the production function encompasses the imports in the form of inputs. Simply put, all imports are considered to be inputs in the form of raw materials, machinery and so on.

The importing firm faces a domestic demand schedule for its output (Q) which is related positively with the price of other goods in the domestic economy (PD) and domestic money income (Y), but inversely related with the price (P) and non-price rationing (CU) of its own output:

$$Q=a_1P+ a_2PD+ a_3Y+ a_4CU \qquad 3.1$$

3.2 Exchange Rate

The first thing to understand about exchange rate is that it is simply a price. Copeland (2005) defines exchange rate as the domestic currency price of foreign currency. In general, the exchange rate of currency A is the number of units of B needed to buy one unit of A. In the same vein, Naira exchange rate is the price of foreign currency, say Dollar, expressed in terms of Naira ($1=₦160.3), or the amount of foreign currency needed to buy one Naira (₦1=$0.00624). This paper will use the first expression of exchange rate (i.e. N/$)

Two measurements of exchange rate exist: **nominal rate** and **real rate**. While nominal exchange rate measures the relative price of two currencies, the real exchange rate measures the relative price of two goods (Odusola A, 2006). A change in the nominal rate can lead to short run change in the real rate.

A country manages the value of its currency through various mechanisms. Such mechanisms are called exchange rate regimes**.** There are three basic types of exchange rate regimes. They are discussed as follows:

3.2.1 Floating Exchange Rate

A completely flexible or (purely or freely) floating exchange rate is one whose level is determined exclusively by the underlying balance of supply and demand for the currencies involved, with no outside intervention (Copeland, 2005). In other words, the exchange rate is determined by market forces alone. The role of the central bank is to determine the money supply and allow the market to determine the nominal rate. This means exchange rate is an endogenous variable in this kind of regime.

One of the advantages of floating exchange rate is that it guarantees the country's ability to implement domestic monetary policies independently. Under this kind of regime, exchange rates adjust to the inflation differentials. However, it has a disadvantage as it makes the exchange rate susceptible to unhealthy volatility.

It is important to note that international demand for currencies may undermine the freedom of domestic policy under this regime. In a region with currency substitutability, shifts in money demand between currencies can become a major component of exchange rate inconsistency (Frankel, 1995).

In order to avoid currency speculative attack, the central bank has to allow both exchange rates and prices to adjust to market pressures.

3.2.2 Managed Floating

From considering a fixed rate with fluctuation bands, it is easy to envisage a system, or rather non-system, where the authorities manipulate the exchange rate to suit their own (usually unannounced) objectives, sometimes intervening to fix rates, sometimes staying on the side-lines. This type of compromise is known as "managed" or "dirty" floats. In fact it characterises the behaviour of most of the exchange rate during the so-called floating rate era of 1970s and 1980s. As proof, one only needs to cite the fact that the announced foreign reserves of all the major countries fluctuated quite substantially over this period (Copeland, 2005, p.17)

For big open, developing countries (like Nigeria) that rely on foreign trade and savings, a managed floating regime is an attractive alternative (Stiglits, 1994). This is because managed floating exchange regime helps developing countries to have stable macroeconomic policies.

Two preconditions are necessary for a managed floating exchange rate regime: (i) credible monetary policy and central bank independence; (ii) well-developed financial institutions (Clark and MacDonald, 1998)

3.2.3 Fixed Rate

Based on argument that exchange rate volatility is detrimental to economy, government "must do something", for example fix the exchange rate at an "acceptable" level. The authorities peg the exchange rate without operating via the market. Currencies subjected

to controls are referred to as “inconvertible” or “not fully convertible”. The authority has to keep foreign currency reserves that allow it to intervene whenever the exchange rate deviates from the fluctuation band.

In general exchange rate regimes could be classified by their implication for the foreign currency reserves. The reserves are constant under a pure float because the monetary authority needs not hold any reserves. Under a managed float, reserves fluctuate around a broadly constant level.

3.3 Exchange Rate Models

In order to explain the behaviour of exchange rate, various models have been developed over time. The models can be classified into three major categories: Partial Equilibrium Models, General Equilibrium Models and Hybrid Models. Purchasing Power Parity model, Balance of Payment model, Portfolio Balance model and Interest Rate Parity model make up the Partial Equilibrium models. General Equilibrium models consist of Mundell-Fleming model and Balassa-Samuelson models. Monetary model makes a good example of Hybrid models of exchange rate. The famous ones are discussed below:

3.3.1 Purchasing Power Parity

The PPP model is based on the “law of one price”, which states that a unit of a currency can buy the same bundle of goods or services everywhere in the world. Assume that a handbag costs N1600 in Nigeria, the same handbag should cost $10 in the USA at the exchange rate of $1=N160 (i.e. $10=N1600)

However, it is eventually the interaction of demand and supply that will determine the equilibrium prices of both Naira and US dollar. Therefore, both the law of one price and purchasing power parity between US dollar and Naira will be reinstated.

The effect of inflation differentials on the prices of goods and services will also be eliminated, as the PPP adjusts the ratio of the price levels of the countries involved to be equal. In other words, “percentage change in the exchange rate over a given period just offsets the difference in inflation rates in the countries concerned over the same period” (Taylor A.M and Taylor M.P, 2004)

To illustrate this theory, let and P_h and P_f signify the price of the commodity at home and abroad expressed respectively in domestic and foreign currency, and e is the exchange rate. Let Hp and F_p be respectively the home and foreign price level quoted in their respective currencies. Based on the "law of one price" the price of a given good will be the same in both home and foreign market, that is P_h=e P_f .

Now let the home price index be H_p=f(P_i) and foreign price index be F_p=g(P_i), and i= 1, 2, …….n. If the prices of each good, expressed in home currency, are equalized across countries and the same goods enter each country's market basket with the same weights, then **absolute PPP** prevails. In this special case, the law of one price can be extended to aggregate price levels. In other words, absolute PPP holds if the functions of home and foreign price indices are homogeneous of degree one.

$$e = H_p / F_p = \frac{home \text{ price of the standard market basket of goods}}{foreign \text{ price of the same standard basket}} \qquad 3.2$$

Where, the right-hand-side is the common multiple of the price of each good in one currency and in the other (Dornbusch R, 1985). If P_h/P_f=k for all goods, then $e=H_p/F_p$=k. The implication of the absolute PPP is that P_h/eP_f=1 at all times. However the postulation of the absolute PPP is violated in practice by the presence of transport costs and other trade obstacles.

The PPP theory is restated in terms of changes in the exchange rate and relative price levels: $e=\beta H_p/F_p$, where β is a constant which reflects the trade obstacles. This weak version is called the **relative PPP**. According to Dornbusch R(1985): "an increase in the home price level relative to that of abroad implies an equi-proportionate depreciation of the home currency". Relative PPP can be stated mathematically as follows:

$$\%\Delta e = \%\Delta H_p - \%\Delta F_p \qquad 3.3$$

Where the above equation in words means percentage change in exchange rate is the difference between percentage change of home price level and percentage change of foreign price level.

3.3.2 Portfolio Balance Model

According to this model, substitution between money and financial assets gives birth to the exchange rate (Joyce A.O, 2012). This model depicts that investors diversify their portfolio assets in order to avoid the risk associated with investing in financial assets of only one country, either domestic or foreign country.

Portfolio balance model views exchange rate as "a function of relative supplies of domestic and foreign bonds". Unlike monetary model which assumes perfect substitutability between domestic and foreign bonds, the portfolio balance model does not hold such an assumption. Moreover PPP is not a precondition in this model (Husted S. and Melvin M, 2007)

Prominent proponents of this model include Black (1973), Kouri (1976), Branson (1977), and Girton and Henderson (1977) and McKinnon

Money, foreign bonds and domestic bonds are the three assets covered by portfolio balance model. Assume that cash (M) is just a means of exchange and has no interest, domestic Bonds (B_d) yield i interest rate and Foreign Bonds (B_f) provide i* interest rate. For simplicity we consider both domestic bonds and foreign bonds as the sum of bonds held by the public and by the monetary authority in the country. Then the agent's wealth is given by:

$$W = B_d + e\,B_f + M \qquad 3.4$$

In real terms,

$$W/P = B_d/P + eB_f/P + M/P \qquad 3.5$$

$$W^* = B_d^* + eB_f^* + M^* \qquad 3.6$$

Solving for e, we have:

$$e = \frac{W^* - B_d^* - M^*}{B_f^*} \qquad 3.7$$

The above equation 3.7 implies that exchange rate positively is related to real wealth, but inversely related to real money supply and real values of domestic and foreign bonds. In short, exchange rate is a function of wealth, domestic bonds, foreign bonds and money supply as shown in the equation below:

$$e=f(w^*,\ B_d^*, B_f^*, M^*) \quad 3.8$$

Portfolio balance approach is usually discussed based on three market setups: money market, domestic bond market, foreign bond market.

Let us assume that home currency depreciates by 20 per cent. As a result the value of the foreign asset would increase by 20 per cent. The domino effect keeps operating in the form of increasing the total wealth and expanding the demand for all other assets (including money). The reverse if often the case, or put differently, increase in the real money supply leads to depreciation of the home currency. This simply explains how the activities of money market plays a role in determine the exchange rate.

In the domestic bond market, the 20 per cent depreciation of the home currency results in high demand for the domestic bonds. This in turn causes domestic interest rate to fall. The combination of the exchange rate and the interest rate will set the markets for domestic and foreign bonds at equilibrium. However supplying more domestic bonds means raising the domestic interest rate in order to attract agents to buy the bonds. This would put pressure on the domestic currency as it is the means of buying the bonds. As a result the home currency will appreciate.

If the agents decide to buy more foreign bonds because its interest rate is higher than that of domestic bonds, the home currency would depreciate due to the fact that they need foreign currency for the purchase of the foreign bonds.

3.3.3 The Balance of Payment (BOP) Model

This model explains the determination of exchange rate in terms of balance of payment. The balance of payment is the systematic record of all the international economic transactions of a given country, during a given period time, usually one year. The categories of these transactions include the current account, the capital account and financial account according to IMF classification. The current account records the flow (both direction) of goods, services and transfers. The capital account takes care of the flow of the portfolio and direct investments. Financial account deals with the records of foreign exchange reserves.

The above mentioned categories could show a surplus (positive balance) of a deficit (negative balance), but the overall balance of payments should be zero theoretically.

The postulation of this model is that countries adjust the exchange rate of their currencies in order to achieve current account balance. However, effectiveness of the exchange rate manipulation depends on the sensitiveness of imports and exports to price.

Alfred Marshall and Abba P. Lerner came up with technical reason why devaluing domestic currency may not lead to immediate improvement of trade balance. The technical reason is known as **Marshall-Lerner Condition**, which states that the absolute values of the price elasticity of imports and exports must exceed 1 for devaluation to have a positive effect on trade balance.

Mathematically:

$$|N_x| + |N_m| > 1 \qquad 3.9$$

Where; N_x stands for absolute value of elasticity of export, and

N_m denotes absolute value of elasticity of import

Another form of exchange rate-trade balance relationship is explained in terms of **J-curve**, pioneered by Magee in 1973 (Zorlubas C., 2011). J-curve refers to the *J-like* trend of trade balance in response to a devaluation of currency. Devaluation implies the course of action taken by the monetary authority to deliberately increase the amount of home currency needed to buy one unit of foreign currency. Based on this mechanism, in short run, currency devaluation can initially exacerbate the current account balance as the traders take time to adjust to the new exchange rate. However, the balance of payment improves in the long run after the traders adjust to the new exchange rate. The shape of the trend gives an inverted J-curve.

3.3.4 Interest Rate Parity Model

Interest Rate Parity (IPR) model analyses the relationship between the spot and future rates of currencies with interest rate on domestic and foreign bonds. The model explains the behaviour of exchange rate, inflaltion and interest rate in the two economies. This model is further classified into two: Covered Interest Rate Parity (CIRP) and Uncovered Interest Rate Parity (UCIRP).

Covered Interest Rate Parity model argues that exchange rate forward premiums offset interest rate differentials between home and foreign economies. Put differently, the return from depositing Naira in Nigeria shoud be equivalent to the return from saving dollars in United States of America. Mathematically, the covered interest rate parity condition is expressed below:

$$1+i_t=(1+i_t^*)S_{t+1}/S_t \quad 3.10$$

Or

$$1+i_t/1+i_t^*=S_{t+1}/S_t \quad 3.11$$

Where i_t is the home interest rate, i_t^* is the foreign interest rate, S_{t+1} is the forward rate and S_t is the spot rate.

Uncovered Interest Rate model, on the other hand, argues that expected increase (decrease) in the value of a currency is offset by lower (higher) rate of interest. Expectation plays an important role in this model. Replacing forward exchange rate in equation 3.11 with expected exchange rate, the Uncovered Interest Rate Parity can be expressed below:

$$1+i_t/1+i_t^*=E(S_{t+1}/S_t) \quad 3.12$$

Where E stands for Expected, i_t is the home interest rate, i_t^* is the foreign interest rate, S_{t+1} is the forward rate and S_t is the spot rate.

3.3.5 Fleming-Mundell Model

Robert Mundell and Marcus Fleming developed a model of exchange rate that explains the short run relationship between nominal exvhange rate, interest rate and output.The model is also called the IS-LM-BoP model. Furthermore, this model is extends the traditional IS-LM Model and it is applicable in an open economy. The model explains the behaviour of exchange rate based on three components: IS Curve, LM Curve and Balance of Payment components.

The Mundell–Fleming model argues that no economy can simultaneously have a fixed exchange rate, independent monetary policy and free capital movement. This principle is referred to as “impossible trinity”.

The model portrays that there exists a correlation between the level of exchange rate and monetary supply in the long run. The model also implies that devaluation may result in further devaluation unless inflation, fiscal discipline and balance of payment are well coordinated.

3.3.6 Balassa-Samuelson Model

For the fact that Fleming-Mundell model lacks micro-foundation, Balassa-Samuelson was developed to explain the behaviour of exchange rate from the viewpoints of both producer and consumer.

To illustrate the standard version of the Balassa-Sasmuelson model, let us assume a single-factor aggregate production function for both domestic and foreign economies (see Kanamori T. and Zhao Z, 2006). For simplicity, let the production function take the following forms:

$$Q_T = C_T L_T \quad 3.13$$

$$Q_N = C_N L_N \quad 3.14$$

$$Q_T^* = C_T^* L_T^* \quad 3.15$$

$$Q_T^* = C_T^* L_T^* \quad 3.16$$

$$Q_N^* = C_N^* L_N^* \quad 3.17$$

where Q is the home production, L is the home labour force, Q* is the foreign production, L* is the foreign labour force and C is a constant describing technology. Subscript T stands for tradable goods, and subscript N for non-tradable goods. The only difference between home and foreign production is the magnitude of technological parameter, C. Some of the assumptions of this model include the existence of PPP for tradable goods, perfect mobility of labor within an individual economy.

The relative price vis-à-vis the outside world is

$$\frac{P}{P*} = \left(\frac{GDP_{nom}}{GDP_{nom}^*}\right)^{1-\gamma} \left(\frac{C_N^*}{C_N}\right)^{1-\gamma} \quad 3.18$$

Where P and P* stand for home and foreign price, γ is the share of tradable goods in total output. The formula states that the relative price is determined by relative GDP and the relative technological level or productivity in nontradable sector of the two

economies (Kanamori T. and Zhao Z, 2006). This model argues that if home nominal GDP growth is higher than that of abroad, real exchange rate appreciates. Holding economic growth rate constant, higher productivity of nontradables in the home country than the foreign country will lead to depreciation of the real exchange rate (Kanamori T. and Zhao Z, 2006).

3.3.7 Monetary Model:

This is one of the oldest models of exchange rate determination. It is built on two basic pillars: Purchasing Power Parity (or law of one price), supply curve and simple demand for money curve. According to this model, the rate of exchange between two or more currencies is determined by the interaction of demand and supply of the currencies involved. In other words, exchange rate is established by the stock of money of each currency and willingness of economic agents (individuals, firms and government) to hold these stocks.

As mentioned earlier, Purchasing Power Parity (PPP) and Quantity Theory of Money (QTM) have been employed to explain this model. The former refers to "the rate at which the currency of one country would have to be converted into that of another country to buy the same amount of goods and services in each country" (IMF, 2002). The latter on the other hand states that there is a positive correlation between the quantity of money and general price level of goods and services.

Based on QTM postulates, the following equation holds:

$$MV=PY \qquad 3.2$$

Where M stands for money supply/demand

V means velocity of circulation

P signifies average price level, and

Y is the GDP.

Finally, it can be concluded that increase in the stock of money results in inflation, which in turn causes the value of money (or purchasing power) to fall, and hence the value of the domestic currency falls.

The monetary models of exchange rate are of two types: the Flexible Price Monetary Model (FPMM) and the Sticky Price Monetary Model (SPMM). The former is developed by Frankel (1978) and Hodrick (1978) and the latter by Dornbusch (1976) and Frankel (1979) (see Civcir I, 2004). While, the FPMM assumes that PPP holds continuously, SPMM casts doubts about the existence of such an assumption.

Flexible Price Monetary Model assumes that an increase in the domestic real income can play a vital role in creating an excess demand for the home currency. Moreover, agents now have the advantage of increasing their real money balances through decreasing their expenditures. The result of the agents' actions is a fall in the prices of goods and services. Given the fact that PPP holds continuously, appreciation of the home currency helps in restoring the equilibrium.

The sticky-price monetary model is based on the assumption that "jump variables" such as interest rates and exchange rates compensate for stickiness of the price of goods and services. Since the prices of goods and services are sticky in the short run, a fall in the nominal domestic money supply means fall in the real money supply, and interest rates consequently will rise. The rise in domestic interest rates causes not only capital inflow but also an appreciation of the home currency (Neely C.J and Sarno L, 2002). In the long run, the prices of goods and services fall in response to the fall in the real money supply which results from high domestic interest rate. In other words the exchange rate will gradually move towards the long run PPP.

One important point to note is that FPMM and SPMM offer exactly the same fundamental explanation for the exchange rate in the long run. This is because the reduced equation of SPMM nests the FPMM, and in the long run the former reduces to the latter (for details, see Civcir I, 2004).

3.4 Previous Studies

Ever since the adoption of US dollar floating exchange rate regime in 1973, there has been a plethora of studies that seek to establish the relationship between the changes in exchange rate and trade balance. However, their findings are diverse as there is no unanimous view about the effect of exchange rate volatility on trade flows. The diversity of the outcomes is attributable to the difference in the estimation technique adopted (OLS, VAR, GARCH, ECM), data frequency (yearly, quarterly, monthly),

length of time (decade, century), data series (time series or panel data), data measurement (nominal or real), and the development level of country of study (developed or developing).

The category of trade data employed in empirical studies plays an important role in shaping the outcomes of the studies. In order to investigate the link between exchange rate volatility and trade, some authors employ aggregate or multilateral trade data, while prefer bilateral trade data or sectoral trade data, in some cases. However, there is no consensus as to which category of data should be used given the fact that the results are mixed in any of the studies: some studies produce negative results, while others find negative result or even no effect at all.

Exchange rate-trade relationship has been explained in two ways: *partial equilibrium approach* and *general equilibrium approach.* Partial Equilibrium Approach considers exchange rate as the sole determinant of trade (see for example Cote, 1994, and Polodoo, 2013). The assumption is that other factors such as transaction costs, distance, market structure and production pattern affect the exchange rate, but trade is only influenced by the exchange rate. This approach has witnessed many criticisms from Clarke et al (2004) and Sercu and Uppal (1995) based on the fact that it ignores the dynamic nature of the linkage between exchange rate volatility and trade (see Polodoo, 2013). In short, this approach ignores the role macroeconomic variables play in determining the trade. The assumption that demand and cash flow equations are given is also vehemently criticised.

In order to avoid the limitations of Partial Equilibrium Approach, the best option is to consider using General equilibrium approach in explaining the effect of exchange rate volatility on trade. This approach explains the impact of exchange rate volatility on trade along with other probable factors that can exert effects on trade. In other words, this approach allows for the endogeneity of exchange rate. Most of the studies on exchange rate-trade relationship consider exchange rate as an exogenous variable and ignore the influence of trade on the exchange rate. However General Equilibrium approach endogenises the exchange rate in order to have a better explanation of the impact of exchange rate on trade.

Polodoo V. et al (2013) study the effect of exchange rate volatility on agricultural and manufacturing trade flows of Mauritius using yearly data spanning 1980-2011. Utilising EGARCH and VAR econometric models, they found that exchange rate volatility does not have any effect on real agricultural and manufacturing export and imports.

Another study on exchange rate uncertainty and export performance in Egypt using optimal GARCH was conducted by Bouoiyour J. and Selmi R (2013). They figure out that the effect of exchange rate volatility on export hinges on the frequency-to-frequency variation. In other words, the higher the frequency of variation, the lower the effect of exchange rate volatility on exports and vice versa.

Zorlubas C (2011) asserts that exchange rate volatility has strong positive impact on the trade balance of Norway. His study employs error correction model (ECM) and covers the period of 1990: I to 2009: IV

Bala D.A and Asemota J.O (2013), based on monthly data series from 1985:1 to 2011:7 for Naira/dollar, 2004:1 to 2011:7 for naira/British pounds and Naira/Euro rates, confirm the existence of exchange rate volatility in Nigeria. They employed variants of GARCH models which include EGARCH, PARCH, IGARCH, CGARCH and GARCH with volatility break.

Using Engle-Granger residual-based co-integrating technique on quarterly panel data from 1980 to 2005 on six countries, Ozturk I and Kalyoncu H (2009) investigates the impact of exchange rate volatility on the trade flows. The outcomes show a significant negative effect on increased exchange rate volatility on trade for Pakistan, Poland, South Africa and South Korea In the long run. However, they found a long run positive impact for Hungary and Turkey

Shehu A.A (2008) examines the impact of foreign exchange volatility on the changes of nominal SITC[4] import on Nigeria based on the three foreign exchange market structures (SFEM, AFEM and IFEM). He uses annual time series data covering 1987 to 2008; 1987 to 1994 for SFEM, 1995 to 1999 for AFEM, and 2000to 2008 for IFEM. In order to estimate the relationship he employs simple Ordinary Least Square (OLS). He finds

[4] SITC stands for Standard International Trade Classification

no significance relationship between AFEM Naira/dollar exchange rates and the SITC import. However the study finds highly negative and moderately positive significant relationship between the two variables under IFEM and SFEM respectively.

Chowdhury A.R (1993) finds a significant negative impact of exchange rate variability on the trade flows of the G-7 countries based on a multivariate ECM estimation technique. The study employs quarterly real data for the sample period of 1973 to 1990.

Oloba O et al (2013) confirm the existence of volatility of Naira/dollar exchange rate in Nigeria. The econometric model EGARCH is employed on quarterly data from 1986:1 to 2009:4.

In an effort to determine the link between exchange rate volatility and real international trade flows, Ozkan N et al (2013) use a monthly bilateral data set of 13 countries from 1980 to 1998. Their findings reveal a nonlinear effect of exchange volatility on trade flows. Furthermore, trade partner's volatility of economic activity influences the outcome.

With a view to determining the long run link between exchange rate volatility and export growth, Nishet M and Aqeel A (2006) use a multivariate co-integration and ECM techniques on quarterly data spanning 1982:1 to 2000:4. The outcome of their study reveals that there exists an inverse relationship between exchange rate volatility and real export of Pakistan.

McKenzie (1998) utilises ARCH and GARCH models in order to analyse the effect of exchange rate variability on Australian trade flows. The study employs nominal value quarterly data over the period of 1963:3 to 1995:4, amounting to 106 observations. The results, based on aggregate import and export data, show that imports are affected in a negative fashion, but export in a positive fashion.

By using Johansen co-integration test, ARCH and GARCH, Asogwa F.O and Ngene A.N (2012) establish a significantly negative relationship between exchange rate and Nigeria's trade flows. The study employs trade data between Nigeria and US for the sample period of 1980 to 2008

Rahmetsyah T et'al (2012) test the impact of real exchange rate volatility on the Thailand's imports and exports with Japan and the U.S. Sample bilateral data from 1970

to first quarter of 1997 have been estimated by EGARCH, and the empirical findings have shown that increased exchange rate volatility has adverse consequences on both imports and exports.

Hayakawa K and Kimura F (2009) determine the relationship between the exchange rate volatility and international trade in East Asia by using OLS. The study includes monthly bilateral data among 60 countries from 1992 to 2005. The outcome emanating from their study indicates that exchange rate volatility has a negative impact on the trade flows among these countries.

With the help of EGARCH, Sekantsi L examines the link between real exchange rate volatility and South Africa's export to the U.S over the range of January 1995 to February 2007. He establishes a piece of evidence that the variability of the real exchange rate exerts a statistically significant negative effect on the export of South Africa to the U.S.

Vergil H (2002) investigates how the variability of real exchange rate influences the flows of Turkey's real export to the US and other three major trade partners in the EU. Co-integration and ECM techniques have been employed on monthly bilateral data for the period of 1990:1 to 2000:12. The results obtained from this study provide proof that real exchange rate volatility leads to a significant negative impact on Turkey's real exports.

Baak S (2004) employs annual real exchange rate and export data for the period of 1980 to 2002. His investigation using OLS reveals that there exists a significant negative impact of exchange rate volatility on the volume of exports among 14 Asia Pacific countries.

Table 3.1 is a summary of previous studies starting with those on Nigeria, and subsequently arranged based on the econometric techniques adopted. It is clear from the table that using the similar or the same econometric techniques does not guarantee arriving at the same findings.

Table 3.1 Summary of Literature Survey

STUDY	COUNTRY /REGION	SAMPLE	ECONOMETRIC TECHNIQUE	FINDINGS
Bala and Asemota(2013)	Nigeria	1985-2011M	Variants of GARCH	Existence of volatility
Oloba et al (2013)	Nigeria	1986-2009Q	EGARCH	Existence of volatility
Shehu AA (2008)	Nigeria	1987-2008A	OLS	Not significant, mixed effects on imports
Asogwa and Ngene (2012)	Nigeria	1980-2008A	Co-integration, ARCH, GARCH	Significant negative effect on trade flows
Hayakawa and Kimura (2009)	East Asia	1992-2005M	OLS	Negative effect on trade flows
Baak (2004)	Asia Pacific countries	1980-2002A	OLS	Significant negative effect on exports
Bouoiyour and Selmi (2013)	Egypt		Optimal GARCH	Negative effect that increases with frequency of volatility
McKenzie (1998)	Australia	1963-1995Q	ARCH, GARCH	Negative effect on import and positive on export
Polodoo et al (2013)	Mauritius	1980-2011A	VAR and EGARCH	No effect
Rahmetsyah et al (2012)	Thailand	1970-1997Q	EGARCH	Negative on both import and export
Sekantsi	South Africa	1995-2007M	EGARCH	Negative effect
Ozturk and Kalyoncu (2009)	Six countries	1980-2005Q	Co-integration	Negative effect for 4 countries, and positive for the other two.
Vergil (2002)	Turkey	1990-2000M	Co-integration, ECM	Significant negative effect on real export

Nishat and Aqeel (2006)	Pakistan	1982-2000Q	Multivariate co-integration, ECM	Negative effect on export
Chowdhury (1993)	G-7 countries	1973-1990Q	ECM	Significant negative effect on trade
Zorlubas (2011)	Norway	1990-2009Q	ECM	Significant positive effect on trade
Ozkan et al (2013)	13 countries	1980-1998M	Flexible distributed lag model	Nonlinear effect on trade flows

Source: author's compilation: A, Q and M stands for annual, quarterly and monthly respectively

CHAPTER FOUR

METHODOLOGY AND DATA ANALYSIS

4.1 Method of Data Collection

The study will employ time series data estimation technique, from 1980 to 2012, to empirically examine the impacts of exchange rate volatility on Nigeria's trade. The choice of the sample period and the data frequency is to ensure availability of the data.The data for each of the variables were obtained from secondary source: the World Bank statistical database (http://databank.worldbank.org) ; International Financial Statistics (IFS) database (http://elibrary-data.imf.org/FindDataReports.aspx)[5]; statistics section of the Central Bank of Nigeria (http://www.cenbank.org/); and National Bureau of Statistics (http://nigerianstat.gov.ng/)

4.2 Method of Data Analysis

This study investigates long-run and short-run relationships between Naira/dollar exchange rate volatility and Nigeria's trade balance by using ARDL approach and equilibrium correction mechanism (ECM). Vita G.D and Abbott A (2004), Cheong T.T (2008), Arief B and Jayanthakumaran K (2007), are among the authors who employed the same estimation technique in modeling the link between exchange rate volatility and trade in their various studies. The conditional ECM technique is appropriate given the fact it allows testing for cointegration regardless of whether the regressors are individually I(1) or I(0). The statistic underlying the procedure in this technique is the familiar Wald or F-statistic in a generalized Dickey–Fuller type regression used to test the significance of lagged levels of the variables under consideration in a conditional unrestricted equilibrium correction model (ECM). The bounds test is based on the null hypothesis that there exists no long run relationship in levels between the included variables, irrespective of whether the regressors are purely I(0), purely I(1) or mutually cointegrated (Pesaran et al, 2001). In other words, the technique allows for the mixture

[5] http://elibrary-data.imf.org/FindDataReports.aspx?d=33061&e=169393. Subscription required for accessing data.

of I(0) and I(1) variables unlike the Johansen Co-integration Technique, which is applicable if and only if all the variables are of the same order of integration.

All the variables become stationary at the first difference, except the "volatility measure" which is stationary at levels. Technically, all the variables are I(1), except for volatility variable which is I(0). Among the advantages of ECM over other estimation techniques is that it includes not only the short-run information, but also the long-run dynamics.

To ensure the suitability of using the data series for conditional ECM, empirical tests of unit root and ARDL approach to co-integration are employed. Augmented Dickey-fuller (ADF) and its counterpart Phillips-Perron (PP) are employed to determine the order of integration of the series. The author manually determined the optimal lag length in ADF test, and the optimal bandwidth size in PP test. Both the two tests reveal that, at 5 per cent significance level, the time series data are integrated of order one, only volatility variable is integrated of order 0. The mixture of only I(1) and I(0) variables makes ARDL Approach to Co-Integration suitable.

Econometric views (Eviews 8), Microfit 4.1 and Microsoft Excel 2010 are the computer packages used for data processing in this study.

4.3 Model Specification

In order to investigate the impact of exchange rate volatility on trade balance in Nigeria, it is pertinent to note that there are several factors other than exchange rate volatility which exerts influence on imports and exports and that these factors are taken into account in this study in order to reflect the existing economic theory. Various types of trade models have been employed as discussed in the empirical literature; import equations, export equations, and trade balance equations. The import and export equations will be employed in this study.

In the field of International Economy, many researchers, for example McKenzie (1998), Ozturk and Kalyoncu (2009) and Chowdhury (1993), used the model for empirical study that provides a standard long-run relationship among real exports, exchange rate volatility, the level of real activity, and competitiveness to examine the exchange rate volatility-trade relationship. Models in this study differ from other models in terms of

using monthly real exchange rate to generate the volatility measure as an explanatory variable to examine the volatility-trade relationship. The models are given below:

$$\ln X_t^o = \beta_0 + \beta_1 \ln Y^f_t + \beta_2 \ln P_t + \beta_3 \ln REER_t + \beta_4 \ln V + U_t \quad 4.1$$

$$\ln X^{no}_t = \beta_0 + \beta_1 \ln Y^f_t + \beta_2 \ln P_t + \beta_3 \ln REER_t + \beta_4 \ln V + U_t \quad 4.2$$

$$\ln M_t^o = \beta_0 + \beta_1 \ln Y^d_t + \beta_2 \ln P_t + \beta_3 \ln REER_t + \beta_4 \ln V + U_t \quad 4.3$$

$$lnM^{no}_t = \beta_0 + \beta_1 \ln Y^d_t + \beta_2 \ln P_t + \beta_3 \ln REER_t + \beta_4 \ln V + U_t \quad 4.4$$

Where;

- X^o is the real oil export (nominal oil export/home export price index);
- X^{no} is the real non-oil export (nominal non-oil export/home export price index)
- M^o is the real oil import (nominal oil import/home import price index)
- M^{no} is the non-oil real import (nominal non-oil import/home import price index)
- Y^f is the foreign real income (US real GDP used as a proxy)
- Y^d is the domestic real income (Nigeria's real GDP)
- P is relative prices (home export price index/industrial countries export price index);
- REER is the real effective exchange rate
- V is a measure of exchange rate volatility
- Subscript t signifies time (year)
- ln stands for natural logarithms
- β_1 and β_3 measure the Income elasticity and Price elasticity respectively; and
- U_t is the white noise error term.

4.4 Description of the Variables

After specification of the models, the next important task involves describing the variables and their sources, as well as giving the theoretically expected signs of the coefficients.

4.4.1 Real Oil/Non-Oil Export

This is estimated from the nominal oil export data obtained from the CBN. It involves dividing nominal oil export by export price index. Mathematically,

$$X_t^i = \frac{NX_t^i}{XP_t} \quad 4.5$$

Where:

- X_t^i stands for real oil/non-oil export at time t,
- NX_t^i is the nominal oil/non-oil export at time t,
- XP_t is the export price index at time t; and
- t signifies time (year)

4.4.2 Real Oil/Non-Oil Import

Similar to real export estimation, it involves dividing the nominal oil/non-oil import values by import price index.

$$M_t^i = \frac{NM_t^i}{MP_t} \quad 4.6$$

Where:

- M_t^i is the real oil/non-oil import at time t,
- NM_t^i is the nominal value of oil/non-oil import at time t,
- MP_t stands for import price index at time t,
- t is the time subscript (year)

`4.4.3 Real Income

Income has been widely used as an independent variable by almost all the studies about exchange rate-trade relationships. Income is theoretically expected to be positively related to both oil/non-oil real exports and real imports. This study uses US real GDP to represent foreign income, and Nigeria's real GDP to stand for domestic income. The higher the level of income of a trading partner, the higher demand for domestically produced goods. In other words, an increase in the real GDP of Nigeria's trading partner tends to boost the country's export. The converse is often equally the case. In other words, there exists a positive relationship between real income and trade.

The data for the US real GDP is taken in US dollar from the World Bank database. The real GDP is then multiplied by Naira/dollar exchange rate in order to express the value in Nigerian Naira. To ensure the use of uniform unit, the real GDP is divided by 1,000,000 because all other variables are expressed in ("Naira Million"). The Nigeria's real GDP is obtained from the CBN Statistical Bulletin (section C).

4.4.4 Effective Exchange Rate.

Real effective exchange rate is merely an index of a country's currency vis-à-vis a basket of currencies of its trading partners. Thus it is also known as trade weighted exchange rate. The proportions of trade with a country determine the weight of its currency in the computation of the real effective exchange rate index. Two types of effective exchange rates dominate the literature of exchange rate volatility: Nominal Effective Exchange Rate (NEER) and Real Effective Exchange Rate (REER). Some authors use either NEER or REER, while others like make use of both the measures in their analysis of the effect of exchange rate volatility on trade.

This study uses REER because it takes into account the purchasing power of a country's currency and at the same time reflects the competitiveness of the country's trade. The coefficients of REER measure the price elasticity of trade, and are expected to be positive theoretically. This is because appreciation of REER signifies the weakness or depreciation of the country's currency against the currencies of its trading partners. The depreciation of the country's currency will eventually make export commodities cheaper which will in turn increase demand.

4.4.5 Relative prices

Relative price is used in this study as a proxy for competitiveness. It is the ratio of Nigeria's export price index and US export price index multiplied by 100. Decrease in the export price of a country is expected to bring about increase in the demand for export commodities. Therefore the signs of the coefficients of this variable are theoretically expected to be negative.

Algebraically:

$$P_t = \frac{NXP_t}{UXP_t} \times 100 \qquad 4.7$$

Where:

- P_t is the relative price at time t,
- NXP_t represents Nigeria's export price index; and
- UXP_t siginifies US export price index

4.4.6 Volatility

A large number of models have been developed to measure the exchange rate volatility: implied volatility models, exponentially weighted moving average models, Autoregressive volatility models, Autoregressive Conditionally Heteroscedastic (ARCH) models, Generalised Autoregressive Conditionally Heteroscedastic (GARCH) models and so on (Brooks C, 2008). In addition, some studies employ only one measure while others employ more than one measure.

The volatility measure in this study is computed using Moving sample standard deviation of the growth rate of the monthly real exchange rate data from 1981:1 to 2012:12. The formula for the volatility measure is given by equation 4.8 below:

$$V_t = \left[\frac{1}{m}\sum_{i=1}^{m}(lnQ_{t+i-1} - lnQ_{t+i-2})^2\right]^{\frac{1}{2}} \qquad 4.8$$

Where:

- m is the order of moving average (m=12 is used to estimate the volatility); and
- Q is the monthly real effective exchange rate.

Table 4.1: Variables and Data Sources

Variables	Source(s) of data
Non-Oil Export (NOE)	CBN Statistical Bulletin, section, section D (Excel sheets D 2.1 to D2.1a) http://www.cenbank.org/documents/Statbulletin.asp
Non-Oil Import (NOI)	CBN Statistical Bulletin, section, section D (Excel sheets D 2.1 to D2.1a)
Oil Export (LOE)	CBN Statistical database, section, section D (Excel sheets D 2.1 to D2.1a)
Oil Import (LOI)	CBN Statistical database, section, section D (Excel sheets D 2.1 to D2.1a)
REER	Obtained from World Bank database (2005=100) http://data.worldbank.org
Real GDP (RGDP)	CBN Statistical Bulletin, section, section C
US Real GDP (URGDP)	Obtained in US dollars from World Bank database. Converted to Naira using official exchange rate by the author.
Price (P)	Export price indices for both the US and Nigeria are obtained from Economist Intelligence Unit website http://www.eiu.com
Volatility (V)	Author's computation based on the monthly real exchange rate index (2005=100) generated from International Financial System. http://elibrary-data.imf.org/FindDataReports.aspx?d=33061&e=169393

4.5 Unit Root Test

As mentioned earlier, this study employs ADF and PP unit root test procedures. The two tests are discussed briefly below.

Dickey and Fuller (1979) developed ADF unit root test procedure which includes lagged terms of the dependent variables in order to eliminate autocorrelation. The choice of the number of lags in this study is determined by the lag length necessary to "whiten" the residuals (in each case autocorrelation test on ADF regression is performed to check whether its residuals are autocorrelated or not through LM tests).

The following equations provide the three possible forms of the ADF test:

$$\Delta Y_t = \alpha_0 + \delta Y_{t-1} + \alpha_2 t + \sum_{i=1}^{p} \Delta Y_{t-k} + u_t \quad 4.9$$

$$\Delta Y_t = \alpha_0 + \delta Y_{t-1} + \sum_{i=1}^{p} \Delta Y_{t-k} + u_t \quad 4.10$$

$$\Delta Y_t = \delta Y_{t-1} + \sum_{i=1}^{p} \Delta Y_{t-k} + u_t \quad 4.11$$

Where ΔY_t is the change in the dependent variable, α_0 is a constant term, α_2 is a coefficient of a time trend t, ΔY_{t-k} is the set of lagged explanatory variables, u_t is by assumption a white noise error term and k is the lag length. The difference between the three equations concerns the presence of the deterministic elements α_0 and $\alpha_2 t$.

ADF unit root test involves testing the following hypothesis:

H_0: $\delta = 0$ (Y_t is not stationary or Y_t has a unit root)

H_1: $\delta > 0$ (Y_t is stationary)

Phillips and Perron (1988) developed a generalization of the ADF test procedure to take care of the wrong assumption made by ADF that "the error terms are statistically independent and have a constant variance" (Asteriou D and Hall S.G, 2007). The test regression for the Phillips-Perron test is given below in the form of AR(1) process:

$$\Delta Y_{t-1} = \alpha_0 + \delta Y_{t-1} + \alpha_2 t + e_t \quad 4.12$$

$$\Delta Y_{t-1} = \alpha_0 + \delta Y_{t-1} + e_t \quad 4.13$$

$$\Delta Y_{t-1} = \delta Y_{t-1} + e_t \quad 4.14$$

Where ΔY_{t-1} is the change in the lagged dependent variable, α_0 is a constant term, α_2 is a coefficient of a time trend t, Yt_{t-1} is the first lag of explanatory variable, and u_t is by assumption a white noise error term. The difference between the three regressions again concerns the presence of constant and time trend terms.

Similarly, Phillips-Perron unit root test involves testing the following hypothesis:

H_0: $\delta = 0$ (Y_t is not stationary or Y_t has a unit root)

H_1: $\delta > 0$ (Y_t is stationary)

The unit root test involves estimating the most general model and then answering some set of questions. The procedure is summarised in the following Figure 4.1.

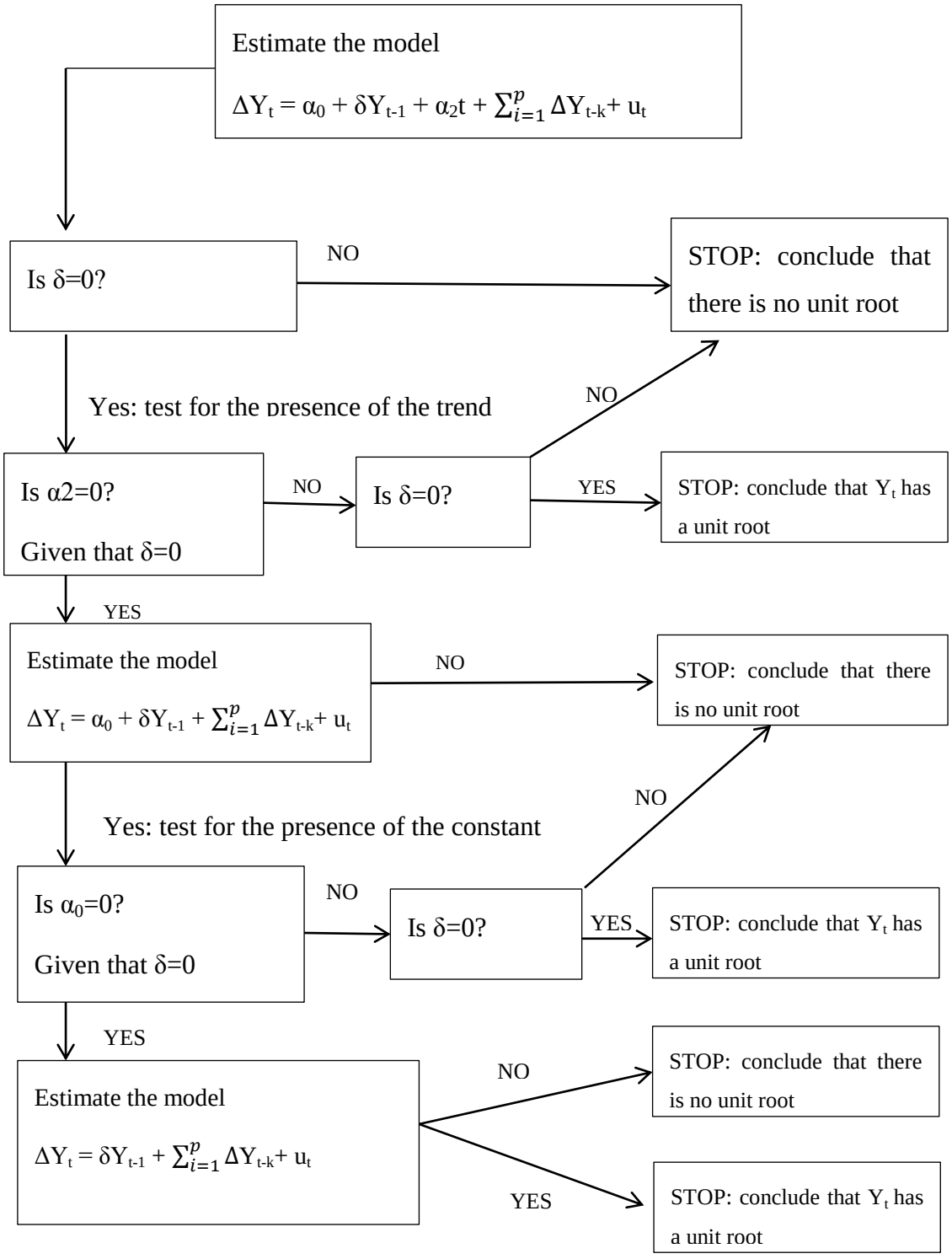

Figure 4.1: Procedure for Testing for Unit Root

Source: Enders (1995)

4.6 ARDL Approach to Cointegration

To investigate the long-run relationship among the variables under consideration, the bounds test for co-integration within ARDL (the autoregressive distributed lag) modeling approach is adopted in this study. Pesaran et al. (2001) developed the model and can be applied regardless of the order of integration of the variables (irrespective of whether regressors are purely I (0), purely I (1) or mutually cointegrated). In simple form, the ARDL modeling approach involves estimating the following conditional error correction models:

$$\Delta Y_t = \alpha_0 + \alpha_2 t + \sum_{i=1}^{n-1} \Delta Y_{t-k} + \sum_{i=0}^{m-1} \gamma \Delta X_{t-k} + \delta_0 Y_{t-1} + \delta_i \mathbf{X}_{t-1} + u_t \qquad 4.15$$

In equation 4.15, Δ is the difference operator, Y_t is the dependent variable, X_t is the independent variable and u_t is serially independent random error term with zero mean. F-test is used for investigating one or more long-run relationships among the variables in the equation. The null hypothesis of no co-integration and the alternative hypothesis of co-integration are given below:

H_0: $\delta_0 = \delta_i = 0$ (no cointegration)

H_0: $\delta_0 \neq \delta_i \neq 0$ (cointegration exists)

In the case of co-integration based on the bounds test, the error correction model (ECM) can be estimated. The ECM is a reparametrisation of the ARDL (Asteriou D and Hall S.G, 2007). Therefore, the most informative way to write the error correction models of co-integration can be specified as follows:

$$\Delta Y_t = \alpha_0 + \alpha_2 t + \sum_{i=1}^{n-1} \Delta Y_{t-k} + \sum_{i=0}^{m-1} \gamma \Delta X_{t-k} - \pi e_{t-1} + \varepsilon_t \qquad 4.16$$

In 4.16, Δ denotes the difference operator, ε_t is serially independent random error with zero mean, and π is the error correction term (also known as the adjustment coefficient) derived from the long-run co-integration model. In fact π tells us how much of the equilibrium error is corrected each period and it is expected to be negative and statistically significant. If π=0, then there is no adjustment and therefore there is no long run relationship.

Based on the above ARDL equation, our trade equations can be transformed as follows:

$$\Delta \ln X_t^o = \alpha_0 + \alpha_2 t + \sum_{i=1}^{n-1} \Delta \ln X_{t-i}^o + \sum_{i=0}^{m-1} \gamma \Delta \ln Y_{t-i}^f + \sum_{i=0}^{m-1} \gamma \Delta \ln P_{t-i} + \sum_{i=0}^{m-1} \gamma \Delta lnREER_{t-i} + \sum_{i=0}^{m-1} \gamma \Delta \ln V_{t-i} + \delta_0 \ln X_{t-1}^o + \delta_1 Y_{t-1}^f + \delta_2 lnP_{t-1} + \delta_3 lnREER_{t-1} + \delta_4 \ln V_{t-1} + u_t \quad 4.17$$

$$\Delta \ln X_t^{no} = \alpha_0 + \alpha_2 t + \sum_{i=1}^{n-1} \Delta \ln X_{t-i}^{no} + \sum_{i=0}^{m-1} \gamma \Delta \ln Y_{t-i}^f + \sum_{i=0}^{m-1} \gamma \Delta \ln P_{t-i} + \sum_{i=0}^{m-1} \gamma \Delta lnREER_{t-i} + \sum_{i=0}^{m-1} \gamma \Delta \ln V_{t-i} + \delta_0 \ln X_{t-1}^{no} + \delta_1 Y_{t-1}^f + \delta_2 lnP_{t-1} + \delta_3 lnREER_{t-1} + \delta_4 \ln V_{t-1} + u_t \quad 4.18$$

$$\Delta \ln M_t^o = \alpha_0 + \alpha_2 t + \sum_{i=1}^{n-1} \Delta \ln M_{t-i}^o + \sum_{i=0}^{m-1} \gamma \Delta \ln Y_{t-i}^d + \sum_{i=0}^{m-1} \gamma \Delta \ln P_{t-i} + \sum_{i=0}^{m-1} \gamma \Delta lnREER_{t-i} + \sum_{i=0}^{m-1} \gamma \Delta \ln V_{t-i} + \delta_0 \ln M_{t-1}^o + \delta_1 Y_{t-1}^d + \delta_2 lnP_{t-1} + \delta_3 lnREER_{t-1} + \delta_4 \ln V_{t-1} + u_t \quad 4.19$$

$$\Delta \ln M_t^{no} = \alpha_0 + \alpha_2 t + \sum_{i=1}^{n-1} \Delta \ln M_{t-i}^{no} + \sum_{i=0}^{m-1} \gamma \Delta \ln Y_{t-i}^d + \sum_{i=0}^{m-1} \gamma \Delta \ln P_{t-i} + \sum_{i=0}^{m-1} \gamma \Delta lnREER_{t-i} + \sum_{i=0}^{m-1} \gamma \Delta \ln V_{t-i} + \delta_0 \ln M_{t-1}^{no} + \delta_1 Y_{t-1}^d + \delta_2 lnP_{t-1} + \delta_3 lnREER_{t-1} + \delta_4 \ln V_{t-1} + u_t \quad 4.20$$

4.7 Empirical Results

This section covers the initial results of analysing the relationship of exchange rate volatility on trade equations modeled above. The sample period runs from 1981 to 2012. The use of lagged explanatory variables in the conditional ECM and the construction of the volatility measure led to loss of some observations at the beginning of the sample period. The estimation period is 1983 to 2012.

For each trade equation a conditional ECM is developed and bounds test conducted using Wald test. However, a precondition for developing such a model is to test the long run relationship among the variables included in each of the four equations. The Autoregressive Distributed Lag Modelling Approach to Co-integration Analysis developed in Pesaran et al (1998) and Pesaran et al (2001) is employed to test the long-run relationship in all the four equations.

Implementation of the ARDL approach to co-integration requires the determination of an optimal lag length for the VAR model for each equation and the orders of integration of the variables entering each of the VAR models to ensure that none of the variables is I(2). The augmented Dickey-Fuller (ADF) test and Phillips-Perron (PP) test are used determine the order of integration of the individual time series. Regardless of the equation considered, the result shows that all the variables included in this study are integrated of order one, except the volatility measure which is integrated of order zero.

According to Vita G.D and Abbott A. (2004), standard trade equations are characterised by a mixture of I(1) and I(0) variables. Real effective exchange rate, real income and relative price are usually found to be I(1), while the volatility measure is often found to be I(0).

4.7.1 Unit Root Test Results

In order to have a reliable and valid result concerning the relationship between exchange rate volatility and trade, a stationarity testing using ADF and PP unit root testing was carried out. This is done so as to check make sure that all the variables are either I(1) or I(0). In other words, the aim of the unit root test is to ensure variable of greater order of integration than one is not included in the trade equations.

Table 4.2: ADF Unit Root Test Results

Unit root tests at logarithmic levels						
VARIABLE	DETERMINISTIC TREND	K	TEST VALUE	PROB**	5% CRITICAL VALUE	DECISION
LNOE	CONSTANT	1	-1.916515	0.3206	-2.963972	I(1)
LNOI	NONE	1	2.050931	0.9884	-1.952473	I(1)
LOE	CONSTANT	1	-1.495709	0.5220	-2.963972	I(1)
LOI	CONSTANT	1	-1.816927	0.3654	-2.963972	I(1)
LREER	CONSTANT	1	-2.330767	0.1694	-2.963972	I(1)
LRGDP	NONE	1	3.077061	0.9990	-1.952473	I(1)
LURGDP	CONSTANT	1	-2.026314	0.2746	-2.963972	I(1)
LV	CONSTANT AND TREND	1	-3.753105	0.0339	-3.568379	I(0)
LP	CONSTANT	1	-2.749142	0.0778	-2.963972	I(1)
Unit root test at first differences						
VARIABLE	DETERMINISTIC TREND	k	TEST VALUE	PROB**	5% CRITICAL VALUE	DECISION
LNOE	CONSTANT	2	-3.687866	0.0100	-2.971853	I(0)
LNOI	CONSTANT	2	-3.866434	0.0065	-2.971853	I(0)
LOE	CONSTANT	1	-4.232942	0.0026	-2.971853	I(0)
LOI	CONSTANT	1	-4.879696	0.0005	-2.967767	I(0)
LREER	NONE	1	-3.807538	0.0073	-2.967767	I(0)
LRGDP	CONSTANT	0	-3.782355	0.0076	-2.967767	I(0)
LURGDP	CONSTANT	1	-3.433094	0.0179	-2.967767	I(0)
LV	-	-	-	-	-	-
LP	NONE	3	-3.515476	0.0011	-1.953381	I(0)

Table 4.3: Phillips-Perron Unit Root Test Results

Unit root tests at logarithmic levels						
VARIABLE	DETERMINISTIC TREND	k	TEST VALUE	PROB**	5% CRITICAL VALUE	DECISON
LNOE	CONSTANT	1	-1.105580	0.7009	-2.960411	I(1)
LNOI	NONE	1	2.156647	0.9910	-1.952066	I(1)
LOE	NONE	1	2.158873	0.9910	-1.952066	I(1)
LOI	CONSTANT	1	-1.653859	0.4440	-2.960411	I(1)
LREER	NONE	1	-0.790257	0.3656	-1.952066	I(1)
LRGDP	CONSTANT & TREND	1	-1.716234	0.7198	-3.562882	I(1)
LURGDP	CONSTANT	1	-1.853189	0.3490	-2.960411	I(1)
LV	CONSTANT	1	-4.006465	0.0042	-2.960411	I(0)
LP	CONSTANT	1	-2.387051	0.1534	-2.960411	I(1)
Unit root test at first differences						
VARIABLE	DETERMINISTIC TREND	K	TEST VALUE	PROB**	5% CRITICAL VALUE	DECISON
LNOE	CONSTANT	1	-5.510030	0.0001	-2.963972	I(0)
LNOI	CONSTANT	1	-5.961308	0.0000	-2.963972	I(0)
LOE	CONSTANT	1	-6.096878	0.0000	-2.963972	I(0)
LOI	CONSTANT	1	-5.043673	0.0003	-2.963972	I(0)
LREER	NONE	1	-4.228691	0.0001	-1.952473	I(0)
LRGDP	CONSTANT	0	-3.782355	0.0076	-2.963972	I(0)
LURGDP	CONSTANT	1	-4.675867	0.0008	-2.963972	I(0)
LV	-	-	-	-	--	-
LP	NONE		-4.888242	0.0000	-1.952473	I(0)

Note: the selection of lag length k is "user-defined". I(1) signifies the rejection of the null hypothesis that the variable is non-stationary at the 5% significance level . I(0) means do not reject the null hypothesis, and ** represents MacKinnon (1996) one-sided p-values.

Our unit root test results obviously reveal that the variables are a mixture of I(1) and I(0), none is I(2). This makes it suitable for the ARDL approach to cointegration.

4.7.2 Bounds Test Results

After confirming the absence of I(2) in all the variables used in the trade models, the next important task is to check whether there exists a long run relationship among the variables in each of the trade equations. To achieve that, we estimate each of the equations using ordinary least squares (OLS) technique and then conduct a Wald test in Eviews 8. The F-values obtained from this test are then compared with the lower and upper Critical value Bounds for the F-statistic found in Pesaran et al (1999).

Table 4.4: F-Statistic of Cointegration Relationship

Equation	ARDL Order[6]	F	Deterministic Trend	Critical value Bounds for the F-Statistic	
				I(0)	I(1)
Oil Export	4, 2, 2, 2, 2	3.764733**	Constant	2.45	3.52
Non-Oil Export	2, 2, 2, 2, 2	2.325314	Constant	2.86	4.01
Oil Import	3, 2, 2, 2, 2	2.320291	Constant	2.86	4.01
Non-Oil Import	2 ,2, 2, 2, 2	6.251410*	Constant	2.86	4.01

Note: * and ** denote "rejection" of the null hypothesis that there is no long run relationship at 5 per cent and 10 per cent level of significane respectively. The F-value is obtained from Wald test results in Eviews 8, and the critical value bounds are obtained from Pesaran et al (1999)

Table 4.4 reveals that the F values of oil export and non-oil import equations are greater than the I(1) critical value. Therefore, oil export and non-oil import have long run relationship with other regressors in their individual equations. However, the F values for oil import and non-oil export equations are less than the I(0) critical value, meaning that no cointegration among the variables in each of the two equations. Hence, the ECM for oil export and non-oil import can be estimated. Non-oil export and oil import will be analysed using short run models. The decision whether to include the deterministic term or not is made after plotting the graphs of each of the dependent variables.

4.7.3 Long Run and ECM Models

Based on our findings about the existence of long run relationship in two of the trade equations, we begin by presenting the long run and univariate ECM models of the two equations and then bring the short run estimates of all the four trade equations in the next section.

[6] The ARDL order is determined by the author. However the maximum lag length is based on "lag length criteria" in Eviews 8.

Table 4.5: The Long Run Model Of Oil Export Equation: ARDL (4, 2, 2, 2, 2): Dependent variable is LOE

Regressor	Coefficient	Standard Error	T-Ratio	[Prob]
LURGDP	1.0152	.11931	8.5083	[.000]
LP	-.53123	.70331	-.75533	[.466]
LREER	-.79300	.51186	-1.5492	[.150]
LV	-.68060	.50997	-1.3346	[.209]
CONSTANT	-6.8159	5.6886	-1.1982	[.256]

The above Table 4.5 contains the long run coefficients of oil export equation. Based on the probabilities, LURGDP is statistically significant, while LP, LREER and LV appear to be statistically insignificant at 5 per cent level. Unlike the coefficient of LREER, the coefficients of LURGDP and LP have the expected theoretical signs. However, LV appears to have negative sign, which means that exchange rate volatility exerts negative effect on the Nigeria's real oil export in the long run. One possible explanation as to why the coefficient of REER deviates from the theoretical underpinning is that real oil is a necessity good, as the industrialised countries need it as an input. In other words, real oil export is independent of changes in REER.

One per cent increase in US real income brings about 1.0152 per cent increase in real oil export in the long run. Similarly, one per cent decrease in relative price, REER and exchange rate volatility leads to decrease in real oil export by 0.53123, 0.79300 and 0.68060 per cent respectively in the long run.

Table 4.6: The Long Run Model of Non-Oil Import: ARDL (2, 2, 2, 2, 2): Dependent Variable is LNOI

Regressor	Coefficient	Standard Error	T-Ratio	[Prob]
LRGDP	4.1627	1.2020	3.4631	[.003]
LP	1.2597	1.3670	.92152	[.371]
LREER	-4.2230	1.6596	-2.5447	[.022]
LV	.26657	.61256	.43518	[.670]
CONSTANT	-28.4838	17.1372	-1.6621	[.117]

Table 4.6 shows that the long run estimates of the real non-oil import appear to have the expected theoretical signs, even though the coefficients of LP and LV (as in the real oil export equation) are not statistically significant. The coefficients of LREER, LP and LRGDP have expected theoretical signs. In contrast to real oil export equation, LV is

found to be positively related with the real non-oil import. As stated earlier, coefficient of LV could be either negative or positive.

One per cent increase in REER results in 4.2230 per cent decline in real non-oil import in the long run. However one per cent rise in Nigeria's real income (RGDP), relative price, and exchange rate volatility causes increase in real non-oil import by 4.1627, 1.2597, and 0.26657 per cent respectively.

Table 4.7: Error Correction Representation for Oil Export: ARDL (4, 2, 2, 2, 2): Dependent Variable is dLOE (1985 to 2012)

Regressor	Coefficient	Standard Error	T-Ratio	[Prob]
dLOE1	-.18476	.24642	-.74976	[.465]
dLOE2	-.31537	.16103	-1.9585	[.069]
dLOE3	-.38788	.12037	-3.2225	[.006]
dLURGDP	1.2360	.61128	2.0219	[.061]
LURGDP1	.45843	.61462	.74588	[.467]
dLP	.38097	.48365	.78770	[.443]
dLP1	.37523	.43964	.85349	[.407]
dLREER	-.89287	.31112	-2.8699	[.012]
dLREER1	.32099	.26849	1.1955	[.250]
dLV	-.21217	.099468	-2.1331	[.050]
dLV1	.0080791	.10715	.075398	[.941]
Constant	-3.2779	4.0700	-.80538	[.433]
ecm(-1)	-.48092	.24405	-1.9706	[.068]
R-Squared=0.91713 R-Bar-Squared=0.79660 Serial Correlation*CHSQ(1)=0.040391[0.841] Heteroscedasticity*CHSQ(1)= 0.18167[0.670]				

The error correction regression associated with the real oil export equation is given in table 4.7 above. The error correction coefficient is estimated to be -.48092 with probability of 0.068, which means that it is statistically insignificant at 5 per cent significance level. However if we make decision with 10 per cent level of significance, the error correction term will be large and significant. This means that 48.09 per cent of the adjustment takes place every year. Despite the presence of many insignificant coefficients in this error correction result, the regression fits reasonably well (see Figure 4.2) and shows no presence of autocorrelation or heteroskedasticity (see Table 4.7).

The coefficients of dLURGDP, dLP, dLREER and dLV represent the short run estimates of the oil export equation. Table 4.7 displays that the only statistically significant coefficient from this short run model is LREER. Theoretically, only

LURGDP has the expected sign because significant amount of Nigeria's oil export goes to the United States. The contradiction of LP concerning the expected theoretical signs can be explained by the fact that Nigeria's oil export is not determined by relative price, but rather by the export quota imposed by the oil cartel OPEC (Organization of the Petroleum Exporting Countries). The coefficient of LREER also deviates from the theoretical underpinning: the explanation is that Nigeria depends largely on oil export for its budget; therefore any temporary (short run) decline in REER will induce the country to export more oil in order to meet its budgetary target. The aforementioned argument is based on the fact that a fall in REER implies revaluation of Nigeria's Naira.

As in the long run, exchange rate volatility affects real oil export negatively in the short run. Unlike in the long run model, the coefficient of LV can be significant if we make decision using 10 per cent significance level.

Table 4.8: Error Correction Model for Non-Oil Import: ARDL (2, 2, 2, 2, 2): Dependent Variable is dLNOI (1983 to 2012)

Regressor	Coefficient	Standard Error	T-Ratio	[Prob]
dLNOI1	-.24355	.17223	-1.4141	[.174]
dLRGDP	1.0539	1.1076	.95154	[.353]
dLRGDP1	-3.4778	1.4998	-2.3188	[.032]
dLP	-.15709	.18873	-.83232	[.416]
dLP1	-.47989	.16971	-2.8277	[.011]
dLREER	-1.4618	.20254	-7.2174	[.000]
dLREER1	.48466	.26759	1.8112	[.086]
dLV	.023160	.062313	.37168	[.714]
dLV1	-.16320	.072263	-2.2584	[.036]
Constant	-4.3641	4.0245	-1.0844	[.292]
ecm(-1)	-.15321	.066581	-2.3011	[.033]
R-Squared=0.90912 R-Bar-Squared=0.82429 Serial Correlation*CHSQ(1)=0.90748[0.341] Heteroscedasticity*CHSQ(1)=3.7174[0.054]				

The error correction regression associated with the real oil export equation is given in Table 4.8 above. The error correction coefficient is estimated to be -0.15321 with probability of 0.033, which means it is small but statistically significant. This means that only 15.32 per cent of the adjustment takes place every year. In spite of the fact more than half of the coefficients are insignificant in this error correction specification, the regression result fits reasonably well (see Figure 4.2) and passes the diagnostic tests of autocorrelation and heteroskedasticity (see Table 4.8).

The coefficients of dLRGDP, dLP, dLREER and dLV are the short run estimates of the non-oil import equation. The only coefficient that appears to be statistically significant in Table 4.8 is DLREER. However, all the coefficients, except DLP, have the theoretically expected signs. Exchange rate volatility is positively related with the real non-oil import.

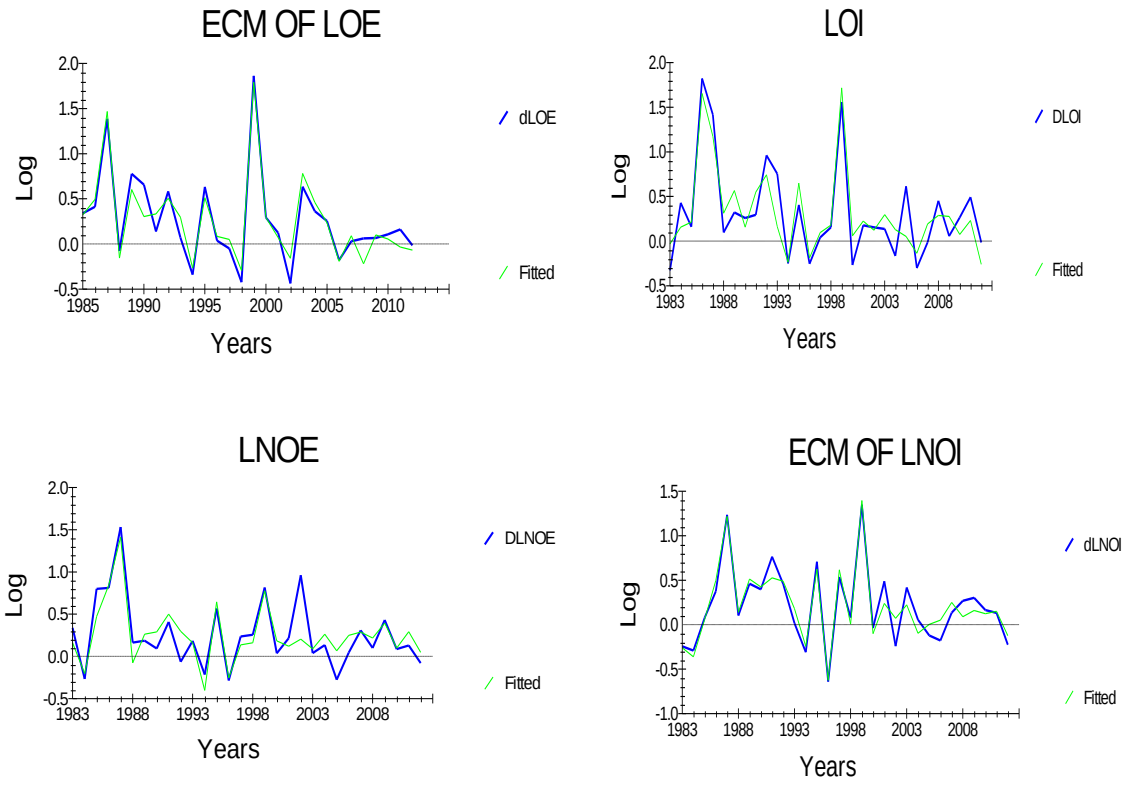

Figure 4.2: Plots of Actual and Fitted Values

4.7.4 Short Run Models

The following are the estimates of the short run models of all the trade equations. The estimates of oil export and non-oil import equations are extracted from Table 4.7 and Table 4.8 respectively. The estimates of oil import and non-oil export are estimated using ordinary least square after taking the first difference of the non-stationary variables in the models.

Table 4.9: The Short Run Model of Non-Oil Export Equation:
Dependent Variable is dLNOE

Regressor	Coefficient	Standard Error	T-Ratio	[Prob]
DLNOE(-1)	-.26862	.19568	-1.3728	[.185]
DLURGDP	-.62825	.53835	-1.1670	[.257]
DLURGDP(-1)	-.15622	.53971	-.28946	[.775]
DLP	-.24140	.41306	-.58442	[.565]
DLP(-1)	-.23089	.37641	-.61340	[.547]
DLREER	-1.2750	.25383	-5.0230	[.000]
DLREER(-1)	-.021265	.35473	-.059946	[.953]
LV	.10938	.099097	1.1038	[.283]
LV(-1)	.028549	.12098	.23598	[.816]
INPT	.89086	.75336	1.1825	[.251]
R-Squared=0.72663 R-Bar-Squared=0.60361 Serial Correlation*CHSQ(1)=1.4517[.228] Heteroscedasticity*CHSQ(1)=0.31914[.572]				

The coefficients of DLURGDP, DLP, DLREER and LVare the short run estimates of the non-oil export equation . In the real non-oil export equation presented in Table 4.9, LREER is the only variable that appears to be significant. In terms of theoretically expected sign, LP is the only coefficient that conforms to theoretical underpinnings. Exchange rate volatility is positively related with real non-oil export; however the impact is not significant. The insignificance of the coefficients has something to do with the fact that the Nigeria's non-oil export is insignificant itself.

Table 4.10: The Short Run Model of Oil Import Equation:
Dependent Variable is dLOI

Regressor	Coefficient	Standard Error	T-Ratio	[Prob]
DLOI(-1)	-.29750	.20869	-1.4255	[.169]
DLRGDP	.012501	1.7093	.0073140	[.994]
DLRGDP(-1)	-.088260	1.6890	-.052256	[.959]
DLP	-.30960	.24138	-1.2826	[.214]
DLP(-1)	-.061381	.23472	-.26151	[.796]
DLREER	-.88262	.27002	-3.2687	[.004]
DLREER(-1)	-.22615	.28146	-.80347	[.431]
LV	.26322	.084613	3.1108	[.006]
LV(-1)	.0023433	.11157	.021003	[.983]
INPT	1.2467	.43556	2.8623	[.010]
R-Squared =0 .78778 R-Bar-Squared=0 .69227 Serial Correlation*CHSQ(1)=1.7316[0.188] Heteroscedasticity*CHSQ(1)=0.42130[0.516]				

The coefficients of DLRGDP, DLP, DLREER and LV are the short run estimates of oil import equation. Based on the short run estimates oil import shown in Table 4.10, we can see that the coefficients of DLREER, LV and Constant are significant. DLRGDP and DLREER have the expected theoretical sign. The coefficient of DLP does not have the expected theoretical sign as it should be positive for import. The reason for the deviation of relative price from theoretical explanation is that oil is a necessity good, so traders take advantage of importing it at lower price so that they can make larger profit.

4.7.5 Marshall-Lerner Condition

In order to investigate whether Marshall-Lerner condition holds, we use the coefficients of LREER to serve as the price elasticity estimates. We consider only the short run models because we can only estimate the short run export and import equations.

Table 4.11: Price Elasticity Estimates of the Trade Equations

Equation	Variable	Coefficient	Absolute sum of coefficients
Oil export	DLEER	-0.89287	1.77549
Oil import	DLEER	-0.88262	
Non-oil export	DLEER	-1.2750	2.7368
Non-oil import	DLEER	-1.4618	

Table 4.11 provides the estimates of the price elasticity of the trade equations. The absolute sum of the elasticities of oil export and non-oil import is 1.77549, and for the non-oil export and non-oil import is 2.7368. The two values confirm the presence of Marshall-Lerner Condition in both oil and non-oil trade in the short run.

4.7.6 Stability test

In order to test for structural break in models, two dummy variables will be employed separately: D86 to test for post-SAP period, and the other D99 to take care of democratic era[7]. None of the trade models show any sign of structural break, either in the short run or long run.

[7] The two dummy variables are introduced into all the models separately, but all their coefficients in each model are statistically insignificant. Hence the results are not worth reporting.

Figure 4.3 and Figure 4.4 depict a family of Plots of Cumulative Sum of Recursive Residuals and Plots of Cumulative Sum of Squares of Recursive Residuals for all the trade equations. The straight lines represent critical bounds at 5 per cent significance level. The two figures further confirm the stability of the trade models as the entire CUSUM test lines fall within the straight lines.

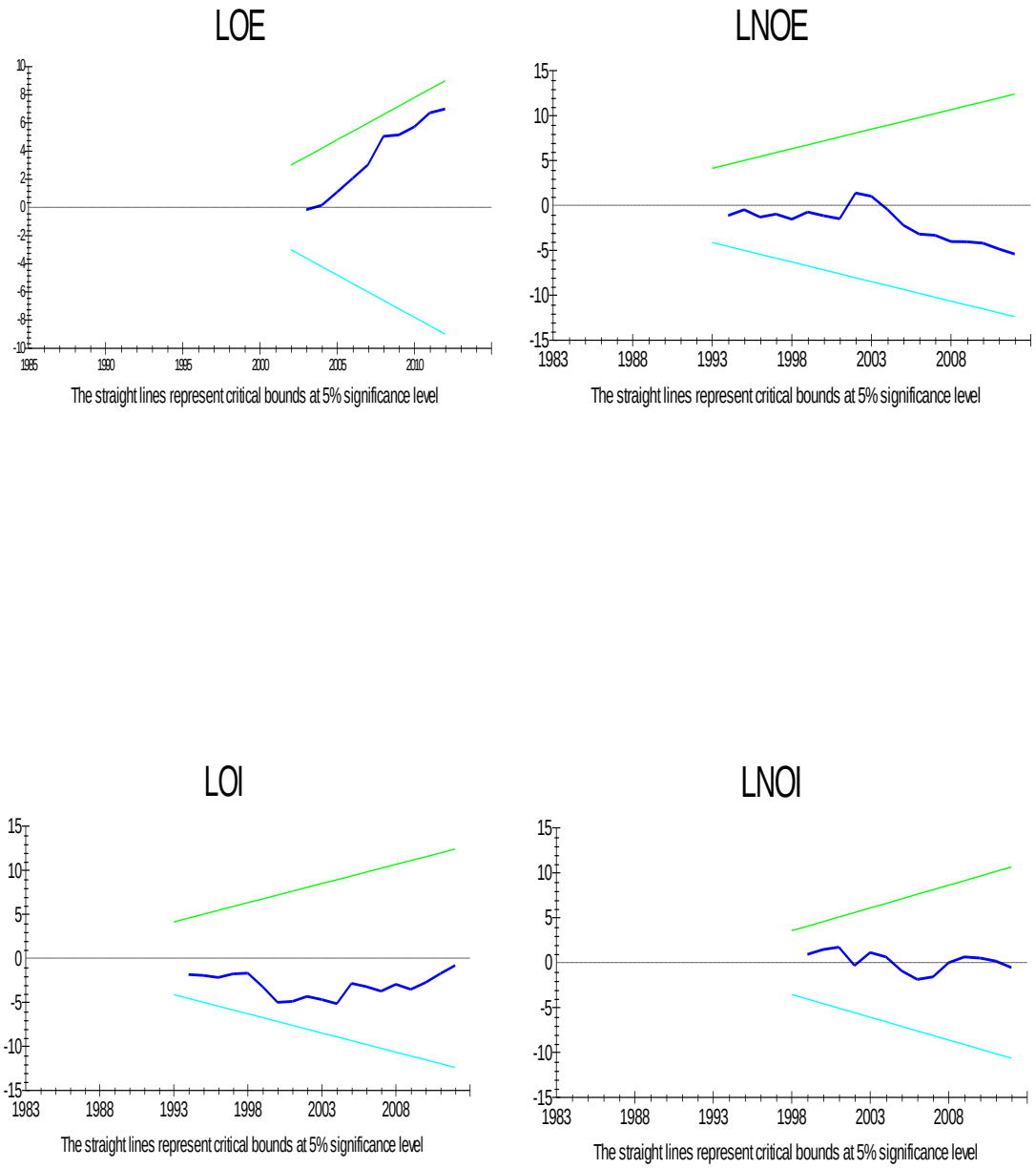

Figure 4.3: Plots of Cumulative Sum of Recursive Residuals

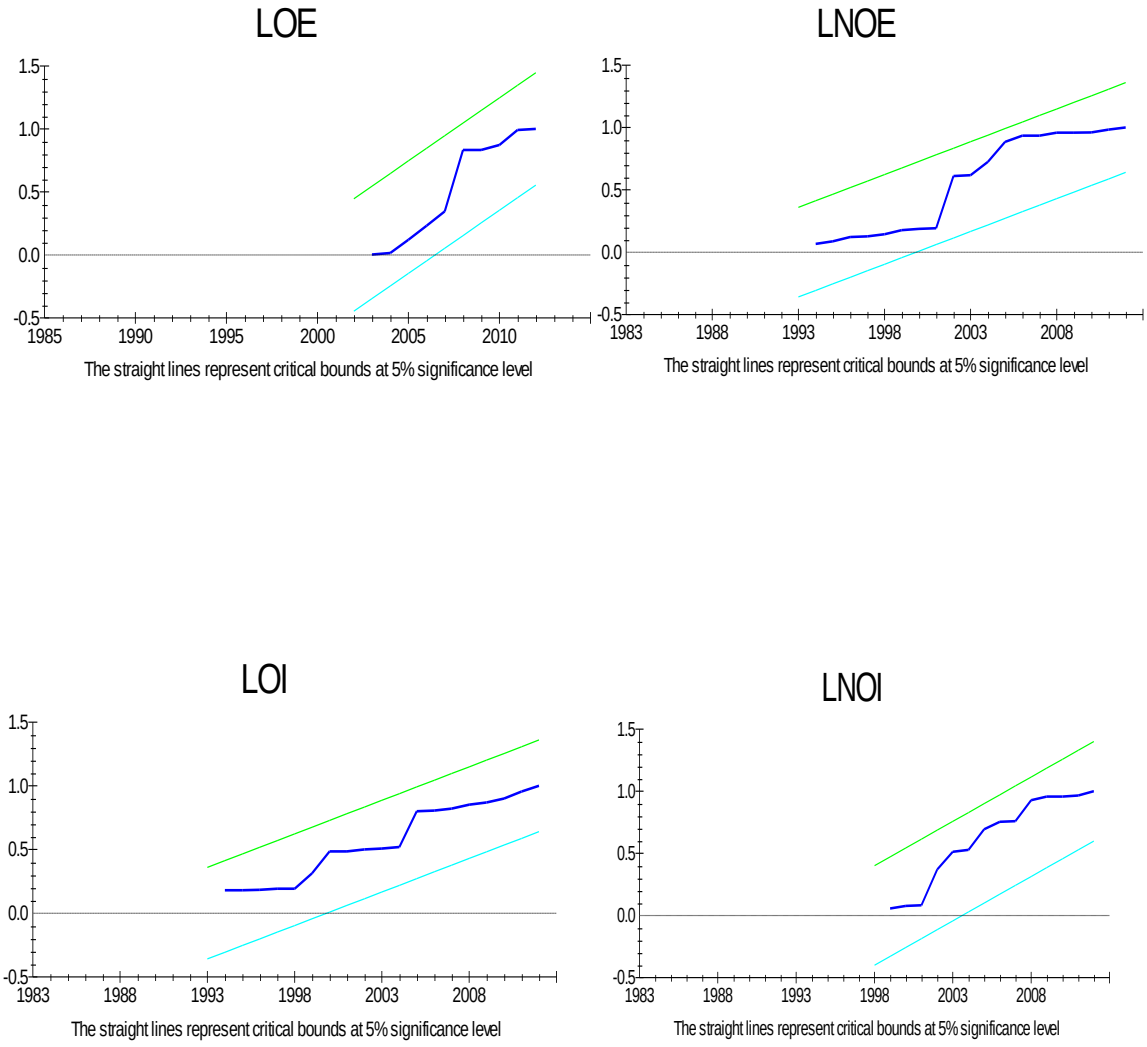

Figure 4.4: Plots of Cumulative Sum of Squares of Recursive Residuals

CHAPTER FIVE

SUMMARY, CONCLUSION AND FURTHER RESEARCH AREAS

5.1 Summary

This study investigates the impact of exchange rate volatility on the trade balance of Nigeria using ARDL approach to cointegration. It involves estimating four trade equations, namely: oil export equation, oil import equation, non-oil export equation and non-oil import equation. The econometric analysis employs annual real trade data for the period spanning 1981 to 2012 and standard deviation measure of exchange rate volatility. The volatility measure is derived using Moving sample standard deviation of the growth rate of the monthly real exchange rate data from 1981:1 to 2012:12. The independent variables used in the real oil and non-oil export equations include US real GDP, REER, relative price and volatility measure, while the real oil/non-oil import equations contain the same variables except US real GDP which is replaced by the Nigeria's real GDP. All the variables are I(1), except volatility measure which is I(0) .

The study reveals that only the variables used in oil export and non-oil import equations are cointegrated. Therefore long run equations can be modelled only for these two equations. The other two equations are estimated using OLS after taking the first difference of the non-stationary variables. As seen in the empirical literature review, the impact of exchange rate volatility on trade could be negative, positive, or even insignificant. Hence, the real oil export is found to have insignificant relationship with the exchange rate volatility in both the short run and long run at 5 per cent significance level, but the relationship can be significantly negative in the short run if decision is made at 10 per cent significance level. Exchange rate volatility exerts significant positive effect on the real oil import in the short run. The short run impact of exchange rate volatility on real non-oil export is insignificantly positive. On the other hand, exchange rate volatility has an insignificant positive effect on the real non-oil import in both the long run and short run. In short, exchange rate volatility makes significant effect on the real oil import in the short run only, when decision is made based on 5 per cent significance level.

The study also confirms the presence of Marshall-Lerner Condition based on the coefficients of DLEER. The absolute sum of the elasticity estimates is greater than unity.

5.2 Conclusion

The findings of this study are intended to have practical application in Nigeria's trade policies. In fact, it can also be a case for traders who can use the findings to convince the government to implement a trade-friendly macroeconomic framework, which will assist them in effectively planning their trade activities. Considering that exchange rate volatility could negatively affect real oil export in the short run, regulatory efforts such as protecting competitiveness (through pricing or OPEC membership) could be a good way of ameliorating the negative impact of excessive exchange rate uncertainty. Given that exchange rate volatility is not a serious problem for the non-oil export and non-oil import for the period of study, the government should provide basic infrastructure needed for diversifying the productive base of Nigerian economy. However, for the fact that higher exchange rate volatility is found to be positively related wtih real oil import, government needs to establish more refineries and make sure that the existing ones are in good state of repair in order to curve the excesses of the volatility. Moreover, further privatisation of the oil sector can help mitigate will also be a good policy. Another important policy is subsidisation of oil production. Now that government has removed subsidy on oil import, the proceeds should be used in establishing more vocational insititutions, giving incentives to trader who are willing to set up refineries within the Nigeian borders and other developmental projects.

5.3 Further Research Areas.

For the fact this study is not exhaustive in the area exchange rate-trade relationship, the following can give a better insight on the relationship:

- Sector-specific studies (for example study on manufacturing sector) may provide more information as to the level of the real effects of exchange rate volatility on trade.

- There is need to investigate the impact of exchange rate volatility on Nigeria's trade when various measures of exchange rate volatility are used for each of them could have a differing effects on the relationship.

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APPENDIX I

DATA

The Variables (in Naira Million)

DATE	OE	OI	NOE	NOI	RGDP	URGDP	REER
1981	75.05622	1.277583	2.408995	81.13141	251052.3	3709638	381.0315
1982	53.07901	1.495566	1.347668	64.93676	246726.6	4013609	390.1508
1983	45.18287	1.076679	1.890462	50.89943	230380.8	4519571	462.163
1984	51.72513	1.652283	1.447503	38.06454	227254.7	5120774	638.5437
1985	72.70113	1.93937	3.220624	41.17308	253013.3	6236698	572.5481
1986	109.7769	11.98856	7.24246	59.8536	257784.4	14594990	312.5993
1987	439.5917	49.40159	33.53592	206.0527	255997	30026948	99.63166
1988	407.0341	54.43888	39.47037	228.381	275409.6	35329194	100.1483
1989	884.6709	75.11939	47.50679	362.2715	295090.8	59679489	89.17241
1990	1705.915	97.16338	52.15026	539.1351	328606.1	66142469	82.69902
1991	1959.89	130.3535	78.44492	1158.654	328644.5	81485146	70.11558
1992	3508.202	340.7689	73.65863	1830.033	337288.6	1.47E+08	58.15215
1993	3763.844	724.2526	88.42389	1859.301	342540.5	1.93E+08	63.7247
1994	2677.135	564.8722	71.34664	1365.492	345228.5	1.99E+08	118.3327
1995	5042.735	847.4028	125.8407	2773.875	352646.2	2.05E+08	100.315
1996	5226.533	657.8623	94.60645	1463.004	367218.1	2.12E+08	123.5177
1997	4974.797	684.7082	119.6624	2498.236	377830.8	2.22E+08	143.3279
1998	3255.926	798.1761	154.5334	2703.596	388468.1	2.32E+08	159.4272
1999	20943.73	3790.572	349.0924	10410.93	393107.2	1.03E+09	80.29567
2000	28021.89	2899.138	362.1142	10033.32	412332	1.18E+09	81.36651
2001	31660.2	3457.275	449.3954	16346.47	431783.2	1.31E+09	90.46575
2002	20443.28	4034.74	1174.109	12838.81	451785.7	1.44E+09	90.27409
2003	38562.56	4625.663	1221.078	19495.49	495007.2	1.58E+09	85.31571
2004	55357.24	3922.5	1397.156	20578.68	527576	1.69E+09	87.58406
2005	71405.79	7248.168	1059.559	18214.16	561931.4	1.73E+09	100
2006	59677.06	5366.984	1108.672	15234.86	595821.6	1.73E+09	106.9551
2007	61396.67	5292.1	1508.387	17409.77	634251.3	1.72E+09	104.8084
2008	65264.33	8307.599	1664.935	22783.38	672202.6	1.62E+09	116.3901
2009	69725.44	8796.446	2559.148	30814.96	718977.3	1.97E+09	108.9734
2010	77478.55	11465.77	2786.157	36326.36	776332.2	2.04E+09	117.921
2011	90904.31	18734.23	3169.696	41450.42	834000.8	2.13E+09	119.7652
2012	89395.9	18442.09	2930.388	33048.21	888893	2.24E+09	135.6036

Source: URGDP and REER are obtained from the World Bank, other variables from the Central Bank of Nigeria.

The Logaarithms Of The Variables

YEAR	LNOE	LNOI	LOE	LOI	LP	LREER	LRGDP	LURGDP	LV
1981	0.87921	4.39607	4.318237	0.24497	5.161977	5.942882	12.43342	15.12644	-3.66727
1982	0.298376	4.173414	3.971782	0.402505	5.231412	5.966533	12.41604	15.2052	-4.14905
1983	0.636821	3.929852	3.810718	0.073881	5.293841	6.135918	12.34749	15.32393	-3.96506
1984	0.36984	3.639283	3.945944	0.502158	5.363435	6.45919	12.33383	15.44882	-3.17722
1985	1.169575	3.717785	4.286357	0.662363	5.280559	6.350097	12.4412	15.64596	-3.59318
1986	1.979961	4.091902	4.69845	2.483953	4.584784	5.744922	12.45988	16.49619	-1.16668
1987	3.512617	5.328132	6.085846	3.899983	4.37536	4.60148	12.45292	17.21761	-2.96061
1988	3.67555	5.431015	6.008897	3.997079	4.391218	4.606652	12.52601	17.38022	-2.91886
1989	3.860873	5.892394	6.785216	4.319079	4.250946	4.490572	12.59504	17.9045	-2.9747
1990	3.954129	6.289966	7.441857	4.576394	4.247593	4.415208	12.70261	18.00732	-4.12266
1991	4.362397	7.055014	7.580644	4.87025	4.192508	4.250145	12.70273	18.21593	-2.97673
1992	4.299441	7.512089	8.162859	5.831205	4.153876	4.063063	12.72869	18.80594	-2.379
1993	4.482142	7.527956	8.233196	6.58514	4.137654	4.154572	12.74415	19.0782	-2.88624
1994	4.26755	7.21927	7.892503	6.3366	4.394244	4.7735	12.75196	19.10882	-2.30388
1995	4.835017	7.928001	8.525704	6.742176	5.101586	4.608315	12.77322	19.13852	-1.65404
1996	4.549726	7.288247	8.561504	6.488996	5.379285	4.816384	12.81371	19.1721	-3.92798
1997	4.784675	7.82334	8.51214	6.528993	5.403024	4.965135	12.8422	19.21819	-3.84804
1998	5.04041	7.902338	8.088232	6.682329	5.378237	5.071587	12.86997	19.26225	-3.50914
1999	5.855337	9.250611	9.949595	8.240272	4.10492	4.385716	12.88184	20.75282	-1.71195
2000	5.89196	9.213667	10.24074	7.972169	4.294056	4.398964	12.92958	20.88878	-3.35161
2001	6.107903	9.701767	10.36282	8.148236	4.207302	4.504971	12.97568	20.99329	-3.83845
2002	7.068265	9.460228	9.92541	8.302697	4.475445	4.50285	13.02096	21.08791	-3.64646
2003	7.10749	9.877939	10.56004	8.439375	4.420944	4.446359	13.11233	21.18069	-3.58084
2004	7.242194	9.932011	10.92156	8.274484	4.42705	4.472599	13.17605	21.24799	-3.99815
2005	6.965608	9.809955	11.17613	8.888504	4.60517	4.60517	13.23914	21.27139	-3.99166
2006	7.010918	9.631341	10.9967	8.588021	4.75664	4.672409	13.2977	21.27139	-3.94272
2007	7.318796	9.764787	11.02511	8.57397	4.800911	4.652134	13.3602	21.26559	-4.21876
2008	7.417541	10.03379	11.0862	9.024926	4.882087	4.756948	13.41831	21.20569	-3.16614
2009	7.84743	10.33576	11.15232	9.082103	4.657073	4.691104	13.48559	21.4013	-3.50647
2010	7.932419	10.5003	11.25776	9.347121	4.837258	4.770015	13.56234	21.43622	-3.97153
2011	8.061391	10.63225	11.41756	9.838108	4.841061	4.785533	13.63399	21.47939	-3.339
2012	7.98289	10.40572	11.40083	9.822391	4.868111	4.909736	13.69773	21.52974	-4.65503

Source: author’s computation

Monthly Real Exchange Rate (2005=100)

time	reer	time	reer	time	reer	time	reer	time	reer
Jan-81	377.333	Jan-84	565.115	Jan-87	118.461	Jan-90	89.701	Jan-93	62.391
Feb-81	392.073	Feb-84	550.655	Feb-87	110.981	Feb-90	87.881	Feb-93	60.121
Mar-81	378.193	Mar-84	556.815	Mar-87	102.821	Mar-90	89.151	Mar-93	54.730
Apr-81	389.783	Apr-84	595.965	Apr-87	99.521	Apr-90	87.711	Apr-93	54.500
May-81	390.593	May-84	652.385	May-87	94.201	May-90	85.491	May-93	63.071
Jun-81	376.783	Jun-84	645.375	Jun-87	94.281	Jun-90	85.011	Jun-93	65.551
Jul-81	381.223	Jul-84	662.956	Jul-87	101.581	Jul-90	81.661	Jul-93	66.471
Aug-81	371.373	Aug-84	683.016	Aug-87	99.031	Aug-90	79.631	Aug-93	67.141
Sep-81	374.753	Sep-84	717.556	Sep-87	94.121	Sep-90	78.941	Sep-93	66.991
Oct-81	373.493	Oct-84	702.366	Oct-87	95.441	Oct-90	77.371	Oct-93	66.501
Nov-81	383.173	Nov-84	665.606	Nov-87	92.791	Nov-90	75.291	Nov-93	69.021
Dec-81	383.603	Dec-84	664.716	Dec-87	92.351	Dec-90	74.551	Dec-93	68.211
Jan-82	381.393	Jan-85	681.956	Jan-88	95.781	Jan-91	70.551	Jan-94	99.141
Feb-82	386.033	Feb-85	672.656	Feb-88	100.741	Feb-91	66.581	Feb-94	103.061
Mar-82	385.073	Mar-85	659.315	Mar-88	95.501	Mar-91	71.661	Mar-94	102.391
Apr-82	380.883	Apr-85	611.875	Apr-88	101.251	Apr-91	75.221	Apr-94	106.301
May-82	373.813	May-85	597.335	May-88	99.461	May-91	73.461	May-94	106.501
Jun-82	386.063	Jun-85	584.575	Jun-88	101.791	Jun-91	71.461	Jun-94	108.501
Jul-82	385.603	Jul-85	545.665	Jul-88	104.551	Jul-91	66.381	Jul-94	112.951
Aug-82	384.373	Aug-85	533.004	Aug-88	106.221	Aug-91	64.501	Aug-94	121.641
Sep-82	392.823	Sep-85	526.294	Sep-88	105.331	Sep-91	69.541	Sep-94	128.201
Oct-82	402.453	Oct-85	499.594	Oct-88	105.391	Oct-91	71.371	Oct-94	133.301
Nov-82	410.453	Nov-85	490.464	Nov-88	98.761	Nov-91	69.811	Nov-94	143.921
Dec-82	412.843	Dec-85	467.814	Dec-88	86.991	Dec-91	70.851	Dec-94	154.081
Jan-83	413.073	Jan-86	437.694	Jan-89	83.071	Jan-92	72.691	Jan-95	158.731
Feb-83	416.943	Feb-86	428.844	Feb-89	75.351	Feb-92	68.721	Feb-95	84.391
Mar-83	433.244	Mar-86	410.053	Mar-89	79.121	Mar-92	51.710	Mar-95	82.371
Apr-83	434.124	Apr-86	398.613	Apr-89	82.051	Apr-92	52.700	Apr-95	86.481
May-83	444.994	May-86	397.733	May-89	86.471	May-92	53.000	May-95	90.791
Jun-83	448.124	Jun-86	371.333	Jun-89	95.861	Jun-92	56.030	Jun-95	93.001
Jul-83	458.214	Jul-86	330.433	Jul-89	94.391	Jul-92	55.780	Jul-95	94.861
Aug-83	470.284	Aug-86	317.623	Aug-89	94.291	Aug-92	55.860	Aug-95	99.591
Sep-83	481.504	Sep-86	296.702	Sep-89	95.381	Sep-92	53.820	Sep-95	102.311
Oct-83	487.434	Oct-86	102.941	Oct-89	95.221	Oct-92	56.210	Oct-95	101.521
Nov-83	512.954	Nov-86	123.911	Nov-89	94.821	Nov-92	59.860	Nov-95	101.751
Dec-83	545.055	Dec-86	135.311	Dec-89	94.041	Dec-92	61.441	Dec-95	107.981

Monthly Real exchange rate (2005=100) continued

time	reer	time	reer	time	reer	time	reer	time	reer	time	reer
Jan-96	111.811	Jan-99	85.371	Jan-02	96.171	Jan-05	90.511	Jan-08	110.031	Jan-11	119.611
Feb-96	113.311	Feb-99	87.701	Feb-02	98.661	Feb-05	91.871	Feb-08	109.801	Feb-11	118.931
Mar-96	115.571	Mar-99	87.311	Mar-02	97.201	Mar-05	93.451	Mar-08	108.161	Mar-11	117.981
Apr-96	115.811	Apr-99	84.381	Apr-02	96.431	Apr-05	93.851	Apr-08	107.681	Apr-11	115.921
May-96	120.071	May-99	80.311	May-02	94.091	May-05	96.781	May-08	109.611	May-11	116.191
Jun-96	122.051	Jun-99	80.511	Jun-02	89.741	Jun-05	98.771	Jun-08	111.521	Jun-11	117.101
Jul-96	128.101	Jul-99	79.091	Jul-02	88.191	Jul-05	104.921	Jul-08	112.861	Jul-11	119.961
Aug-96	129.701	Aug-99	75.571	Aug-02	84.981	Aug-05	106.141	Aug-08	116.401	Aug-11	112.101
Sep-96	131.921	Sep-99	76.151	Sep-02	84.901	Sep-05	106.021	Sep-08	121.621	Sep-11	122.201
Oct-96	133.771	Oct-99	75.421	Oct-02	82.591	Oct-05	106.051	Oct-08	129.911	Oct-11	125.611
Nov-96	130.741	Nov-99	75.491	Nov-02	85.881	Nov-05	106.411	Nov-08	136.101	Nov-11	125.291
Dec-96	129.341	Dec-99	76.241	Dec-02	84.451	Dec-05	105.221	Dec-08	122.981	Dec-11	126.281
Jan-97	133.261	Jan-00	74.391	Jan-03	84.691	Jan-06	103.101	Jan-09	113.031	Jan-12	127.731
Feb-97	137.351	Feb-00	75.631	Feb-03	81.971	Feb-06	105.701	Feb-09	113.901	Feb-12	127.211
Mar-97	136.961	Mar-00	76.161	Mar-03	81.841	Mar-06	109.351	Mar-09	112.921	Mar-12	128.931
Apr-97	138.281	Apr-00	77.171	Apr-03	84.481	Apr-06	109.301	Apr-09	111.261	Apr-12	130.541
May-97	138.301	May-00	80.941	May-03	81.141	May-06	106.581	May-09	109.281	May-12	133.991
Jun-97	138.681	Jun-00	81.181	Jun-03	83.571	Jun-06	106.071	Jun-09	107.371	Jun-12	137.181
Jul-97	141.911	Jul-00	77.901	Jul-03	86.951	Jul-06	106.421	Jul-09	107.901	Jul-12	138.761
Aug-97	147.631	Aug-00	83.051	Aug-03	87.490	Aug-06	108.101	Aug-09	104.691	Aug-12	138.821
Sep-97	147.801	Sep-00	86.871	Sep-03	90.550	Sep-06	109.211	Sep-09	104.061	Sep-12	139.621
Oct-97	147.741	Oct-00	89.131	Oct-03	88.890	Oct-06	108.851	Oct-09	106.781	Oct-12	140.001
Nov-97	150.671	Nov-00	89.191	Nov-03	86.460	Nov-06	106.511	Nov-09	106.371	Nov-12	142.321
Dec-97	161.341	Dec-00	84.781	Dec-03	85.751	Dec-06	104.261	Dec-09	110.071	Dec-12	142.121
Jan-98	166.981	Jan-01	81.611	Jan-04	85.351	Jan-07	104.831	Jan-10	111.781		
Feb-98	157.381	Feb-01	83.821	Feb-04	86.111	Feb-07	105.041	Feb-10	115.961		
Mar-98	156.841	Mar-01	86.061	Mar-04	86.531	Mar-07	105.231	Mar-10	115.851		
Apr-98	155.661	Apr-01	88.561	Apr-04	85.791	Apr-07	104.271	Apr-10	116.281		
May-98	154.811	May-01	91.511	May-04	89.781	May-07	104.281	May-10	119.271		
Jun-98	159.561	Jun-01	91.251	Jun-04	87.751	Jun-07	104.751	Jun-10	122.201		
Jul-98	164.571	Jul-01	92.071	Jul-04	86.261	Jul-07	102.311	Jul-10	119.721		
Aug-98	164.841	Aug-01	91.881	Aug-04	87.001	Aug-07	104.661	Aug-10	119.751		
Sep-98	158.121	Sep-01	93.561	Sep-04	88.131	Sep-07	104.571	Sep-10	118.731		
Oct-98	154.611	Oct-01	95.991	Oct-04	89.971	Oct-07	103.481	Oct-10	116.081		
Nov-98	159.371	Nov-01	95.101	Nov-04	89.151	Nov-07	105.651	Nov-10	118.571		
Dec-98	160.371	Dec-01	94.171	Dec-04	89.171	Dec-07	108.621	Dec-10	120.761		

Source: International Financial Statistics.

Export price index

YEAR	Nigerian Price Index	USA Price Index
1981	142.3*	81.5
1982	150.8	80.6
1983	159.4	80.0
1984	170.9	80.1
1985	154.4	78.6
1986	76.2	77.8
1987	64.2	80.7
1988	69.9	86.5
1989	62.2	88.6
1990	62.5	89.4
1991	59.6	90.1
1992	57.4	90.1
1993	56.8	90.7
1994	75.0	92.6
1995	159.7	97.2
1996	212.0	97.8
1997	214.2	96.4
1998	202.0	93.3
1999	55.8	92.1
2000	68.6	93.6
2001	62.3	92.8
2002	80.7	91.9
2003	77.6	93.3
2004	81.1	96.9
2005	100.0	100.0
2006	120.5	103.6
2007	132.1	108.6
2008	151.9	115.2
2009	115.7	109.8
2010	145.3	115.2
2011	157.6	124.5
2012	162.5	124.9

Source: Economist Intelligence Unit. * signifies the entry is calculated by the author by taking the average value of observations from 1982 to 1986.

APPENDIX II

Unit Root Test Results

ADF Test Results

Unit Root Tests at Logarithmic Levels				
Variables	Constant	Constant and trend	None	k
Log of non-oil export (LNOE)	-1.916515	-2.068798	1.561298	1
Log of non-oil import (LNOI)	-1.048300	-1.378714	2.050931	1
Log of oil export (LOE)	-1.495709	-1.411301	2.055115	1
Log of oil import (LOI)	-1.816927	-1.589083	1.347441	1
Log of REER (LREER)	-2.330767	-2.022229	-0.735056	1
Log of real GDP (LRGDP)	1.490352	-1.620579	3.077061	1
Log of US real GDP (LURGDP)	-2.027021	-1.129538	2.256202	1
Log of Volatility (LV)	-3.030687*	-3.753105*	-0.417884*	1
Log of Price (LP)	-2.749142	-2.618128	-0.397321	1
Unit Root Test at First Differences				
variables	Constant	Constant and trend	None	k
Log of non-oil export (LNOE)	-3.687866*	-4.330174*	-2.296610*	2
Log of non-oil import (LNOI)	-3.866434*	-4.254038*	-2.484111*	2
Log of oil export (LOE)	-4.232942*	-4.641976*	-2.952903*	1
Log of oil import (LOI)	-3.807538*	-4.465526*	-2.581033*	1
Log of REER (LREER)	-3.554873*	-3.855608*	-3.545024*	1
Log of real GDP (LRGDP)	-3.782355*	-4.374505*	-2.058788*	0
Log of US real GDP (LURGDP)	-3.423385*	-4.127160*	-2.404871*	1
Log of Volatility (LV)	*	*	*	
Log of Price (LP)	-3.457892*	-3.655118*	-3.515476*	3

Note: * signifies significance at the 5% level and the rejection of the null hypothesis that the variable is non-stationary. The augmented dickey fuller critical values are -2.960411, -3.562882, and -1.952066 for the first, second and third model respectively. The optimal lag lengths *k* is user-defined in Eviews 8.

Phillips-Perron Test Results

Unit Root Test at Logarithmic Levels				
Variables	Constant	Constant and trend	None	k
Log of non-oil export (LNOE)	-1.105580	-1.788308	1.914944	1
Log of non-oil import (LNOI)	-0.808293	-1.741080	2.156647	1
Log of oil export (LOE)	-1.085269	-1.664319	2.158873	1
Log of oil import (LOI)	-1.653859	-1.446468	1.795383	1
Log of REER (LREER)	-1.981153	-1.642505	-0.790257	1
Log of real GDP (LRGDP)	2.418688	-1.716234	5.188048	1
Log of US real GDP (LURGDP)	-1.853189	-0.922601	3.030205	1
Log of Volatility (LV)	-4.006465*	-4.400492*	-0.348910	1
Log of Price (LP)	-2.387051	-2.278380	-0.359882	1
Unit Root Test at First Differences				
Variables	Constant	Constant and trend	None	k
Log of non-oil export (LNOE)	-5.510030*	-5.732074*	-4.148856*	1
Log of non-oil import (LNOI)	-5.961308*	-5.931762*	-4.903088*	1
Log of oil export (LOE)	-6.096878*	-6.096878*	-4.890828*	1
Log of oil import (LOI)	-5.043673*	-5.288540*	-3.942495*	1
Log of REER (LREER)	-4.195705*	-4.313584*	-4.228691*	1
Log of real GDP (LRGDP)	-3.782355*	-4.374505*	-2.058788*	0
Log of US real GDP (LURGDP)	-4.675867*	-5.144388*	-3.527517*	1
Log of Volatility (LV)	-	-	-	-
Log of Price (LP)	-4.809137*	-4.802120*	-4.888242*	1

Note: * signifies significance at the 5% level and the rejection of the null hypothesis that the variable is non-stationary. The augmented dickey fuller critical values are -2.960411, -3.562882, and -1.952066 for the first, second and third model respectively. The optimal lag lengths *k* is user-defined in Eviews 8.