Asymmetric and Nonlinear Exchange Rate Pass-Through to Consumer Price in Nigeria: 1986 - 2013

By

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Abstract

This study examines the effect of exchange rate changes on consumer prices in Nigeria by examining the magnitude and speed of exchange rate pass-through (ERPT) to consumer prices in Nigeria using quarterly time series data from 1986 to 2013. The study also examines the potential nonlinearities and asymmetries in the ERPT in Nigeria during the same period. The study used vector error correction model (VECM) and smooth transition autoregresive (STAR) model. The methodology employed, are free from some weaknesses of the previous empirical studies and contributed to the analysis of ERPT from a macroeconomic perspective. This study focuses on the macroeconomic perspective of the effect of ERPT which is more relevant for monetary policy. To design and implement an efficient monetary policy, theoritical and empirical knowledge of the ERPT to domestic consumer price is necessary. Similarly, the understanding of the level of ERPT to domestic consumer prices would offer more understanding of the international transmission of shocks and the efficiency of exchange rate policy measures on external adjustment. The study results show full and statistically significant ERPT in the long-run in Nigeria during the sample period. However, using linear model (VECM) the short-run estimate shows no significant ERPT in Nigeria. Whereas, the nonlinear STAR model shows significant ERPT even in the short-run in Nigeria. The results of the nonlinear model (STAR) show evidence of nonlinearities and asymmetries in the ERPT in Nigeria. The nonlinearities and asymmetries tend to be prevalent during periods of higher inflation and greater exchange movements when the changes in prices and exchange rates exceed certain thresholds. This study, therefore, confirms Taylor's (2000) hypothesis that pass-through declines in low and stable inflation environment which create nonlinear ERPT. The result shows asymmetric ERPT to the direction of exchange rate change (appreciation or depreciation). The result also shows clear evidence of nonlinearity with respect to the size of the exchange rate change. This result is in line with the menu cost hypothesis where the importing firms do not transfer the exchange rate changes due to the cost of changing their menu. Therefore, the effect of the exchange rate changes on consumer price is minimal when the exchange rate changes are below the threshold level. The study also examined the output growth as a source of nonlinearities. However, the result does not show evidence of nonlinear ERPT due to the output level. The comparison of statistical test results of linear autoregressive (AR) and the nonlinear (STAR) model indicates that the nonlinear STAR model fits the data better than the linear AR model in all cases. The results of this study, therefore, show a significant impact of exchange rate changes on the domestic consumer price in both short run and long run. The asymmetric and nonlinear ERPT induced by the pricing behaviors of the importing firms also significantly influences the speed and magnitude of the ERPT to consumer prices in Nigeria.

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List of Abbreviations

ADF	Augmented Dickey-Fuller
AFEM	Autonomous foreign exchange market
AIC	Akaike information criteria
AR	Autoregressive
ARCH	Autoregressive conditional heteroskedasticity
CBN	Central bank of Nigeria
CISS	Comprehensive import supervision scheme
CPI	Consumer price index
CRR	Cash reserve requirement
CVAR	cointegrated vector autoregression
DAS	Dutch auction system
DGP	Data generation process
DMBs	Deposit money banks
EEG	Export expansion grant
ENFP	Enlarged national focal point
ERPT	Exchange rate pass-through
ESTR	Exponential smooth transition regression
FDI	Foreign direct investment
FEM	Foreign exchange market
GIRF	Generalized Impulse response function
HQIC	Hannan-Quinn information criteria
IFEM	Inter-bank foreign exchange market
IMF	International monetary fund
IRF	Impulse response function
ISI	Import substitution industrialisation
IT	Inflation targeting
KPSS	Kwiatkowski, Phillips, Schmids and Shin
LCP	Local currency pricing
LCU	Local currency unit
LM	Lagrange multiplier
LOOP	Law of one price
LR	Liquidity ratio
LSTR	Logistic smooth transition regression
MPC	Monetary policy committee
MPR	Monetary policy rate
MRR	Minimum rediscount rate

NBS	National Bureau of statistics
NEEDS	National economic empowerment and development strategy
NEER	Nominal effective exchange rate
NEPC	Nigeria export promotion council
NEPZA	National export processing zones authority
NEXIM	Nigeria export-import bank
NFP	National focal point
NIPC	National investment promotion commission
NLS	Nonlinear least square
NOEM	New open economy macroeconomics
NNPC	Nigerian National Petroleum Corporation
NTBs	Nigerian treasury bills
OFN	Operation feed the nation
OLS	Ordinary least squae
OPS	Organised private sector
OSIC	one-stop investment centre
PCP	Producer currency pricing
PP	Phillip-perron
RBS	Real business cycle
Repos	Repurchase agreements
RER	real exchange rate
RTGS	Real-time gross settlement system
SAP	Structural adjustment programme
SEC	Security and exchange commission
SETAR	Self-exciting threshold autoregression
SFEM	Second-tier foreign exchange market
SIC	Schwarz information criteria
SSR	Sum of squared residuals
STAR	Smooth transition autoregressive
TAR	Threshold autoregression
TPN	Trade policy of Nigeria
TSLS	Two-stage least square
USD	United states dollar
VAR	vector autoregression
VDC	variance decomposition
VECM	Vector error correction model
WTO	World trade organisation

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Declaration

I declare that, except where explicit reference is made to the contribution of others, that this thesis is the result of my own work and has not been submitted for any other degree at the Kingston University London or any other institution.

Signature

Babagana Mala MUSTI

Chapter 1 :
Introduction and Overview of chapters

1.1 Introduction and Motivation

This chapter introduces the thesis and provides a general summary of all the chapters in the thesis. Exchange rate pass-through (henceforth ERPT), as defined by Goldberg and Knetter (1997) is the percentage change in import prices in the domestic currency due to a one percent change in the exchange rate. However, this original definition of ERPT is now called 'Stage one ERPT'. The definition has been extended to include the impact of changes in exchange rate on the producer or consumer price which is known as 'Overall ERPT'. While, the effect of a change in import prices on the producer or consumer prices is called 'Stage two ERPT' (Aron *et al*., 2014).

There is distinction also between a long-run (equilibrium) ERPT and a short-run ERPT which is considered most relevant for monetary policy. Due to how the definition evolved over time to include other types of the prices, particularly producer prices and consumer prices, the ERPT can now be seen more broadly as the change in domestic prices (import, producer and consumer prices) due to the change in the nominal exchange rate. Regarding the degree of the pass-through, if the exchange rate change is entirely passed on to domestic prices, the ERPT is said to be full or complete pass-through. If only some part of the shift in the exchange rate is transferred into the prices, then ERPT is considered as partial, or incomplete (Aziz *et al*., 2014).

In open economies such as Nigeria ERPT plays a significant role in design and implementaion of optimal monetary policy considering its implication in the transmission of shocks. For instance; the primary argument for a floating exchange rate is that exchange rate flexibility help relative price adjustment when the country is confronted with real shocks. The relative prices adjustment creates an expenditure-switching effect between locally produced goods and imported goods which to some degree balance the original effect of the shock. This argument is built on the assumption that local currency prices of imported goods react to changes in nominal exchange rates. When the level of ERPT is low, (i.e. when the import prices react only slightly to the variations in the exchange rate) the expenditure-switching effects will be minimal, hence restricting the short-run adjustment task of the nominal exchange rates and therefore the attraction of flexible exchange rates.

The changes in the exchange rate are transmitted to the consumer prices via direct and indirect channels. The changes in the exchange rate are transmitted directly to consumer prices through their impact on the import prices of imported finished goods and raw materials. For instance, when Nigeria's currency (Naira) depreciates, imports price (in Naira) of finished goods will become more expensive which ultimately raises the consumer prices. The proportion of the changes in the exchange rate and the import prices passed to the consumer prices depends on the pricing decisions of the importing firm.

The indirect channel of the transmission of the exchange rate changes to consumer prices is through production costs and real channel. Depreciation in Naira value will result in higher cost of production as the imported inputs will become more expensive, and that will eventually have the effect of increasing the domestic consumer prices.

Although there is vast empirical literature on exchange rate pass-through, only a small fraction of the studies examined the topic from the perspective of developing and emerging economies like Nigeria, despite the significance of understanding ERPT to the developing countries. The knowledge of the degree and speed of ERPT is more relevant to developing countries considering that, most developing and emerging economies including Nigeria pursue an export-led growth strategy, where the exchange rates policy is expected to play an important role. Likewise, most developing countries import technology and capital goods for their exporting industries (Aziz *et al*., 2014).

Another essential behaviour of the ERPT that is not very much examined in the literature is the issue of nonlinearity and asymmetry in the ERPT. The standard models assume ERPT is linear (in logs of prices and the exchange rate). However, some recent studies have shown evidence of nonlinear and/or asymmetric responses of prices to exchange rate fluctuations (for example see, Pollard & Coughlin, 2003; Marazzi & Sheets, 2007; and Bussière, 2007, 2013).

There is the possibility of directional asymmetries that depreciation could cause a different price reaction compared to appreciation, and/or nonlinearity where smaller changes might lead to a disproportionate response compared to larger changes. The asymmetry could occur from strategic considerations and downward price rigidities. Nonlinearities could result from factors like menu cost and market share objectives of the importing firms. The importing firms in Nigeria who face the competition of locally produced goods tend to absorb minor exchange rate changes in their profit margins and only pass-through the changes to consumer prices when the changes exceed a given threshold they consider significant. The importing firms also do not change their prices immediately sometimes due to the cost of changing the menu until the change exceed a certain threshold they deemed high enough to effect the change of menu. Sometime they also do not change their price until they perceive that the change is permanent as sometime the changes are just temporary shocks.

To design and implement an efficient monetary policy in Nigeria, the knowledge of the speed and degreee of exchange rate pass-through to domestic consumer price is necessary. A large and fast ERPT to consumer prices under the free floating exchange rate system would lead to more inflation. On the other hand, with small and sluggish ERPT changes in the exchange rate cannot be transmitted to the consumer prices substaintially and quickly. Similarly, the understanding of the level of ERPT to domestic consumer prices would offer more knowledge of the international transmission of shocks and the efficiency of exchange rate policy measures on external adjustment. Considering that Nigeria embraced openness policies, the consumer price inflation could be partly influenced by external factors.

The key empirical question here then should be about the degree and speed of the ERPT to consumer prices in Nigeria and whether there are asymmetries and nonlinearities in the ERPT process. Even though the empirical literature on ERPT in Sub-Saharan Africa (SSA) countries, and particularly Nigeria is increasing, there is no agreement on the degree and speed of the ERPT. Some recent studies are Essien (2005), Aliyu *et al*. (2009), Zubair *et al*. (2013) and Bada *et al*. (2016). The studies present conflicting results on the degree of pass-through in Nigeria. The work of Aliyu *et al*. (2009) shows a small pass-through in the long-run. Zubair *et al*. (2013) also found that the ERPT in the log-run is incomplete, low and somewhat slow. On the other hand, Essien (2005) found a full pass-through.

The findings that ERPT in the long-run is low in Nigeria is startling, considering the import as a percent of GDP in Nigeria rises of up to 31% in 2009 (World Bank, 2017). Also considering the persistent consumer price inflation which seems to be moving together with the exchange rate depreciation rather than the money supply or the output growth in the economy. The changes in the exchange rate could, therefore, have a significant impact on the local consumer prices.

Aim of the study

This study critically examines the effect of changes in exchange rate on consumer prices in Nigeria during the period 1986 to 2013. The study reviews the effect of the different exchange rate policies adopted in Nigeria since independence in 1960 and particularly from 1986 when the country adopted a floating exchange rate regime to understand their implication on the economy. The study also examined the potential nonlinearities and asymmetries in the pass-through of the exchange rate changes to the consumer prices in Nigeria and its implication on consumer price inflation.

The study uses methodologies that avoid some weaknesses of the previous empirical studies and contributes to the analysis of ERPT from a macroeconomic perspective. The study also contributes to the literature by providing answers to the inadequacies like not checking cointegration and nonlinearity using appropriate econometric methods.

Most of the previous studies conducted their work from the microeconomic perspective, for instance, taking the particular industry. This study differs as our study looks at the macroeconomic perspective of the effect of ERPT using the composite consumer price index which is more relevant for monetary policy. This study also concentrates on the analysis of the effect of exchange rate changes in consumer prices as against some other studies that examined the effect of the exchange rate changes on import price as the two have different effects and policy implication.

This study attempts to apply a different and more suitable method of vector error correction model (VECM) Model. The approach helps us in determining both the short-run and long-run degree of the pass-through, and the speed of adjustment. The study also identified and applied appropriate remedies for structural breaks in the sample period, the aspect which was not adequately considered in the previous studies. As such we expect the study to provide a robust and reliable estimate of the speed and level of the ERPT in Nigeria.

Asymmetries and nonlinearities are another important topics in the literature of ERPT. In developed countries, significant asymmetries were established (for example see, Pollard and Coughlin (2003); Campa and Goldberg (2005); Bussière (2007, 2013)). There are different situations that could create an asymmetric and nonlinear reaction of prices to changes in the exchange rate which could not be modeled using linear models. The huge Naira exchange rate movements and consumer price inflation experienced in Nigeria in the late 1980s and the 1990s after the adoption of floating exchange rate regime seems to be a classic example of an asymmetric and nonlinear ERPT. Nevertheless, the empirical literature on the asymmetries and nonlinearities in ERPT are few despite its strong policy relevance. For instance, there is no study of asymmetric and nonlinear ERPT on Nigeria. Hence, this study also aims to fill this gap in the literature on ERPT in developing and emerging markets, particularly Nigeria on this aspect. Given the increased globalisation and the fact that most of the countries in Africa, particularly Nigeria, embrace openness as a trade policy, it is important to fill this study gap.

This thesis is organised as follows. Chapter two provides a review of the Nigerian macroeconomic policy pertaining exchange rate and effect on the consumer price. Chapter three discusses the theoretical and empirical literature about inflation and exchange rate pass-through. In chapter four we reviewed the asymmetric and nonlinear exchange rate pass-through literature. In Chapter five we discuss the research methodology of the study. Then in chapter six, we examine the degree and speed of exchange rate pass-through to consumer prices in Nigeria. In chapter seven, we examine the presence of asymmetry and nonlinearity ERPT in Nigeria and its impact. Chapter eight presents summary and conclusion of the study.

1.2 Overview of the chapters

This section provides a brief outline of all the chapters in this thesis, which gives a picture of what to expect in the chapters and the objectives of the chapters.

1.2.1 Overview of Chapter Two

Chapter two analyses the effect of exchange rate and trade policies on consumer prices inflation in Nigeria from independence in 1960 to 2013. The goal of the chapter is to provide a holistic critical review of the case study economy (Nigeria) focusing on the effect of exchange rate movement on the domestic consumer price and to consider the successes and failures of the government policies on controlling the problem. Considering that economic performance and exchange rate policy are interlinked through the effect of latter on the aggregate demand, the exports and imports, hence we first review the general economic performance of the country by analysing the key economic indicators. The chapter also provides an overview of exchange rate policies, monetary policy framework and implementation and trade policies in relation to their effect on the pass-through of exchange rate changes to consumer prices. The chapter is divided into seven sections. After an introduction to the chapter in section one, the second section provides an overview of Nigeria's economic performance under different macroeconomic policy regimes. The third section reviews different exchange rate policies adopted since independence in 1960 to 2013 and the motivation behind the policies. Section four provides an overview of the overall monetary policy direction of the country. In section five, a discussion of the nation's trade policies and practice over the period from 1960 to 2013 is provided. Section six provides a conclusion to the chapter.

1.2.2 Overview of Chapter Three

Chapter three critically reviews theories and empirical literature on inflation and the transmission of changes in the exchange rate to consumer prices (Exchange rate pass-through). We examine the perspective of different schools of thought like the classical, Keynesian and monetarist among others on the cause of inflation and the channels and determinant of ERPT. The goal of the chapter is to critically review the different arguments on the cause of inflation and identify how the change in exchange rate induces consumer price inflation in the domestic economy of a developing country like Nigeria. The two main sections in the chapter are on inflation and on exchange rate pass-through. The first part concerning inflation presents a critical review of the leading theories of inflation put forward by different schools of thought and examined their practical applications. The second section of the chapter concentrates on discussing the transmission of changes in the exchange rate to consumer price. The review in the section comprises of theoretical background on the pass-through process and discussion of channels and determinant of the exchange rate pass-through. A review of empirical studies on the exchange rate pass-through is also carried out. Finally, a summary of the review and conclusion is presented.

1.2.3 Overview of Chapter Four

Chapter four critically reviews theoretical and empirical studies that examined the presence of asymmetric and nonlinear exchange rate pass-through to consumer prices. The goal of the chapter is to provide the theoritical basis of the argument of potentials of asymmetries and nonlinearities in ERPT and empirical evidence of asymmetric and nonlinear ERPT in some countries. In the literature, several microeconomic and macroeconomic arguments have been put forward as potential causes of the asymmetric and nonlinear response of the domestic consumer prices to exchange rate changes. The empirical applications also confirmed its existence in some instances and could not in some. The chapter is divided into four sections. After the introduction to the chapter in the first section, the second section discusses causes for nonlinear and asymmetric exchange rate pass-through to consumer prices. The review of the causes of asymmetric and nonlinear exchange rate pass-through is carried out under microeconomic and macroeconomics perspective. In section three a critical review of empirical studies on the nonlinear and asymmetric exchange rate pass-through is conducted. The empirical literature reviews cover the scope, outcome and the approaches to the studies. In section four summary and conclusion of the review is presented.

1.2.4 Overview of Chapter Five

Chapter five discusses the Vector error correction model (VECM) and the Smooth transition autoregressive (STAR) model used in this study and their advantages and disadvantages and their application. The goal of the chapter is to describe the method used in conducting the research and their application. The chapter is divided into two sections discussing the two empirical methodologies adopted for the two empirical studies. In section one, the VECM model is introduced, and some important econometric issues in a VECM application like stationarity, cointegration, structural break and evaluations are discussed. In the second section, the STAR model is introduced, and its modelling approach is described.

1.2.5 Overview of Chapter Six

The chapter six of the thesis presents one of the empirical investigation carried out in the study about the degree and speed of ERPT in Nigeria using a VECM model. The chapter is divided in to four section. After the introduction in section, the theoritical model presented in section two. The empirical model is specified in section three, and the results of the estimations are presented in section four. Section five provides a conclusion and policy recommendation. The study reports full pass-through in the long-run; however, no significant exchange rate pass-through in the short run.

1.2.6 Overview of Chapter Seven

The chapter seven of the thesis presents one of the empirical investigation carried out in the study about asymmetric and nonlinear ERPT in Nigeria. After the introduction, the theoritical model is presented in section two. Section three specifies the empirical model and properties of the data. Section four of the chapter presents the results and discussion. Section five draw the conclusion and policy recommendations. The study confirms nonlinearities and asymmetries in ERPT in Nigeria. A statistical test was used to compare the performance of the linear Autoregressive (AR) and the nonlinear STAR model which indicates that the nonlinear STAR model fits the data better than the linear AR model. The result also suggests that with the nonlinear model, there is significant ERPT even in the short-run though incomplete.

Chapter 2 :
Review of Exchange Rate, Trade and Monetary Policies in Nigeria

2.1 Introduction

The aim of this chapter is to critical analyse the impact of the exchange rate policy changes in Nigeria particularly from the 1986. Nigeria adopted the floating exchange rate system following the economic recession in the early 1980s. Again in 1998 after four years of the fixed regime Nigeria reverted to the floating exchange rate system. The review focuses on the effect of exchange rate movement on the domestic consumer price following the policy changes and the successes and failures of the exchange rate policy on controlling the exchange rate pass-through. Considering that economic performance and exchange rate policy are interlinked through the effect of latter on the aggregate demand, the exports and imports, hence this chapter starts by first reviewing the general economic performance of the country by analysing the key economic indicators. This chapter also provides an overview of exchange and trade policies and the motivations behind both policies and their effect on exchange rate pass through during 1960 - 2013. We also reviewed the overall monetary policy framework and implementation in relation to their effect on the ERPT to consumer prices.

Nigeria is one of the most populous less developed countries in the world and the Africa's most populous country with an estimated total population of 185.9 million in 2016 with a population density of 204 per square kilometres and per capita income of USD 2,178 in 2016. The gross savings as a percentage of GDP was 17.7% in 2015. Nigeria’s total adult literacy rate is 59.6% in 2016. Nigeria was ranked 23rd in the World Bank’s GDP ranking in 2015 and emerged Africa's largest economy after its April 2014 statistical "rebasing" exercises (World Bank, 2017).

Similarly, Nigeria is the largest oil producing country in Africa and sixth in the world with a crude oil production capacity of 2.5 million barrels per day (NNPC, 2017). It is also the country with second largest proven oil reserves in Africa and the tenth largest in the world (OPEC, 2017). Since the 1970s, Oil has been the primary source of the nation’s income and government revenues. However, over the last five years, Nigeria’s economic growth was driven by agriculture and services sector which contribute 26% and 54% of real GDP respectively in fourth quarter 2016. Due to the lower oil prices, GDP growth in 2016 fell by 1.5% (NBS, 2017).

Nigeria was a British colony and became independent on 1st October 1960. In the early post-independence era up to 1973, the exchange rate was passive as exchange rate policy was in line with the IMF par value. A fixed exchange system where the country’s currency Naira was pegged to the Great Britain pounds sterling or the US dollar existed from 1973 to 1986. In 1986 a market-based exchange rate system was introduced after the adoption of the IMF structural adjustment programme (SAP). However, the constant pressure on the foreign exchange market leads to persistent depreciation and devaluation of the Naira. High inflation pressures due to exchange rate pass-through to the consumer price compelled the authorities to adopt various policy changes at different times. Those policy changes often lead to intervention in the foreign exchange market. Hence, Nigeria's exchange rate management after 1986 could be described as “managed float” in which the Central Bank of Nigeria (CBN) intervene on a delicate balancing act of controlling volume and price (Obadan, 2006).

With the adoption of the IMF structural adjustment programme, the financial and trade sector which were hitherto controlled became more liberalised. The SAP was aimed at changing and realigning aggregate expenditure and production patterns to reduce overdependence on imports and develop the non-oil export base, to diversify the productive base of the economy through the adoption of floating exchange rate regime, reforming tariff to help the promotion of industrial diversification and improve trade and financial liberalisation.

However, the structural adjustment programme does not achieve most of those objectives. The programme seemed to have stepped up speculative trading activities instead of increasing production. The policy did not bring in the desired foreign direct investments. The private sector did not perform as expected, even with the supportive environment provided. The private sector was unable to respond satisfactorily to the yearning for improved production, employment and price stability.

A persistent depreciation of the Naira followed which generated more problems in the economy. The exchange rate volatility created uncertainties and fuelled consumer price inflation via exchange rate pass-through. The exchange rate depreciations are transmitted to the domestic consumer price directly through an increase in prices of imported finished goods and raw materials, and indirectly through the demand pressure, its creates in the labour market which raises the wages levels, which ultimately reflect in the price of goods produced. Nigeria witnessed its peak inflation rate of 70% in the mid-1990s which compelled the authorities to intervene by introducing various reforms in the exchange policies of the country to address the persistent consumer price inflation.

This chapter is divided into seven sections. The second section provides an overview of Nigeria's economic performance under different macroeconomic policy regimes by reviewing the various macroeconomic indicators. The third section reviews different exchange rate policies adopted since independence in 1960 to 2013 and the motivation behind the policies and their effect on exchange rate pass through. Section four provides an overview of the overall monetary policy direction of the country since independence in 1960 to 2013 and their consequencies on exchange rate pass through. In section five, a discussion of the nation's trade policies and practice over the period from 1960 to 2013 is provided and its effect on pass-through of the exchange rate changes to consumer price. Section six discusses recent developments and the prospect of the nation. In the seventh section, a conclusion to the chapter is drawn.

2.2 Overview of Economic Performance in Nigeria since 1960

This section discusses the general economic performance of Nigerian economy from its independence in 1960 to 2013 under different economic regimes. The review categorises the whole period into the following different sub-periods: the pre-oil boom decade (1960-70); the Oil boom period (1971-1977); the stabilisation and structural adjustment period (1978-1993); the guided deregulation period (1994 - 1998) and the 21st century Nigeria economy (1999-2013). We analysed different financial and macroeconomic indicators under the different sub-periods.

2.2.1 The Pre-oil boom Decade (1960 -70)

The early post-independence Nigerian economy was mainly agriculture, exports and commercial activities based. The export was mainly of raw material, as such, there was no viable industrial sector. Despite fluctuations in world prices, agriculture contributed about 65% of the gross domestic product (GDP) and constituted nearly 70% of total exports (Ekundare, 1973). Agriculture provided the foreign exchange earnings which were used in importing raw materials and capital goods. The economy was self-sufficient in term of food. The government set up various marketing boards which generated considerable revenue. The surplus proceeds were used to improve the basic infrastructure necessary for long-term development. The key economic policy objective then was to make the most of the benefits of the export-led growth strategy (Ekundare, 1973).

Raw materials which comprise of agricultural produce and minerals were exported to the industrialised countries in Europe and America. Import substitution industrialisation (ISI) strategy was adopted. Therefore, many consumer items, which were previously imported, were produced locally. Dumping protection measures like tariffs, quotas, prohibition, etc. were used to ensure that local industries were allowed to grow (Ekundare, 1973).

Throughout this period, the rates of growth, inflation and unemployment and productivity go on the reasonably acceptable level. The economic policy was geared towards strong demand management. Increased productivity preserved stability in prices within the economy. The Nigeria currency's average exchange rate during the period was 0.71 per US dollar. The average annual GDP growth was 2.9%, while the average per capita GDP was USD118. The average annual inflation (Consumer prices) during the period was 4.93%, (see Table 2.1). The Nigerian civil war during 1967-1970 has impacted negatively on the GDP growth and the inflation during the period.

The average real interest rate was negative (-7.32%) during the 1960-1970 period despite the low average inflation rate of 4.93%. The foreign direct investment as a percentage of GDP was also at low 1.63% (See Table 2.2).

The First National Development Plan 1962-1968 ensured that the government engaged in economic activities, directly and indirectly. The Plan maintained that government needs to provide the essential infrastructure. Due to the high poverty rate, the government offered incentives to speed up the rate of economic growth and development. Private savings were still low; therefore, the level of private investment was small. Foreigners still control the manufacturing, trading and services sub-sectors. Multinational companies still dominate until the mid-1960s when some Nigerians began to occupy high-ranking positions in the multinational corporations (Ekundare, 1973).

Table 2.1: Average GDP growth, GDP per capita and consumer price Inflation

Period	Average GDP growth (Annual %)	Average GDP per capita (current USD)	Average Annual Official exchange rate (Naira/USD, period average)	Average Inflation, consumer prices (Annual %)	Exchange rate policy/Financial policy Regime
1960 - 1970	2.90	118	0.71	4.93	Fixed/Controlled
1971 - 1977	6.28	364	0.65	15.84	Fixed/Controlled
1978 - 1986	-1.83	543	5.03	14.01	Fixed/Controlled
1987 - 1993	2.56	263	10.48	34.06	Managed Floating/Liberalised
1994 - 1998	2.22	269	21.91	35.53	Fixed/Liberalised
1999 - 2013	7.48	1241	130.67	11.61	Managed Floating/Liberalised

Source: Researcher's computation based on World Bank data.

The average of the annual GDP growth increased tremendously to 6.28% during the oil boom period of 1971-1977 from the average of 2.9% in the period 1960-1970 which is also reflected in the average GDP per capita which rises to USD364 from USD118.

The improved GDP growth could be due to the increased capital inflow because of rise in the international oil price.

The Nigeria's currency exchange rate appreciated due to the excess foreign exchange in the market.

The boom of the 1971-1977 seems to have fueled the inflation which rises to annual average of 15.84% at the time from the 4.93% of 1960-1970.

However, the rise in inflation rate during the period could not be attributed to exchange rate pass-through as the exchange rate appreciated during the period but to excess money supply in the economy.

The oil boom period of the 1971-1977 was followed by a drop in the average GDP growth to negative -1.83% during 1978-1986.

The fall in the GDP growth could be attributed to the oil price collapse during the period which led to a drastic drop in the foreign exchange inflow.

The collapse of the oil price also led to the fiscal deficit as the oil export is the major source of government revenue.

The inflation rate slightly drops to a period average of 14.01% during the 1978-1986 from the 15.84% of 1971-1977.

There were a serious fiscal crisis and structural imbalance which compelled the government to adopt the IMF's structural Adjustment programme (SAP) in 1986.

The five year period of 1987-1993 saw a tremendous improvement in the GDP growth to 2.56% from the negative -1.83% of the period 1978-1987.

However, the inflation rate rises significantly to 34.06% in the period 1987-1993 from the 14.01% of 1978-1986.

The rise in the inflation rate could be due to the severe exchange rate depreciation that followed the floating of the Naira exchange rate.

The Naira exchange rate depreciated to a period average of 10.48 per USD from the 5.08 per USD of 1978-1986.

Hence the rise in the inflation rate during the period 1987-1993 was probably due to exchange rate pass-through.

The government was compelled to put a hold on the depreciation of the Naira exchange rate and its impact on the consumer by introducing a fixed exchange rate regime in 1994.

The period average of the GDP growth slightly dropped in the fixed exchange rate regime period of 1994-1998 to 2.22% from the 2.56% in the period 1987-1993.

However, the inflation trend continuous as it slightly increases to 35.53% in the period 1994-1998.

But the excessive increase in the inflation rate of the previous period 1987-1993 was not witnessed in the fixed regime period 1994-1998.

From 1999, Nigeria reverted to the managed floating exchange rate.

In the period 1999 to 2013, the period average of the annual GDP growth immensely improved to 7.48% from the 2.22% of the period 1994-1998.

The improvement was also reflected in the GDP per capita as it tremendously increases to USD 1247 from the USD 268 of the 1994-1998 periods.

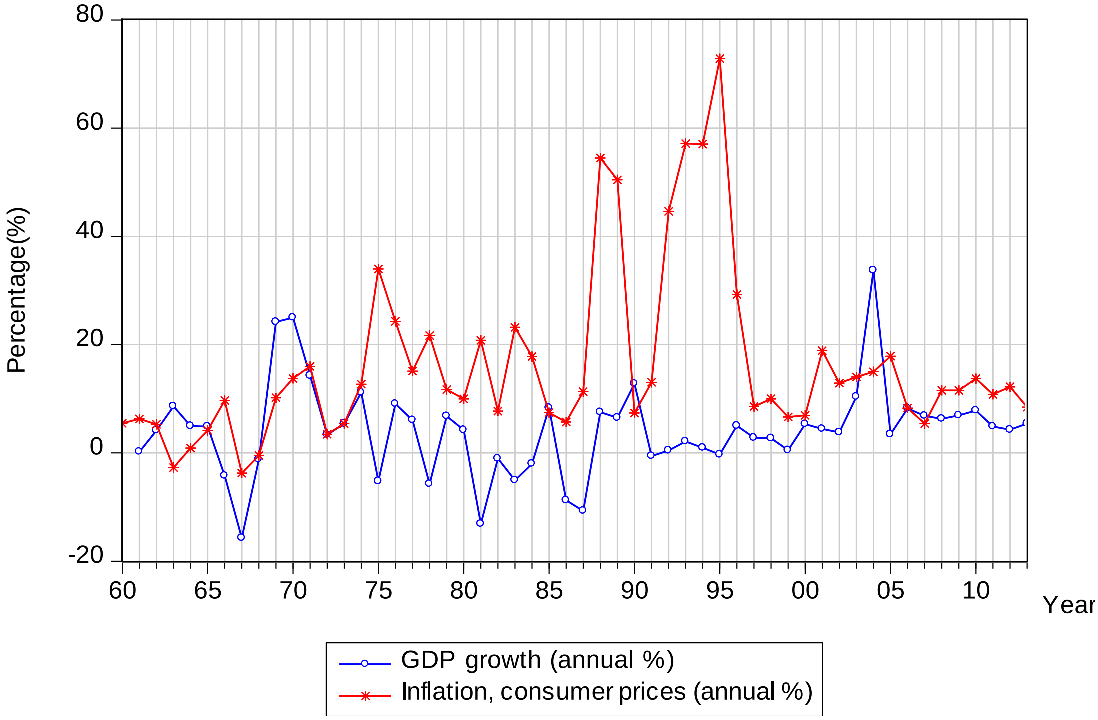
The period average inflation rate also drastically dropped to 11.61% in the period 1999-2013 from the 35.53% in the 1994-1998 periods.

The drastic decrease in the inflation rate could be partially due to a reduction in exchange rate pass-through to consumer prices.

The Naira exchange rate jumped immediately after the 1999 reversion to the managed floating regime but the year-after-year depreciation during the period 1999-2013 was low compared to the period after the first adoption of floating exchange rate regime.

The average Naira exchange rate during the period 1999-2013 was 130.67 Naira per USD.

Figure 2.1: Annual Inflation (consumer price) and GDP growth



Source: Constructed based on World Bank data

The movement in the GDP seem to have been followed by a move in the same direction by the inflation from the 1960s up 1974.

From 1974 to 1985 the inflation rate appears to be rising even when the GDP is falling.

The effect of the major policy change in 1986 is visible in both the GDP and the inflation rate.

Relative stable growth and inflation were achieved in the period 1997 to 2000.

The steady increase in GDP after 2000 seems to have fuel the inflation between 2000 and 2005.

Between 2007 and 2013 there was relative stability both in the growth rate and inflation rate.

2.2.2 The Oil Boom Period (1971-1977)

The oil boom of 1971 to 1977 helped Nigeria earn massive foreign exchange from oil export. That adversely affected the agricultural sector which was previously the principal contributor to the GDP (Pinto, 1987). In 1971, Agriculture contributed 48% to the GDP, but by 1977 it declined to virtually 21%. Agricultural exports as a percentage of total exports that was about 21% in 1971 decreased to about 6% in 1977. The oil production as a share of GDP was 11.1% in 1971 rises to 22.6% by 1977. The oil export as a percentage of the total export was 57.5% in 1971, but it grew to 93.4% by 1977 (Pinto, 1987).

Even though the boom provided the government sufficient needed revenue, on the other hand, it generated severe structural problems in the economy. The agricultural sector was neglected, and rural-urban migration increased. Production of agricultural produces for export dropped. Food production also fell, and food prices skyrocketed. By 1974, the economy turns into a net importer of basic foods. An enormous amount of foreign exchange earnings were used in importing food. The government introduced policy programmes like Operation Feed the Nation (OFN) to encourage agriculture, but the problem could not be reversed. The government participated in direct food production, provided subsidies to agriculture and established more commodity boards for different agricultural and food products.

The average annual GDP growth in the period 1971-1977 was 6.28% which was a substantial improvement from the 2.90% of 1960-1970. The average GDP per capita for the period was USD364 which also more than tripled the average in the period 1960-1970. The Naira exchange rate strengthened as the average Naira/USD exchange rate was 0.65 per US dollar during the period (see Table 2.1). The government expenditure due to the excessive revenue generated seems to have fuelled the inflation. In 1975 the rate of inflation rose to its peak rate during the period of 34%. The average annual inflation rate of 15.84% was recorded in the period 1971-1977. The average annual real interest rate remains negative during the period 1971-1977, though it slightly improved to (-5.66%) from the (-7.32%) of 1960-1970. Similarly, a slight improvement was observed in the average foreign direct investment for the period to 1.85% from the 1.63% of the 1960 - 1970 periods.

Table 2.2: Inflation rate, Real interest rate, gross savings and Foreign direct investment

Period	Average annual Inflation, consumer prices (Annual %)	Average annual Real interest rate (annual %)	Average annual Foreign direct investment, net inflows (% of GDP)	Exchange rate policy/Financial policy Regime
1960 - 1970	4.93	-7.32	1.63	Fixed/Controlled
1971 - 1977	15.84	-5.66	1.85	Fixed/Controlled
1978 - 1986	14.01	-2.28	0.68	Fixed/Controlled
1987 - 1993	34.06	-8.38	4.00	Managed Floating/Liberalised
1994 - 1998	35.53	-3.88	5.35	Fixed/Liberalised
1999 - 2013	11.61	3.33	2.87	Managed Floating/Liberalised

Source: Researcher's computation based on World Bank data.

The average of the annual consumer price inflation increased tremendously to 15.58% during the oil boom period of 1971-1977 from the average of 4.93% in the period 1960-1970.

The boom of the 1971-1977 seems to have fueled the inflation in the economy.

However, the average annual real interest rate improved from negative 7.32% to negative 5.66% which also reflected in the foreign direct investment (FDI).

The average annual FDI (% of GDP) for the period 1971-1977 slight improved to 1.85% from 1.63% of the period 1960-1970 which could be due to the improvement in the real interest rate.

When post oil boom recession sets in, the inflation rate slightly decreased to a period annual average of 14.01% during the period 1978-1986.

The average annual FDI (% of GDP) for the period 1978-1986 also significantly improved though still negative to -2.28% from the -5.66% of the previous period 1971-1977.

The post-floating exchange rate regime period of 1987-1993 witnessed a high inflation rate due to exchange rate pass-through which also worsens the real interest rate to a period annual average of -8.38% from the -2.28% of the previous period 1978-1986.

But still the FDI in the period 1987-1993 improved which could be due to the liberalisation of the financial sector which encourages the foreign investors.

After the return to fixed exchange rate regime in 1994 the inflation rate slightly increased in the period 1994-1998 of the fixed exchange rate regime as the rate increases to 35.53% in the period.

The real interest rate and the FDI both further improved in the period 1994-1998 as the drastic depreciation of the Naira which fuel the inflation and deteriorate the real interest rate was put to hold and the financial system was still liberalised therefore encourage investors.

In the period 1999-2013 with the return to manage floating exchange rate the Naira exchange rate dropped, but it was steady compare to the aftermath of 1986 adoption of floating exchange rate regime.

The average annual real interest rate significantly improved in the period 1999-2013 to positive 3.33%.

However, the foreign direct investment (FDI) dropped to an annual average of 2.87% during the period 1999-2013 which could be due to some policy inconsistencies of the successive regimes in the country.

2.2.3 The Stabilisation and Structural Adjustment Period (1978 - 1993)

For most of the period between 1978 and 1986, the Nigerian economy continued to record negative GDP growth rates. The boom of the 1970s, led to the neglect of the agricultural sector as the country found sufficient funds to import foods, manufactured goods and raw material. The contribution of the agricultural sector to the GDP declined consistently in the 1970 (see figure 2.1). The declining contribution of agriculture and the growing role of the oil industry were astonishing. For instance, by 1979 the annual food import multiplied more than ten times the food imports before 1973 and more than twenty times that of before 1970.

The falling oil revenues, the balance of payments disequilibrium, rising unemployment, swelling rate of inflation and political instability, all revealed that demand-induced policies were not effective anymore. By 1978, a country which had thought that foreign exchange was not a constraint on development went borrowing. The government introduced austerity measures to curtail the growing problems. The GDP, which grew by 9% in 1976 declined to negative -5.8% in 1978. Therefore, the economy goes into recession, which necessitated further stabilisation measures to reverse the situation.

The inflation and unemployment were high as well as a fiscal imbalance. The government's stabilisation and austerity measures of 1979-1983 fail to arrest the deepening crisis. There was no improvement in the balance of payment situation. Consequently, there was an increase in external debt profile. It was evident that the economy was suffering from stagflation. The industrial capacity utilisation of the country declined consistently during the period. The poor performance was recorded in spite of different stabilisation policies in place. The structure of the economy became more vulnerable to external shocks and policies through exchange rate pass-through. The problems were so confounded that restructuring of the economy was inevitable.

Consequently, the IMF's broad economic reform package Structural adjustment programme (SAP) was adopted in 1986. The programme was aimed at changing and realigning aggregate expenditure and production patterns to reduce reliance on imports; re-develop the non-oil export base, and take the economy back on the track of sustainable growth and development. The specific objectives of the programme amongst others include the following:

to restructure and diversify the productive base of the economy to decrease over-reliance on the oil sector and imports;

to achieve favourable fiscal and balance of payments;

to establish the basis for viable non-inflationary or least inflationary growth and to decrease the dominance of unproductive investments in the public sector, improve the industry's efficiency and strengthen the growth potential of the private sector.

The prominent policy measures adopted in pursuance of these objectives included:

adoption of a realistic exchange rate policy (floating exchange rate);

streamlining and reorganisation of tariffs to help the promotion of industrial diversification;

enhanced trade and payments liberalisation;

dropping complicated administrative controls concurrently with a greater reliance on market forces;

adoption of appropriate pricing policies, particularly for petroleum products and public enterprises; and

privatisation and commercialisation of public sector companies (World Bank, 1994).

However, the programme seemed to have step up speculative and trading activities instead of increasing production. The policy did not bring in the desired foreign direct investments. The private sector did not perform as expected, even with the then supportive environment provided. During the programme, the private sector was thought to serve as an engine of growth. But, after eight years of the structural adjustment measures, the private sector was not able to respond satisfactorily to the yearning for improved production, employment and price stability.

Therefore, eight years after the structural adjustment programme, non-oil exports continued to be insignificant. The persistent depreciation of the Naira vis-a-vis the other main currencies created further distortions in the economy. The instability in the exchange rate leads to uncertainty and fuelled inflation. There was a correlation between trends in the exchange rate and inflation as depicted in Figure 2.2.

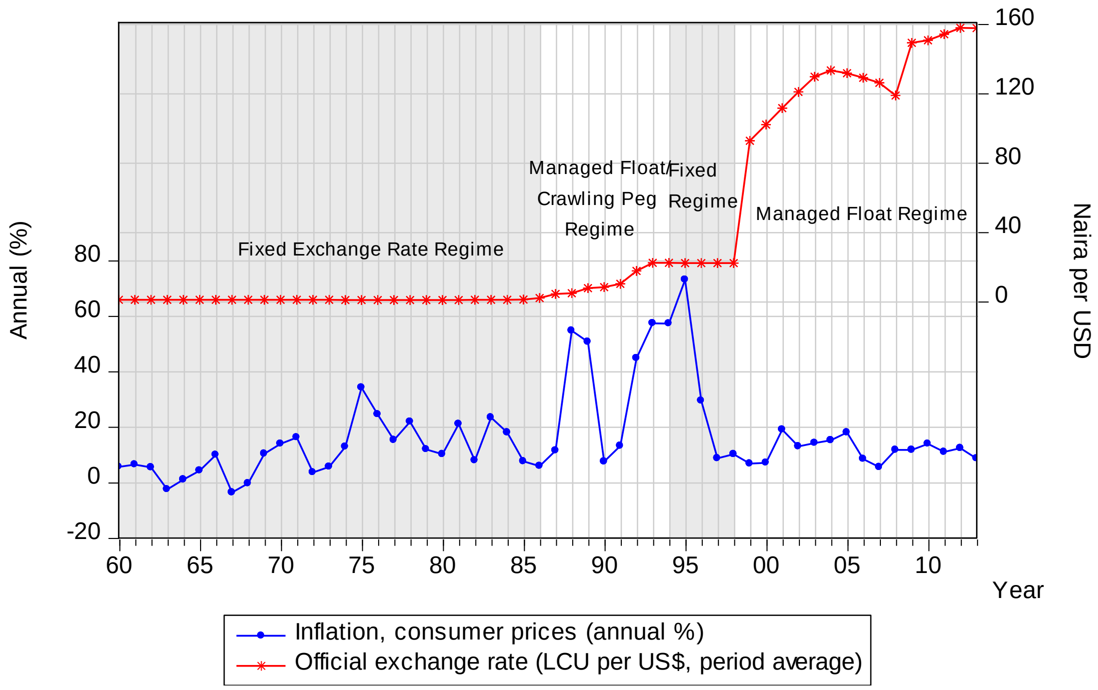
The inefficient foreign exchange market leads to huge profits for the financial sector. The situation was due to the huge differential between the official and the parallel market rate. As a result, there was a boom in the financial sector, although not in the other areas of the economy.

The average annual GDP growth in the period 1978-1993 dropped to 0.09% from the average annual growth of 6.28% of the 1971-1977 period. The average GDP per capita for the period however improved USD421 from the USD364 in the period 1971-1977. The Naira exchange rate depreciated as the country switched to floating exchange regime form 1986. The average Naira/USD exchange rate for the period was 5.05 per US dollar. The average inflation rate for the period tremendously increased to 22.78% from the 15.84% of the 1971-1977 periods (See Table 2.1).

The increase in the consumer price inflation must have been confounded by the exchange rate pass-through as the Naira exchange rate extremely depreciated during the period with the adoption of the floating regime (See Figure 2.2).

The average annual real interest rate continued to be negative during the period 1978-1993, though it marginally improved to (-4.95%) from the (-5.66%) of 1971-1977. Likewise, there was a minor improvement in the average foreign direct investment for the period to 2.13% from the 1.85% of the 1971-1977 period (See Table 2.2).

Figure 2.2: Inflation and Exchange Rate



Source: Constructed based on data obtained from World Bank

After the floating exchange rate regime was adopted in 1986, the exchange rate consistently depreciates up to 1993.

The exchange rate depreciation and increased inflation rate were witnessed from the adoption of the floating system up to when the Naira was pegged in 1994 with the reintroduction of the fixed regime.

Despite the policy change from the floating to the fixed regime the inflation rate continued to increase for a year.

The inflation rate drastically dropped from the historical peak of 73% in 1995 to below 20% by 1998.

The re-introduction of the floating regime from 1998 lead to further devaluation and depreciation of the Naira.

The inflation rate slight increased after the floating system was re-introduced.

The Naira exchange rate kept depreciating for the whole period from 1998 to 2013 except when it slight appreciated between 2004 and 2008.

The inflation rate was maintained below 20% for the period from 1998 to 2013.

2.2.4 The Guided Deregulation Period (1994 -1998)

Some improvements were definitely achieved in the SAP period. However, the programme brought about various problems. The programme was hurriedly implemented. That caused general inflation, foreign exchange shortage, increased unemployment, low capacity utilisation, fiscal deficit and a general deterioration of the poverty condition in the country which necessitated an immediate review of the policy.

Consequently, the dual exchange rate regime was introduced in 1995 in a bid to redress the continuous depreciation of the Naira exchange rate. The goal was to achieve a stable and realistic value for the Naira. In 1996 the Central Bank of Nigeria, intervened in the operations of the autonomous market to make sure that it was sufficiently funded. The average GDP growth for the period improved to 2.22% though the average GDP per capita in current USD price dropped to USD 267 in the period from the USD 421 in the period 1978-1993. This could be due to the annual population increase of about 2.6% recorded which exceeds the annual GDP growth of 2.22%.

In the guided deregulation period, even with struggles by the government and the private sector to amend the condition, the unemployment was still high. The economy was not able to create adequate employment opportunities. The inflation rate rose from 57% in 1994 to about 73% in 1995 but dropped to 29% in 1996. It further decreased drastically to 8.5% in 1997 but rose slightly to 10% in 1998. Prices were therefore often unstable during the period of guided deregulation of 1994-1998 (See Figure 2.2).

A fixed Naira/USD exchange rate of ₦22 per US dollar was maintained during the period as the government pegged the rate. However, the exchange rate at the parallel markets sells at a far higher rate which created rent seeking opportunities in the system that fuelled corruption by the operators in the system.

The average annual real interest rate further improved from the (-4.95%) in the 1987-1993 period to (-3.88%) in the period 1994-1998. The improvement in the real interest rate and the fixed exchange rate must have encouraged foreign direct investment which increased to 5.35% in the 1994-1998 period from the average 2.13% of the 1978-1993 period (See Table 2.2).

2.2.5 The 21st Century Nigerian Economy

After Nigeria had returned to democracy with the 1999 election, the focus was on ensuring political stability, strengthening democratic practices, and tackling corruption. By 2004 the government got on a broad economic reform program built on a home developed strategy, the National economic empowerment and development strategy (NEEDS). The development of NEEDS at the federal level was complemented by individual State economic empowerment and development strategy (SEEDS), which were organised by all 36 Nigerian states and the Federal Capital Territory (FCT). The NEEDS program stressed the significance of private sector development to support wealth creation and poverty reduction in Nigeria (Okonjo-Iweala and Osafo-Kwaako, 2007).

The NEEDS programme was for the period 2004 - 2007. The economic variables have shown some improvement during the period. By 2009 another development agenda, Vision 20: 2020 was conceptualised which is the plan so far under implementation.

The average annual GDP growth in the period 1999-2013 improved tremendously to 7.48% from the average annual growth of 2.22% of 1994-1998. This is also reflected in the average GDP per capita for the period which increased to USD1241 from the USD267 in the period 1994-1998. However, the Naira exchange rate further depreciated to a period average of ₦130.67 per US dollar. But surprisingly the consumer price inflation decreased to a period average of 11.61%. This could be attributed to sound monetary and fiscal policies taken to control the exchange rate pass-through during the period 1999-2013 (See Table 2.1).

The average annual real interest rate also improved to 3.33%. However, the foreign direct investment (FDI) does not reflect the increased real interest rate as the FDI dropped to 2.87 in the period 1999-2013 (See Table 2.2). The decline in FDI could be due to the increasing instability of the exchange rate and policy inconsistency of the successive governments as the country returned to democracy in 1999.

2.3 Review of Nigerian Exchange Rate Policies

This section of the chapter discusses the different exchange rate policies adopted in Nigeria since independence in 1960 to date. The discussion of the exchange rate policies will be categorised into the periods before SAP and periods after SAP.

The exchange rate is a key price variable in an economy. It performs a two-fold role of preserving international competitiveness and serving as a nominal anchor for the domestic price. In Nigeria, the duty of managing exchange rate is on the central bank, since the adoption of SAP in 1986, and is a primary macroeconomic policy function. The overriding objective was to succeed in getting a realistic and stable exchange rate consistent with internal and external balance (Obadan, 2006).

Governments have much interest in the determination of exchange rate due to its significance. Specifically, the exchange rate is vital for the following reason: The exchange rate plays a role in linking the price systems in different countries, hence allowing merchants to compare prices directly. Exchange rates changes have a significant effect on imports and exports of countries through its effects on relative prices of goods. Hence, exchange rates are essential in promoting exports and discouraging imports. For instance: devaluation/depreciation is a measure to raise receipts from the foreign exchange by boosting exports. Devaluation will make the exports price inexpensive in foreign currency and therefore attractive to foreign buyers. Devaluation will discourage imports by making the cost of imports very expensive in local currency. Devaluation also efficiently allocates foreign exchange receipts to competing users of imports by allowing the price mechanism make the allocation. As a price, the exchange rate accomplishes the allocation of resources role of real resources, particularly between the tradable and non-tradable segments of the economy (Obadan, 2006).

Nigeria's exchange rate policy witnessed considerable changes from the early post-independence in the 1960s when the country operates a system of fixed exchange rate up to the beginning of the 1970s and after that from 1986 from the introduction of a market-based exchange rate system after the adoption of the IMF structural adjustment programme (SAP).

2.3.1 Exchange rate policy before SAP (1960 – 1986)

From independence in 1960, up to 1973, the Nigeria's exchange rate policy was in line with the IMF par value or the fixed exchange system. The exchange rate was passive as it was Great Britain pound sterling or the US dollar that determined the fate of the Nigerian currency. The Nigerian currency was pegged to the Great Britain pounds sterling from 1959 to 1972. However, after the devaluation of Great Britain pounds sterling in 1967 and with the aftermath of it that brought about the emergence of strong US dollar; the US dollar was included in the parity exchange. After the collapse of the IMF par value system in the early 1970s and the devaluation of US dollar in 1972, the Naira was adjusted in relation to the US dollar. Then the Nigerian currency was reverted to fixed parity to the pound sterling in 1973. In 1974, to minimise the effect of individual currency devaluation, the US dollar was included again in the parity exchange. Later in 1978, the Nigerian currency, Naira was pegged to a basket of twelve currencies of its major trade partners. This policy was abandoned in 1985 in support of quoting the Naira against US dollar to prevent the arbitrage prevalent in the basket of currencies (Obadan, 2006).

Before the adoption of SAP in 1986, importers and exporters of non-oil supplies need to obtain licences from the Federal Ministry of Commerce for them to partake in the foreign exchange market. Import procedure was in line with the international standard of the opening of letters of credit (L/Cs) and subsequent validation by correspondent banks overseas. In 1979, the use of Form 'M' was introduced when the Comprehensive Import Supervision Scheme (CISS) was established to prevent sharp import practices. The permission of foreign exchange disbursement was a shared responsibility between the central bank of Nigeria and the Federal Ministry of Finance. The central bank allocates foreign exchange in respect of private sector applications, while the Federal Ministry of Finance was responsible for public sector applications. More emphasis was placed on export promotion as a means of decreasing pressure on the external sector. The then government introduced various incentives to boost non-oil exports. For instance, among the incentives introduced are preparations for establishing export free zones, concessions to exporters to keep 25% of their export earnings, the liberalisation of import and export licensing system and the provision for the creation of an export credit guarantee and insurance scheme. The exchange control was removed on September 26, 1986 (CBN, 2016).

Objective of Exchange Rate Policy before SAP (1960 – 1986)

The key aims of the exchange rate policy for the period before 1986 in Nigeria are: to attain a balance of payment equilibrium, to preserve the value of external reserve and maintain stable exchange rate which was essential to the internal and external macroeconomic adjustment and stability. Even though different temporary actions were taken to achieve the policy objectives, the economic goals remained the key players in the exchange rate determination.

Until the time of SAP adoption in 1986, the exchange rate policy promoted overvaluation of the country's currency as evidenced in the appreciation of real exchange rate most especially in the 1970s. For most of the years during the 1970s except in 1976 and 1977, the nominal exchange rate appreciated year on year. It was perhaps to find a cheap import to execute developmental projects and service the import-substituting industries. The policy promotes overdependence on import which eventually led to a balance of payments problems and left the foreign reserves weakening. Then a policy of gradual depreciation of the Nigerian currency against the US dollar and Great Britain pounds sterling was adopted from 1981, after the crash of the oil price in the international market (Obadan, 2006).

The key factor that helps in the appreciation of real exchange rate was the unprecedented rise in the price of oil and foreign exchange inflow. Generally, exchange rate mirrored movements in the prices of oil. The increase in the real exchange rate encouraged imports, and capital flight discouraged exports from the non-oil sector and aided in continued over-reliance on the imported input of the manufacturing sector. The before then booming agricultural sector was neglected, whereas the import substituting industries could not succeed because of the growing imports. The annual output of the major cash crops: cocoa, cotton, groundnut and rubber dropped by 42%, 65%, 64% and 29% respectively between the period 1970 and 1985 (Osaka *et al.* 2003 cited in Obadan, 2006).

Overall, the prime objective of exchange rate management was not the medium and long-term balance of payment goal. Considering that the exchange rate policy was not geared towards achieving a long-term equilibrium rate. Nonetheless help the realisation of some structural adjustment objectives, for instance, reduction in imports reliance and export diversification (Obadan, 2006).

2.3.2 Exchange rate policy after SAP (1986 to Date)

A Second-tier Foreign Exchange Market (SFEM) was adopted on September 26, 1986. With continuous fine-tuning, the market culminated in the full floating of the Naira on March 5, 1992, as the arrangement of pre-determined quotas was dropped. However, the consistent pressure on the foreign exchange market leads to policy reversal in 1994 back to the fixed exchange rate regime up to 1995 when the country switched to guided deregulation. Hence, Nigeria's exchange rate management after 1986 could be described as “managed float” in which the CBN intervene on a delicate balancing act of controlling volume and price (Obadan, 2006).

The exchange rate policies undertaken during this period 1986 to date can be discussed from the perspectives of exchange rate policy targets, strategies and frameworks, the exchange rate movements and their effects.

Objectives of Exchange rate policy after SAP (1986 to Date)

With the adoption of the IMF’s structural adjustment programme that was employed from July 1986, the strategy was to allow the exchange rate of Nigerian currency to float and create the institutional framework for Naira to trade in the market-determined environment. Hence, the market-determined exchange rate was established. The objective of the exchange rate policy was to pursue within the institutional framework of Second Tier Foreign Exchange Market (SFEM) the following:

To achieve an exchange rate determined by the market forces of demand and supply;

To realise more efficient resource allocation via substantial reduction on fraudulent and wasteful transactions;

To stimulate the non-oil exports in the economy;

To boost of foreign exchange inflow and discourage outflow;

To enhance government revenue;

To address the gross imbalances in rural-urban incomes and welfare; and

To eliminate currency trafficking and wiping out unofficial parallel foreign exchange market.

Hence, it was the expectation then that eventually the exchange rate policy and management strategies would result in an improvement in the balance of payment position and warrant a significant amount of convertibility of the naira.

The objectives of exchange rate management under the structural adjustment programme can, to some extent, be said to have revealed the desires of medium/long-term balance of payment equilibrium. The SFEM was expected to achieve realistic Naira exchange rate that will decrease excess demand for foreign exchange to import finished products and services and spark non-oil export earnings.

Institutional Framework and Management Strategies

In the attempt to achieve the objectives of exchange rate policy, various amendments were made to the institutional framework as the SFEM changes to the Foreign Exchange Market (FEM), Autonomous Foreign Exchange Market (AFEM), Dutch Auction System(DAS) and the wholesale and retail DAS.

Second Tier Foreign Exchange Market (FEM)

The Second-tier Foreign Exchange Market (SFEM) started on September 26, 1986, when the Naira exchange rate determination was made to reflect market forces. The Foreign Exchange Market management modalities changed significantly from the introduction of SFEM, in line with the SAP principles which emphasise the market-oriented approach to price determination. The SFEM was expected to develop an efficient exchange rate determination for allocation of foreign currency to ensure short-term stability and long-term balance of payments equilibrium. The SFEM started with a transitory dual exchange rate system (first and second-tier). The official first-tier exchange rate was determined administratively and steadily depreciated. It applies to a few official international transactions, like the obligations to international organisations and debt servicing. The 'free' market rate (Second-tier) applied to the remaining operations and was determined by the demand and supply force of the market within the framework of the foreign exchange market auction system. The main aim of using the dual exchange rate system was to avoid a deliberate uniform and sizable depreciation of the currency but to allow it to depreciate in the SFEM. However, simultaneously the monetary authorities would continue a downward adjustment of the first-tier rate to converge the two rates to create a realistic exchange rate. The convergence was achieved on July 2, 1987, at the rate of N3.74 per $1.00. However, some analysts described it as forced (Ojameruaye, 1991cited by Obadan 2006).

Foreign Exchange Market (FEM)

FEM was established on 2nd July 1987, when the first and second-tier markets which existed under the previous AFEM were merged. Hence with the emergence of an integrated exchange rate system, the first-tier was eliminated. The FEM had two components, autonomous foreign exchange market and official foreign exchange market auction sessions. The former was expected to be competitive with the parallel foreign exchange market and thus be attractive to exporters. Subsequently, different pricing methods, like marginal, weighted average and Dutch system, were adopted. However, the autonomous market later became destabilising due to the trend of higher arbitrage premium, and allegations of authorised dealers engaging in round tripping (CBN, 2016).

Inter-Bank Foreign Exchange Market (IFEM)

IFEM emerged in January 1989 as a result of the merger of the official official and autonomous markets. It was a daily bidding system under which the central bank injects official funds into the market as and when funds were available. The IFEM ended in December 1990 with the re-adoption of Dutch Auction System (DAS). A daily, two-way quote IFEM was re-introduced on October 25, 1999. The IFEM was expected to expand and deepen the foreign exchange market on a daily basis and discourage speculative activities (CBN, 2016).

Dutch Auction System (DAS)

DAS was first introduced in April 1987 and reintroduced in December 1990, and again in July 2002 as the retail DAS. A wholesale DAS was introduced in 2006 and back to retail DAS again in 2013 until its suspension in 2015. DAS was introduced to remedy the widening gap between parallel and official exchange rate and higher demand for the foreign exchange. DAS involves a payment by an authorised dealer of the foreign exchange that bids for the forex, unlike where all dealers pay a centrally determined rate by the central bank. The DAS was introduced to improve professionalism in FEM and check despicably high bid rates which consistently led to naira depreciation (Obadan, 2006).

The DAS is basically an exchange rate determination technique. Besides this, other specific methods were used alone or jointly to determine the exchange rates. The methods include the average and marginal exchange rate. There were operational procedures also, like daily, weekly and forth nightly foreign exchange bidding systems. They were all tried with the aim of achieving a realistic exchange rate (CBN, 2016).

Autonomous Foreign Exchange Market (AFEM)

AFEM was first introduced in 1987 as part of the FEM for trading in privately sourced foreign currency. The exchange rate in the market was market-determined, while the CBN interventions were only to ensure stability in the exchange rate. AFEM was re-introduced again with the policy reversal in 1995 from 'fixed exchange rate system' to 'guided deregulation. A dual exchange rate began with the re-introduction of AFEM in addition to the official exchange rate.

As part of the newly introduced policy measures in managing the country's foreign exchange resources at the time was demand management and supply side policies. The central bank and the government then actively promoted the development of institutions like Nigerian Export-Import Bank (NEXIM) and Nigerian Export Promotion Council (NEPC) to earn more foreign exchange.

Fixed Exchange Rate System

Fixed Exchange Rate System was reintroduced in 1994, and the Naira exchange rate was pegged at N22.00 per $1.00. Likewise, the foreign exchange earnings were domiciled in the central bank. The objectives then were to stabilise the Naira exchange rate and stop the inflationary spiral linked with the continued depreciation of the Naira. Also to create a favourable atmosphere for economic revival and stimulate the aggregate supply of foreign exchange through increased receipt from non-oil exports and foreign investment. However, the development in 1994 indicates that the objectives were not achieved. To stop the trend, the government in 1995 decided to adopt a guided deregulation of the foreign exchange market (Mordi, 2006).

Recently, with the drop in oil price, from last quarter of 2014, Naira suffers substantial depreciation which compelled the central bank to implemented fixed exchange rate from 2015 to June 2016, which pegged the Naira at 198 per USD to protect the Naira (Mitchell, 2016).

Guided Deregulation Exchange Rate System

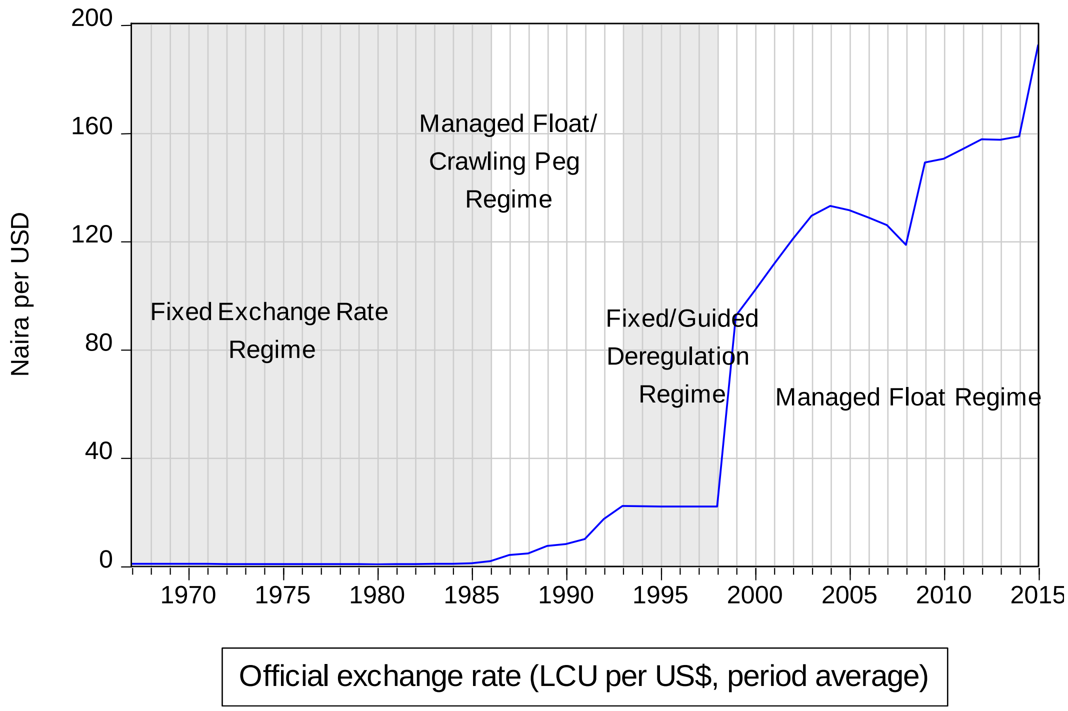
Guided Deregulated Exchange Rate System was introduced in 1995 in an attempt to improve the efficiency of the foreign exchange market by decreasing the parallel market premium. It involved stoppage of the system of pre-determined quotas for banks and allowed the allocations to be determined by the rates that emerged in the market. Therefore, the foreign exchange market was further deregulated by realigning the official exchange rate with that in the parallel market. The CBN bought and sold foreign exchange in the market and was expected to satisfy all requests made by authorised dealers (Mordi, 2006).

2.3.3 The Trends of the Exchange rate and effects of the Exchange Rate Management Strategies

Since the introduction of the market-based exchange rate system in 1986 after the adoption of the IMF's structural adjustment programme, the exchange rate of Nigeria currency Naira has shown the features of volatility, in almost all the period, with repeated depreciation in the official, bureau de change and parallel markets for foreign exchange.

The repeated, and frequently large, devaluation/depreciation of the naira use to be an issue of serious concern sometimes. For instance, in 2001 the parallel foreign exchange market premium broadened to 18.3 percent whereas sharp depreciation in the exchange rate prompted spontaneous reactions from different stakeholders.

Figure 2.3: Official Exchange Rate



Source: Constructed based on data obtained from World Bank

The effect of the exchange rate policy changes in 1986, 1993 and 1998 was quite visible.

In 1986 the floating exchange rate was introduced after the adoption of SAP programme.

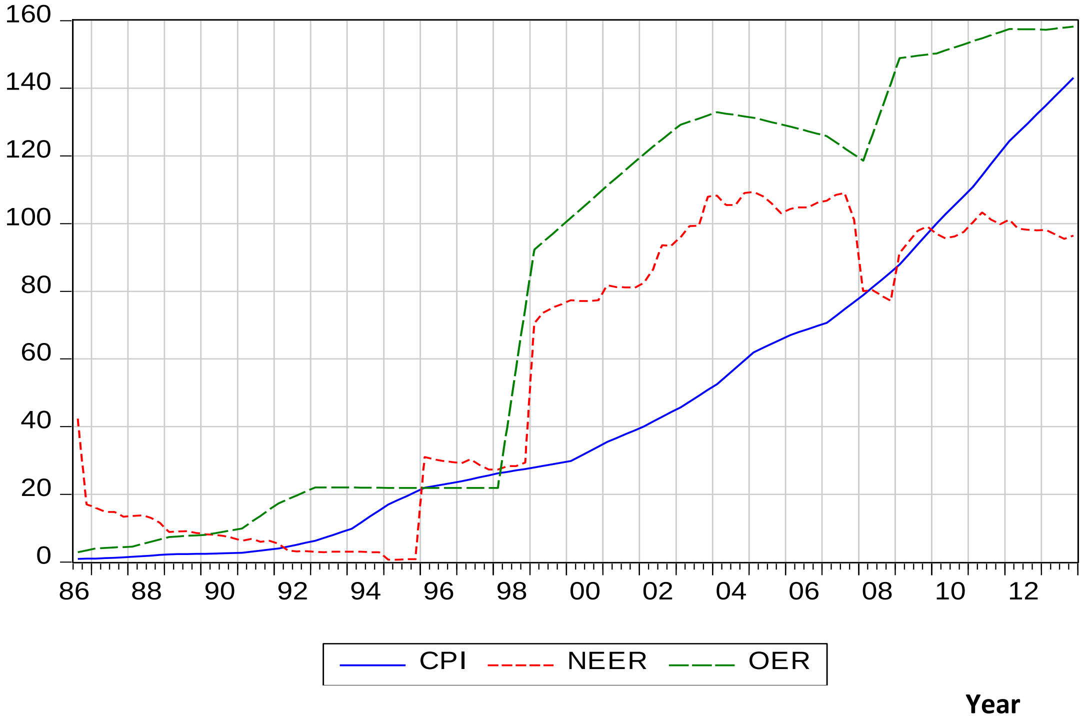
In 1993 a fixed exchange rate regime was introduced following the rising inflation due to potential ERPT.

In 1998 the fixed regime was abandoned, and floating exchange rate system re-introduced.

Figure 2.3, shows the movement of exchange rates. It reveals that from its level of N0.89 per USD1.00 in 1985, the year before the introduction of the market-based SFEM, the exchange rate moved to N17.30 per USD1.00 in 1992 and N22.07 per USD1.00 in 1993. From 1994 when the fixed regime was re-introduced the naira was pegged at N22.00 per USD1.00 up to 1998 when the system was changed to floating again. As the Inter-bank foreign exchange market was re-introduced in 1999 and the exchange rate was allowed to float exchange rate of naira against USD sharply rose to N92.34 per USD1 in 1999 and gradually to N139.89 per USD1 in 2004. Between 1985 and 2004, the naira had depreciated by 99.3 per percent. However, the Naira exchange rate appreciated from 2004, until when it became N118.55 per USD1 in 2008. The appreciation between 2004 and 2008 might be attributed to the foreign exchange policy adopted during the previous period couple with the huge foreign exchange inflows and external reserves induced by the astonishing oil price increases in the international oil market. The external reserves rose from $16.95 billion in 2004 to $28.28 billion in 2005.

There was also a sharp rise from N118.55 in 2008 to N148.90 per USD1 in 2009. The exchange rate stabilised with the upward trend at N148.55 in 2008 to N157.31 per USD1 in 2013.

Figure 2.4: CPI, NEER and Naira-US Dollar exchange rate



Source: Constructed based on CBN data

Figure 2.4, depicts the trend of the CPI inflation and the exchange rate index of NEER and USD/Naira official exchange rate from 1986 to 2013. In the figure, the CPI shows a continuous upward trend. The NEER also shows an increasing trend with two breaks. The first step up break shows the fixed regime of 1994 to1998 from where the trend steps up and continued. The second break which shows appreciation in the Naira exchange rate might be attributed to the foreign exchange policy adopted from where the trend stepped down and continued the upward trend.

2.4 Monetary Policy in Nigeria

In this section, the study provides a review of monetary policy in Nigeria since 1960. We first discuss the frameworks and strategies of the monetary policy followed by the implementation during the period under consideration. Monetary policy is a deliberate act by authorities to stimulate the amount, cost and accessibility of money credit with the aim of achieving macroeconomic objectives of internal and external balances. The quantity of money in the economy is managed through changing the interest rate and/or money supply. Monetary policy decisions are given much attention by the policy authorities and all important stakeholders due to the significance of money in economic life. The Central Bank of Nigeria is the body that is responsible for the conduct of monetary policy in Nigeria.

Monetary policy will be either contractionary or expansionary, subject to the general policy drive of the monetary authorities. Expansionary monetary policy is where the policy adopted by the authorities raises the money supply in the economy whereas contractionary is where the measure decreases the supply of money in the system or restrict the growth or the capabilities of banks to lend out. Attaining increase in output coupled with stable prices complemented with stable long-term interest and real exchange rates is the key objective of monetary policy. This objective will enable firms and individual households to make sound financial and economic decisions with confidence in the future value of their money. The prices stability will help to avoid inflationary boom-bust cycle which leads to recession and unemployment. In their effort to attain the objective of stable price and the associated objectives, the central banks are always aware of the conflicts amongst the objectives.

The monetary policy strategy of Nigeria centres on achieving viable foreign exchange for internal balance. The Central Bank is mindful of the fact that realising prices stability would need constant review and assessment of the implementation framework of country's monetary policy to allow it reacts to the dynamic economic and financial environment.

For instance, the central bank of Nigeria in December 2006 rolled out a new monetary policy framework. The implementation framework was aimed at achieving a stable value of Naira through stability in short-term interest rates over an operating target interest rate, which will be decided and operated by the central bank. The operating target rate which is called the Monetary Policy Rate (MPR) will be an indicative transaction rate in the money market and other Deposit Money Banks' (DMBs) retail interest rate (CBN, 2011).

The guiding principle of the new policy was to regulate the supply of settlement balances of banks and persuade the banking system to aim zero balances at the central, through an active interbank transfer of balances at the central bank. The goal was to prompt symmetric use of surpluses and deficits in the settlement accounts, such that for the banks, the cost of an overdraft at the central bank would be equal to the opportunity cost of maintaining a surplus with the Bank. The central bank intervenes when necessary to ensure smooth operation of the market, (CBN, 2011).

The monetary policy is carried out by the Central Bank of through the Monetary Policy Committee (MPC). The MPC is the body responsible for monetary policy decisions in the central bank. The MPC utilises the monetary policy tools available to regulate the deposit money banks liquidity to stimulate the money supply. Usually, the monetary policy decisions by the MPC are by amending the monetary policy rate (MPR) to influence the short-term interest rates. The central bank does that by altering target for the overnight interest rate. The rate charged by the financial institution for overnight loan among them. That will ultimately affect other interest rates and therefore impacts on all borrowing and spending decisions. The set target rate is reviewed routinely as the MPC meet (CBN, 2011).

2.4.1 Monetary Policy Framework/Strategies

Monetary policy formulation and execution is the main feature that differentiates the central bank from other financial institution. Monetary policy is established based on the utilisation of monetary policy instrument for macroeconomic enhancement in general and to stimulate economic growth through evolving effective, efficient financial system. The central bank uses various strategies to implement the monetary policies. The strategies influence the targets through different channels. The commonly used strategies are; interest rate targeting, monetary targeting, exchange rate targeting, inflation targeting and nominal gross domestic product or output targeting. Since its establishment, the Central Bank of Nigeria utilised two monetary policy implementation frameworks; they are exchange rate targeting and monetary targeting. The central bank of Nigeria used monetary policy framework of exchange rate targeting from 1959 up to 1974, and monetary targeting is in use since 1974 to date (CBN, 2011).

2.4.2 Monetary Policy Implementation in Nigeria

The monetary policy implementation in Nigeria went under two broad regimes, in line with the macroeconomic policy objectives of the Federal Government. The regimes are direct and indirect control. The monetary policy measures under these two regimes are discussed below:

i. Direct Controls

The direct method of monetary policy was used between the periods 1959 and1985. Between 1960 and 1962, the Central Bank of Nigeria ran a passive monetary policy regime in when the focus was on developing and preserving a sound home currency. By 1962/63, emphasis on development issues takes over the policy objective, with the requirement for sufficient credit supply to the economy with least inflationary pressures. Towards the end 1964 and in 1965, the key monetary policy objective was to the achieving an equilibrium balance of payments. The policy instrument at the time was credit rationing. Restriction on credit expansion was relaxed by late 1966 to qualify the banking system to offer the government with adequate funds for the civil war that just started then. The consequence was high inflationary pressures after the war, worsening balance of payments, and a step rise in deficit financing. Later policies were focused on decreasing the inflationary pressures, re-establishing normal economic conditions, getting rid of the pressures of the external payments position, growing government revenue and decreasing government's over-dependence on the banking system. The policy continued during the period 1966 and early 1972(CBN, 2011).

From early 1972 to early 1976, the focus of monetary policy was to grow domestic aggregate output and inhibit inflationary pressures. Throughout the period, government revenue and foreign reserves improved due to rise in oil prices. The result was an increase in aggregate demand and money supply. The task of monetary management turns out to be complex with the excess liquidity. Accordingly, the selective credit control policy was maintained, supported by interest rate and exchange rate policies in the latter part of the period. Stabilisation securities were also introduced in a bid to cut the high liquidity conditions in the banking system. The central bank retained its monetary ceiling policy between early 1976 and end of 1981 because of the continued excess liquidity in the system. Direct credit ceiling, stabilisation securities, cash reserve requirements, the exclusion of deposits against letters of credit from eligible liquid assets and interest rate changes were jointly used to solve the challenge of excess liquidity (CBN, 2011).

The same monetary policies proceeded from 1981 up to 1985, but minor changes to the instruments were carried out in consonance with the challenges faced. The key highlights of this period are:

Instruction on permissible aggregate credit expansion ceilings;

Selective credit controls to boost local businesses, small and medium scale enterprises and the rural areas;

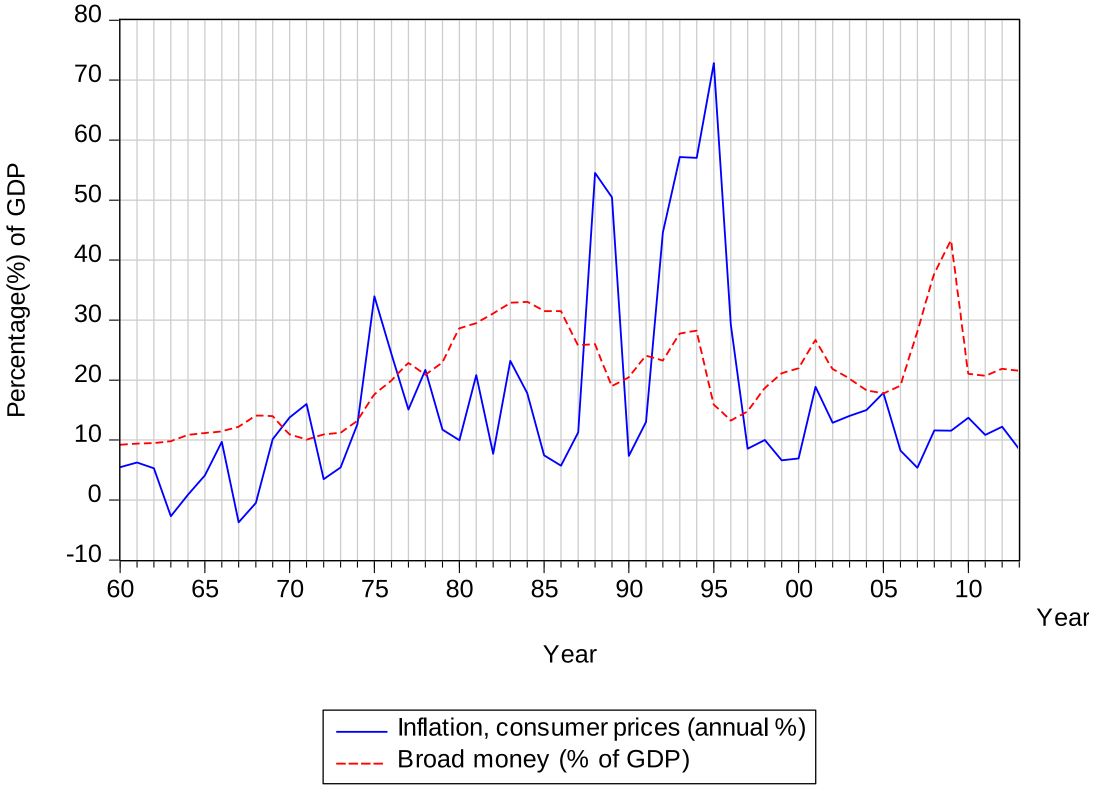
Procedures for the allocation to different sectors of banks‘ loans and advances which continued to support the chosen sectors of the economy;

constant Cash Reserve Requirement (CRR) throughout the period; and

Slight upward amendments to interest rates.

The policy of strict monetary ceiling targeted the safeguarding of foreign reserves and the keeping stable price. Actions taken to lower foreign exchange disbursements included the imposition of pre-import deposits ranging from 10 percent to 250 percent and the re-introduction of pre-shipment inspection. Furthermore, interest rates were increased to boost savings and decrease foreign exchange demand (CBN, 2011).

Figure 2.5: Inflation and M2



Source: Constructed based on World Bank data

The graph shows how the central bank controls the money supply by draining the money in circulation when the inflation rates are rising. Increased money as a percentage of GDP is followed by the increased inflation rate.

The increased inflation rates are also followed by a drop in money supply which is the effect of the central bank control measures.

ii. Indirect Controls

Due to the worsening situation in the economy in 1986, rigorous efforts were made to remove additional economic checks and to free the economy (Ojo, 2000 cited CBN, 2011). Consequently, the IMF's Structural Adjustment Programme (SAP) was introduced in July 1986. The determination was to finally establish a more efficient market system for the allocation of resources, with the insinuation that extreme controls of the earlier two decades would be slowly removed or reduced to levels that would not hinder economic development.

The three most important pillars for realising this main goal are liberalisation of exchange control, the assumption of appropriate policies of pricing in the different sectors of the economy and a further streamlining and reorganisation of public expenditure and import tariffs. Therefore, monetary policy was anticipated to show significant role in the new economic management process. Certainly, the central monetary policy objectives continued to remain as in pre-1986 era. Nevertheless, in the particular economic and financial environment liberalisation, monetary policy was also to stabilise the economy in the short-run and to inspire the advent of a market-oriented financial sector.

As the SAP began operating, old instruments were adjusted to solve the excess liquidity problem in the economy. Some furthermore measures were introduced to curtail the excess liquidity growth. For instance; there was the obliteration of the use of foreign currency deposits as collateral for naira loans. That oblique the deposit money banks not to grant naira denominated domestic loans on the deposits held abroad and in the domiciliary account or security of international guarantees. In mid-1989, the Federal Government ordered that all public sector accounts with bank be withdrawn. The instant effect was the drop in liquidity in the banking system. The order was reversed in 1999 when the retail functions of the central bank were shifted to the deposit money banks. Further policy measures during the take-up of the SAP include:

Sectoral credit controls were rationalised to provide a greater measure of discretion to banks for credit operations in 1986 and 1987;

Ending all compulsory credit allocation mechanisms by the central bank by the end of 1996;

Interest rates deregulation;

Use of stabilisation securities was re-introduced in 1990;

Change to the use of open market operation in 1993 with the aim of moving from direct controls of monetary management to an indirect or market-based approach.

In consonance with the liberalisation policy of SAP, there was a shift in paradigm from the previous direct monetary control method to an indirect approach centred on the use of market instruments in monetary management. This stem from the need to remove the distortions and inadequacies in the financial system produced by the persistent use of administrative controls and the need to create competition between banks and other operators in the financial system(CBN, 2011).

The two most important short and medium-term horizon of policy regimes are:

The Short-term Monetary Policy Horizon (1986 -2001)

After the economic liberalisation in 1986, the monetary policy focus changed to a one-year perspective. In line with the general monetary policy objective for the year, different monetary instrument and targets and were assumed in the one-year horizon. The open market operation, carried out solely using the Nigerian Treasury Bills (NTBs), was sustained to be the key method of monetary policy. This policy was accompanied by the liquidity ratio (LR) and cash reserve requirement (CRR). Other instruments of policy used are the discount window operations, the compulsory sale of special Nigeria treasury bills (NTBs) to banks and the requirement of 200 percent treasury instruments to take care of foreign exchange need of the bank at the Autonomous Foreign Exchange Market (AFEM). Interest rate policy was deregulated via proactive amendments to the minimum rediscount rate (MRR) to indicate policy direction in line with liquidity conditions.

The Surveillance activities of the central bank emphases primarily on sound management and maintenance of a strong balance sheet position on the part of the banks. On foreign exchange, the official and interbank exchange rates were integrated in 1999.

The Medium-term Monetary Policy Horizon (2002 - 2013)

In 2002, the central bank of Nigeria launched a two-year medium-term monetary programme meant at releasing the monetary policy from the time inconsistency problem and reducing over-reaction caused by temporary shocks. The basis of the new monetary policy horizon that is in operation up to now is founded on the evidence that monetary policy actions affect the ultimate objectives with a substantial lag.

Under this policy horizon, monetary policy guidelines are open to six-month review consistent with developments in the financial market and monetary conditions with the aim of achieving a medium to long-term objectives. The fundamental objectives of the monetary policy have continued to be almost the same, that is, to reduce inflation to a single-digit level and maintain exchange rate stability of the naira, and the objectives of growth in output and reducing unemployment. Efforts were also geared towards the necessity of a more competitive financial sector to improve the payments system. The open market operation has continued to be the primary tool of monetary policy and is complemented by discount window operations, reserve requirements, foreign exchange market intervention and movement of public sector deposits in and out of the deposit money banks. The central bank has continued to make certain banking system is sound, and financial sector is stable to enhance the efficiency of the payments system (CBN, 2011).

The Monetary Policy Implementation Framework (2006-2013)

The recent developments in the economy, most especially in the financial sector, necessitated the review the monetary policies to reinforce the mechanism of the monetary policy to realise desired targets and objectives. Particularly, the link between the Minimum Rediscount Rate (MRR) and other rates in the market weakened and the importance of using the MRR as the anchor for other short-term interest rates was eroded.

More so, monetary policy targets were continuously not achieved. Therefore, in December 2006, the central bank launched the recent monetary policy framework implementation with the aim of solving the persistent interest rate volatility and creating a money market that is more reactive to changes in monetary policy interest rate, particularly the overnight interbank interest rate. The control of interest rate volatility was to be solved by applying of some policy measures containing, averaging of reserve requirements over a maintenance period of two weeks. Also the use of Standing Lending and Deposit Facilities to define an interest rate corridor around the monetary policy rate (MPR) which would drive interest rates in the money market (CBN, 2011).

Repurchase Agreements

Repurchase Agreements (Repos) are temporary purchases (repos) and sales (reverse repos) of eligible securities by the central bank to either withdraw or supply or liquidity and guarantee a robust interbank market and inhibit interest rate volatilities. Repo transactions assist the central bank to offer temporary liquidity to needy operators in the discount window on a collateralized basis to warrant the smooth operation of the interbank market on a continuous basis. The transactions (repos and reverse repos) are typically between one to seven days, executed between the central bank and any of the operators (banks and discount houses) in the discount window. Under a repo agreement, the central bank injects domestic currency against the purchase of a domestic asset. Even though most of the transactions are outright sales or purchases, repo agreements are also used for liquidity management, however, remained ineffective as short-term withdrawal of liquidity does not solve the original problem of systemic excess liquidity. Starting from September 2008 the tenure of repos was prolonged to 365 days, due to concerns about the effect of the global financial crisis ignited off by the sub-prime mortgage crisis in the United States. Repos help the operators to solve the instant liquidity deficiencies, in the process, controlling interbank rates (CBN, 2011).

Reverse Repos

Reverse Repos is the reverse of the repurchase agreement ensuing injection of liquidity into the system. It offers money market operators, surplus reserves to invest through the discount window at a decided interest rate. Therefore, it aids in influencing interbank interest rates from dropping to excessively low levels in periods of liquidity glut in the banking system. In a reverse repurchase agreement, the bank sells funds as assets against domestic currency, temporarily retreating liquidity, nonetheless, enters into an agreement to buy back the asset at a future date.

The Central Bank Standing Facilities

The central bank's standing facilities include the Standing Deposit and Standing Lending Facilities. The standing facilities were introduced in December 2006 to enhancement the monetary policy implementation mechanism. The aim was to effectually cut the interest rate volatility in the interbank market and warrant an objectively stable financial market environment that helps investment decisions and creates increased public confidence in the financial system.

Standing Lending Facility

The Standing Lending Facility provides access to liquidity operators in the Real Time Gross Settlement System (RTGS), on an overnight basis, in the interbank market to guarantee the smooth operation of the market.

The Standing Deposit Facility, on the other hand, provides an investment outlet for the surplus reserves of operators in the RTGS, so increasing the incentive for resource mobilisation. The central bank Standing Facilities (Lending and Deposit Facilities) which constitute the nucleus of the new framework of monetary policy implementation were aimed at achieving stable interbank rate by manipulating the short-term money market rates. They, hence, offer the financial valves which absorb surplus funds and inject overnight funds on the basis of lender of last resort. The efficiency of Nigeria’s monetary policy in improves gradually over the years. It started from a point where the country’s economy was basically simple, went through eras of economic crises and the use of different policy instruments. In the last decade, the monetary policy instruments have been significantly improved in harmony with international best practices, which caused a more effective monetary policy. Various factors could be identified as the basis of the strength of the monetary policy developments. A vital element was the quick development of domestic know-how which effectively handled the processes to a globally accepted standard (CBN, 2011).

2.5 Nigeria’s Trade Policies and Practices

In this section, the study reviews the trade policies in Nigeria since independence in 1960 in relation to the impact of exchange rate change on domestic consumer prices. Import, export and investment policies objectives review is provided followed by the performance of those policies.

2.5.1 Trade Policy Objectives

Nigeria's trade policy is aimed at achieving a private sector driven growth to boost domestic output for the local market and export to accelerate economic growth and development. The objectives of Nigeria trade policy have not change for quite some time now. The Trade Policy of Nigeria (TPN) put out in 2002 is up to now in operation as it features in the Nigeria Vision 20:2020. The Nigeria key trade objectives born out of the needs to diversify, drive and promote improved value creation and addition in the different sectors of the economy especially when the country has a comparative advantage. Other requirements include reform in tariff regimes aimed at decreasing the irregularities, ambiguities and lack of transparency of the system.

The Ministry of Commerce and Industry is the body responsible for articulating, directing, and executing the trade and industrial policy. All issues concerning trade, the ministry is the hub as relevant sector-based Agencies of the government offer valuable contributions required for the discharge of the ministry’s mandate. Therefore, the process of articulating, directing, and executing trade policy in Nigeria encompasses broad consultations not only between the agencies but also with the private sector organisations , organised private sector (OPS), including the academia. Within the period under review, the National Focal Point (NFP) on trade does not only grow to involve more interests groups, but a technical committee of the Enlarged National Focal Point (ENFP) was formed to offer technical inputs for informed decision-making. Considering that Nigeria is a federation consisting of 36 federating states the need for cooperation, coordination and coherence are necessary. That necessitated a formation of a National Council of commerce and industries which comprise of the agencies responsible for trade, commerce and industries from all the federating states of the country and the national body (National Planning Commission, 2009).

i. Import Policies

The import policy of Nigeria exhibited a commitment to gradually free up the import regime with the aim of improving efficiency and make local firms more competitive in the international arena by eliminating undesirable barriers. In particular, the country is committed to the elimination of quantitative restrictions. Though, the need to protect genuine interests of local firms against unfair trade practices, to safeguard plant and animal life, to preserve the society from social (health) and moral hazards, and the physical environment obliges the practice of quantitative restrictions. It is basically due to lack of technical and institutional capacities for other suitable trade policy tool(s). Therefore, as soon as these capabilities are fully developed, the barriers would be removed.

Evidence from the last one decade suggests that Nigeria is committed to the gradual elimination of quantitative restrictions and tariff liberalisation. This is confirmed by the significant decrease in the maximum applicable tariffs between 2005 and 2010 from 150 percent to 35 percent which is roughly equivalent to 77 percent reduction in the maximum tariff rate. Furthermore, there was a significant decline in the number of tariff band from 19 to 5. The reduction implies an increase in custom administration efficiency. The effort results in trade liberalisation as the simple average applied rate to fall to 11.5 percent in 2010 from the 28.6 percent in 2003 which is equivalent to approximately 60 percent decline in the applied tariff. The current average is lower than the average for developing countries (WTO, 2011).

Another important step taken by Nigeria was concerning the import prohibition where significant progress was also made toward actualizing the policy objectives. In 2008 the list of the item under import ban was reduced to 26 from the previous 44. There was a gradual decrease in the number of tariff lines placed under import ban, from 2005 when 1011 HS-tariff lines which are equivalent to approximately 20 percent of the total lines to 600 HS-lines which is equal to about 12 percent of the total lines in 2008. A careful analysis shows that the remaining items on the import prohibition list are aimed at safeguarding public morals; and protection of human, animal, plant life or health and physical environment (WTO, 2011).

ii. Export Policies

The export policy of Nigeria is directed towards the need for diversification of the export baskets and markets. Considering that oil and gas export constitute over 90 percent of total export, any shock in the global oil prices will probably induce instability to the system and confound economic management. Furthermore, the oil and gas sector has less forward and backwards integration with the economy, hence restricting the impact of the industry on wealth creation among the populace directly, but only indirectly by government interventions. The export policy is, therefore, encouraging non-oil exports particularly the agricultural outputs, solid minerals and some manufactured goods where the country has the significant unexploited latent potential for growth.

One of the big schemes for supporting the non-oil export launched was named "Commerce 44". The scheme involves identification of 11 agricultural commodities, 11 solid minerals, and 11 manufactured products. It is done with the aim of enhancing the quality and standard of the product to international standard and therefore making them fit for exports to any country in the world. However, this is done with a particular emphasis on 11 selected markets where the country has better market access. These are products where the country has a possible comparative advantage but are inhibited by many challenges. Hence, "Commerce 44" would make available the required skills for re-launching of the products into the global market.

The necessity to promote internal processing and increase value addition of export in Nigeria led to the impositing taxes on the export of some raw or semi-processed goods. It is aimed at generating income and creating employment. Export Prohibition is also imposed on certain goods to ensure self-sufficiency. It is also imposed to inspire value addition and for the preservation of cultural heritage.

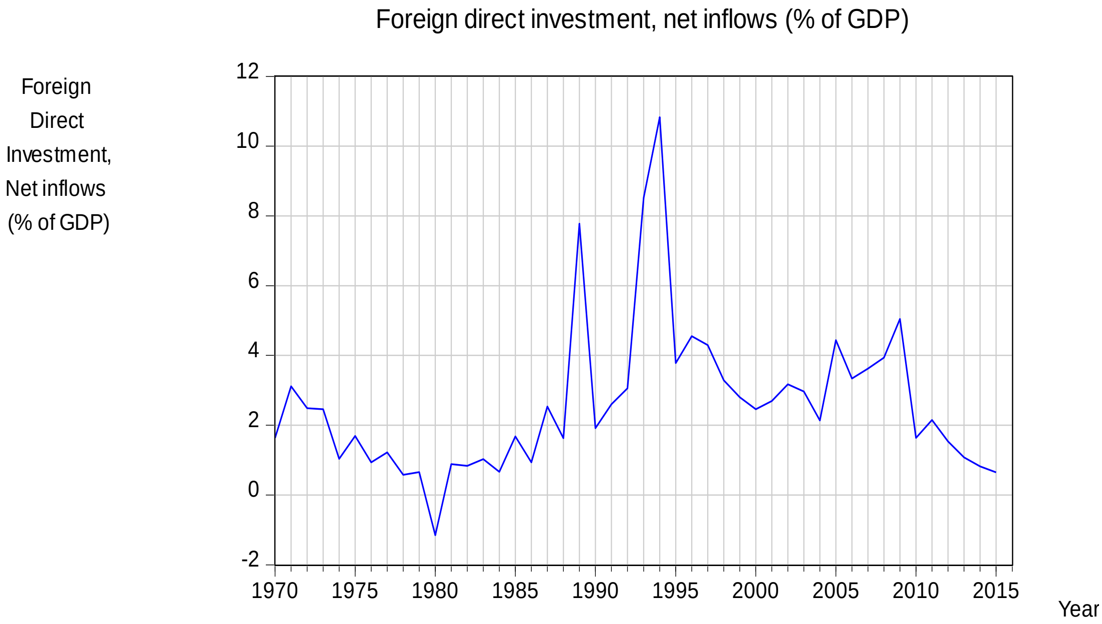
The creation of many export free zones under the management of Nigeria Export Processing Zones Authority (NEPZA) is another determination in the direction of encouraging export in Nigerian. The zones are created with the aim of diversifying the country's revenue source. It was put in place to attract foreign direct investment (FDI) and generate employment. As at 2011, there are about 30 licensed Export free Zones with about half of them fully operational and the remaining half at various levels of development. There are also other more license applications at different stages of approval. The operators of the free trade zones enjoy some incentives which include tax holiday, profit and capital repatriation, full foreign ownership, up to 25 percent sales of produce. Other incentives provided include; rent free land while building factory and provision of essential services like sanitation and transportation.

iii. Investment Policies

The Nigerian Investment Promotion Commission (NIPC) was established to promote investment and implementation of investment policy. The agency was created 1995 to ease the problem associated with the creation of businesses in Nigeria and to support both the existing and new investors in their challenges. It was also to help the flow of both domestic and foreign investments in the country. The government offer numerous incentives to different sectors of the economy like; agriculture, oil and gas, solid minerals, tourism, telecommunications, exporting and Biofuels. The incentives include tax holiday and tax rebate, capital allowance of capital projects, free transfer of profits and capital, cheaper interest on finances, exemption from foreign exchange regulation and Export Expansion Grant (EEG). The EEG is an incentive granted to Nigerian exporters after shipping out goods of Nigeria origin worth more than five million Naira. The arrangement was made to help Nigerian exporters to increase production capacity for export.

In Nigeria the investment and securities act, 1999 regulates foreigner's acquisition of local firms. Under the Act, the Securities and Exchange Commission (SEC) has to grant prior approval for any foreigner's arrangement to take over a local company. Also, Federal high court has to give permission for any merger agreement. The country is making efforts to improve the investment climb record by establishing a one-stop investment centre (OSIC) and enhance the infrastructure levels.

Figure 2.6: Foreign direct investments



Source: Constructed based on World Bank data

It could be observed that the foreign direct investment (FDI) as a percentage of GDP drops from 1970 to 1980 when Nigeria's policy encourages indigenisation.

From 1986 when Nigeria adopted the policy of trade liberalisation the FDI improved tremendously, especially in the 1990s.

Table 2.3: GDP growth, Import and Export

	1960 - 1970	**1971 - 1977**	**1978 - 1986**	**1987 - 1993**	**1994 - 1998**	**1999-2013**
Average GDP growth (annual percent)	8.05	6.28	-1.83	2.56	2.22	7.48
Inflation, consumer prices (annual percent)	4.93	15.84	14.01	34.06	35.53	11.61
Exports of goods and services ((percent of GDP)	10.14	19.01	20.23	34.22	34.67	33.78
Imports of goods and services (percent of GDP)	14.00	19.25	15.37	19.36	28.60	22.79
Average GDP per capita (current US$)	135.49	365.10	546.48	262.99	268.49	1247.07

Source: Computation based on World Bank data.

The imports of goods and services as a percent of the GDP in the period 1960-1970 was averaged 14% for the period while exports stood at 10.14%.

The imports in the period are mainly of capital goods for the development of the domestic manufacturing industries which was one of the main government policy objectives then while the exports are predominantly agricultural produce.

In the period 1971-1977 the export tremendously improved to 19.01% from the 10.14% in the period 1960-1970, which was mainly due to the oil price boom.

The imports also increased to 19.25% in the period 1971-1977.

In the period 1978-1986 the exports slightly increased to 20.23% but the import drops to 15.37% which could be attributed to the fall in imports of consumer and luxury goods due to the recession during the period.

With the adoption of the SAP programme which liberalised the financial sector and floats the Naira the export significantly improved in the period 1987-1993 to 34.22% from the 20.23% of the previous period 1978-1986.

The import also increases to 19.36% in the period 1987-1993 from the 15.37% of the 1978-1986 which could also be attributed to the improved trade environment.

The export remained steady with 34.67% and 33.78% for the periods 1994-1998 and 1999-2013 respectively.

While import increases in the period 1994-1998 to 28.60% and drops to 22.79% in the period 1999-2013.

2.5.2 Nigerian Trade Policy Since 1960

An evaluation of Nigeria's trade policy since the 1960s reveals a typical pattern of uncertain and unpredictable trade regimes known worldwide. Trade policy since the 1960s has observed great policy changes from high protectionism in the 1960s and 1970s to the present more liberal position (Briggs, 2007). At different times tariffs were used to raise fiscal revenue and restrict imports to maintain foreign exchange and protect the local industries from unfair competition. In the same vein, different types of non-tariff restrictions like quotas, licensing schemes and prohibitions were used at various times to restrict imports of certain items.

The general pattern depicts the long-held conviction that trade policy can be used to influence the businesses in directions that can stimulate economic growth. Efforts were made to use trade policy to encourage export of manufactured goods. These were done with the intention of improving the links in the local economy. Furthermore, to raise and stabilise export revenue, and reduce the country's overdependence on the oil sector, trade policies were therefore geared towards achieving the goals of improving the balance of payments; protecting foreign exchange; and generating fiscal revenue (Briggs, 2007).

i. Trade Policy Trends between 1960 and 1970s

In 1960s Nigeria followed an import substitution industrialisation strategy. The strategy then involved the use of trade policy to provide protection to local manufacturing industries, using measures like quantitative restrictions and higher duties on import. Consequently, several items were placed on import prohibition list. During the period, all imports, particularly from Japan, were put under import license. Machinery and spare parts imports were controlled, and exchange controls on dividends and profits repatriation were enforced. Restrictions were similarly imposed on non-essential imports, spare-parts and capital goods.

Even though the import substitution industrialisation strategy was sustained up to the end of Nigerian civil war in 1970, trade policy from 1970 to 1976 took a less restrictive stance, apparently due to the increased demands caused by the post-war reconstruction. Therefore, only items regarded as non-essential consumer goods were restricted, while raw materials import tariff rates were reduced and limits on spare parts, agricultural implements and machinery were relaxed. Likewise, the reconstruction surcharge on imports was reduced from 5 percent from the previous 7.5 percent rate and later entirely removed, whereas profit repatriation and exchange control relaxed. In the 1960s and beginning of 1970s, there were also export duties ranging from 5 to 60 percent of agricultural exports such as cocoa, cotton, groundnuts, palm kernel, palm oil, and rubber. However, in 1973 these duties were ultimately eliminated, as a result of the oil boom and as a requisite to encourage agricultural exports. However, the shot of relaxing restrictions came to an end in 1977, when import of various finished goods was imposed excessive duties and some placed under a ban. The reintroduced of restrictive trade policy heightened in 1979 by putting a ban on 82 items; while additional 25 items were placed on import license (Briggs, 2007).

Figure 2.7: Export and Import of goods and service (percent of GDP)

Source: Constructed based on World Bank data

Sometime before 1984 and especially in the early 1980s the import exceeds export.

From 1986 when Nigeria embraced the liberal trade policy the export exceeds import apart from 1998 when the oil price significantly dropped, as oil is the main export product of the country it affected the export rate.

The gap between the export and import as a percentage of GDP widens in favour of export since 1986.

ii. Trade Policy Trends between 1980 and 1985

From 1981, there was a paradigm shift in trade policy towards exports promotion and a move to step-up the use of local raw materials in industrial production. However, the rise in the imports led to a deterioration of the balance of payments. Also, there was a collapse in world oil prices during the same time which compounds the problem and compelled the government to promulgate the Economic Stabilization Act in early 1982. Under the Act, import duties were increased on about fifty commodities; gaming machines and frozen poultry were put on the list of prohibition. Some other thirty items were moved from the general import license system to specific license list. Between 1983 and 1985, some 152 commodities were placed on specific import license, while foreign exchange regulations strengthened. The fundamental trade policy objective then was to provide protection for local industries and decrease the apparent reliance on imports. The expected outcome of the policy was a drop in unemployment levels and more revenues from the non-oil sector. Hence, tariffs on intermediate capital goods and raw materials were reduced (Briggs, 2007).

iii. Trade Policy under SAP and Post SAP Era (1986 - 2003)

With the implementation of Structural Adjustment programme from 1986, there was a significant shift in trade policy towards more liberalised policy. In 1988 the Customs, Excise, Tariff, etc. (Consolidation) Decree was enacted. The decree provided for a seven-year tariff regime starting from 1988 to 1994 to achieve transparent and predictable rates of the tariff. Hence under the regime Imports attracted ad valorem rates applied on the basis of Most Favoured Nation (MFN) principle. Another seven-year tariff regime to cover period 1995 to 2001 was established by Decree No. 4 of 1995 to replace the previous the 1988 to 1994 regime. The tariff arrangement during 1988 to 2001 raised tariffs on raw materials, and intermediate and capital goods, though duties on consumer goods were marginally decreased. The action was aimed at removing resource allocation distortions and fighting smuggling. Both the two tariff regimes had provisions for reviews and amendments. Nevertheless, they upheld the commonly mixed trends in tariff regimes. The three common forms of changes in the regimes were a rate increase, rate decrease and addition or removal from import prohibition list (Briggs, 2007).

iv. Trade Policy under the NEEDS Era (2004 - 2007)

Nigeria's trade policy regime from 2004 to 2010 is contained in the National Economic Empowerment and Development Strategy (NEEDS) and trade policy documents. The National Economic Empowerment and Development Strategy (NEEDS) 2004 – 2007 is a reform based medium-term plan for economic recovery, growth and development. NEEDS was conceptualised in 2003 and launched in 2004, as a reaction to various challenges confronting the economy. The trade policy under the plan was directed at improving the competitiveness of local industries, with the aim of among others, stimulating value addition and diversification of exports. The strategy chosen to this end was gradual liberalisation of the trade regime. Therefore, the government proposed to liberalise the trade regime. That was to be done in a way, which will guarantee that the resulting local costs of the change do not outweigh the benefits. That was the central base on which to scale the direction and implementation of the policy. The policy packages were then planned to permit some level of protection of local industries.

Consequently, that resulted in tariff rise, with high effective rates in various sectors and lesser import duties on raw materials and intermediate goods unobtainable locally. The policy standpoint also led to the imposition of comparatively higher import duties on finished goods (NPC, 2009).

v. Trade Policy under Vision 20:2020 (2010 - Date)

The Nigerian trade policy regime from 2010 to date is contained in trade policies and strategies under the Vision 20:2020 programme. Nigeria Vision 20:2020 is a national programmeaimed at growing and developing Nigerian economy and bringing her to the league of the world's 20 leading economies by the year 2020. The two primary objectives of the programme are: to efficiently utilise the abundant human and natural resources to achieve fast economic growth and; to transform the economic growth into equitable social development for all populaces.

A shift in the structure of production in the direction of processing/manufacturing activities was envisioned under the Nigeria Vision 20:2020. Prominence is placed on the export of processed and manufactured goods that will assist the country to diversify the economy, increase employment opportunities, and realise the significant growth rates for achieving the Vision. The vision also plans an industrial development policy that is aimed at making Nigeria a global hub for certain specialised products in which the country has both competitive and absolute advantages.

The vision recognises that the country's impact on non-oil global trade is insignificant. Specifically, the country's non-oil exports account for only 2 percent of its trade. Accordingly, the Vision foresees diversification from primary products and growing the market share in new export markets; particularly higher value processed and refined products. The Vision aspires to make the manufacturing, processing, and exportation of value-added goods the crucial point of country's trade strategy (NPC, 2009).

2.5.3 Export Diversification as the Fundamental Element of Trade Policy in Nigeria

It is may be safe to say that export diversification has continuously been established as the important strategy for economic growth since the early 1960s, even when trade policy was geared towards import substitution industrialisation. However, it turned out to be a more apparent instrument of trade policy under the structural adjustments programme in 1986. Nigeria's existing export goal is supported by the firm aspiration to make the country a key player in the global market.

This goal is also coupled with the high desire to change the reliance on oil as a leading source of revenue generation. Hence, there has been a courageous effort to diversifying the export base from the oil exports to give a push to the non-oil export sector.

The current policy framework for Vision 20:2020 is part of the general trade policy, whose objective is to boost the production and distribution of goods and services, so as to serve both domestic and international markets, basically to speed up economic growth.

Overall, the nominal exchange rate appears to be adjusting to the misalignment of the local currency, the naira, relating to the currencies of the major trading partners, largely due to persistent depreciation and devaluation. Unfortunately, however, high inflation rates seemed to have dampened the impact of depreciation on the competitiveness of non-oil export products in particular. At the same time, constraints in the exchange-rate market have widened the gap between the official and non-official exchange rate, which thus constitutes an indirect tax on non-oil exports, and hence a disincentive to export-oriented activities.

The trade account balance, mainly affected by world market prices and domestic production of oil, remains mixed, with developments during years of favourable oil prices. Fiscal policy has also shown a similar trend due to a high import content of expenditure (NPC, 2009).

2.6 Conclusion

The aim of this chapter was to review the key macroeconomic indicators vis-a-vis exchange rate policy regimes in Nigeria from 1960-2013. The review also included the level of consumer price inflation under the different exchange rate policy regimes in Nigeria. The analysis revealed that in the sub-period 1960-1970 the GDP growth was slow but steady, especially before the political unrest and civil war from 1966 to 1970. There was relatively low inflation, but the real interest rate was still negative. The country maintained a restrictive trade and financial policies during the period which was aimed at protecting and developing the local industries. Unsurprisingly the foreign direct investment during the period was also low. The exchange rate policy then was aimed at preserving the value of external reserve and maintain stable exchange rate. The country's currency was pegged to the Great Britain's pound sterling. During the sub-period, 1971-1977 Nigeria witnessed a huge GDP growth due to the oil boom and the relative political stability during the period. However, the boom leads to an escalation of the consumer price inflation and neglect of other previously important sectors like the agriculture and manufacturing. The real interest rate remained negative throughout the period 1971-1977, and the foreign direct investment remained low. Due to the foreign exchange crisis of the 1970s that led to the collapse of the Bretton wood system Nigeria had tried switching the Naira pegging to from Pound sterling to US dollar and back to pound sterling and later to basket of some currency of trading partner countries. By 1978, the oil boom era is over, and Nigerian economy went in to a recession. The economy witnessed a downturn after the collapse of oil price. Nigeria recorded negative GDP growth in the period 1978-1986. During the period 1978-1986, the country borrowed hugely to finance its budget deficits. The real interest rate remained negative over the 1978-1986 periods. The foreign direct investment also remained relatively low during the period 1978-1986.The structural imbalance was evident which compelled the government to adopted IMF's Structural Adjustment Programme (SAP) in 1986. Consequently, Nigeria switched to floating exchange rate regime and relaxed its restrictive trade and financial policies. However, five years after the adoption of the SAP no tremendous success was achieved. The Naira exchange rate kept depreciating due to huge pressure on the foreign exchange market. There was higher demand from importers for foreign currencies as the trade restrictions were relaxed. On the other hand, the supply to the foreign exchange market was less due to the low oil price which is the key export product and the main source of foreign exchange earnings. The exchange rate pass-through to the consumer prices was evident. However, during the period 1987-1993 a significant GDP growth was observed but the soaring inflation rates due to the pass through from the Naira exchange rate depreciation was glaring. The government of Nigeria was compelled in 1994 to peg the Naira to US dollar which lasted up to 1998. The period 1994-1998 saw a drop in the GDP growth, but the consumer price inflation was drawn down. In 1995 the country witnessed its peak inflation rate of 73%. However, by 1997 the inflation rate was down to 9%. The real interest rate remained negative, though slightly improved. However, there was a tremendous improvement in the foreign direct investment (FDI) as the 1994-1998 periods average FDI doubled compared to the average of the period 1978-1993. By 1999 Nigeria reverted to the floating exchange rate regime. The Central bank of Nigeria only intervenes in the foreign exchange market whenever necessary. During the period 1999-2013 Nigeria recorded an impressive GDP growth with a period average of 7.5%. The inflation rate was also drastically reduced to the period average of 11.6%. The period average real interest rate is also positive 3.3%. However, the foreign direct investment dropped during the period 1999-2013 to a period average of 2.87% from the 5.37% of the 1994-1998 period.

The impact of the exchange rate shocks on the consumer prices was apparent in the period under review. The review reveals how the country battled with the persistent inflation rates under almost all the regimes though more pronounced during high currency exchange rate depreciation than low currency exchange rate depreciation period. The impact of ERPT, particularly under the policy regimes with a less firm stance on import is apparent. In chapter six and of this thesis we examined the speed and magnitude of exchange rate pass-through in Nigeria. The result of this study will, therefore, contribute to the literature in this context.

The review also shows that the exchange rate pass-through effect of the Naira depreciation after 1986 introduction of the floating exchange rate system seems to be more profound than the effect seen during the re-introduction in 1999 which could be due to nonlinearity and/or asymmetries in the ERPT. In 1986 when the country was already in recession with the high inflation rate and excessive depreciation of Naira the ERPT seem to be greater than in 1999 when the growth and the inflation rate were relatively stable. Therefore, it is important to examine the potential nonlinearities and asymmetries in the ERPT in Nigeria. The aim is to see if the inflation rate, the exchange rate changes and the output growth rate induce the nonlinearities and asymmetries in the ERPT and impact on the level and speed of ERPT in Nigeria. Accordingly, in chapter seven of this thesis, we examined the asymmetry and nonlinearity in ERPT in Nigeria. The relevance of understanding the dynamics of ERPT and most especially of the asymmetric and nonlinear pass through of exchange rate which was not much explored in the literature is essential.

Chapter 3 :
Inflation and Exchange Rate Pass-through

3.1 Introduction

The growing external imbalances worldwide inspired the study of the connection between changes in exchange rate and the prices known as exchange rate pass-through (ERPT). This has turned out to be even more imperative in developing and emerging market economies undertaking financial and trade liberalisation and adopting floating exchange rate systems, which appears to have supported the likely effects of changes in exchange rate on prices. Considering its consequences on consumer prices, the results of ERPT studies provide more insight into understanding causes of inflation in developing and emerging market economies.

This chapter therefore critically reviews the theoritical and empirical literature on inflation and exchange rate pass-through (ERPT). The level and speed transmission of exchange rate movement to the domestic consumer price influences to consumer price inflation. We review the perspective of different schools of thought like the classical, Keynesian and monetarist among others on the cause of inflation in the short-run and long-run. The objective is to identify the gaps from the different argument on the causes and behaviours of inflation and review the different argument on how the change in exchange rate induces consumer price inflation in the domestic economy of a developing country like Nigeria. We have two main sections in this chapter. The first section focuses on causes of inflation and while the second section concentrates exchange rate pass-through. In the first section, we start with discussing causes of inflation and presents a survey of the leading theories of inflation put forward by different schools of thought. The analysis also provides the theoretical connection between exchange rate and inflation, In the second section the channels of exchange rate pass-through and determinants of exchange rate pass-through. A review of empirical studies on the exchange rate pass-through is also carried out. Finally, a summary of the review and conclusion is presented.

3.2 Inflation

3.2.1 Theories on Causes of Inflation

Inflation has been one of the main macroeconomic problems of concern to policy makers in developing countries like Nigeria considering its economic and social costs. Various theories have been put forward to explain the different causes of inflation. Despite the numerous theories that attempted to explain the inflation phenomenon they all point towards some few factors as the key determinants of the inflation phenomenon. In this section, we discuss the various theories on causes of inflation in the short-run and long-run.

Classical Approach

Prominent classical economists like Adam Smith, David Ricardo, Jean-Baptiste Say, Thomas Robert Malthus, and John Stuart Mill and the neoclassical schools like Alfred Marshall, A. C. Pigou and Irving Fisher argued that inflation is a monetary phenomenon. They believe that excess supply of money cause increase in the general price level *Ceteris paribus*. Monetarist led by Milton Friedman also later confirmed the same assertion by the classical and neoclassical economist notably through the famous work of Friedman (1968). Their account was built on two key elements; quantity equation of the quantity theory of money, and market clearing in the real sector. Regarding the market, according to the classical economists, the real sector works competitively and efficiently such that, in the long-run, the market is cleared which results in equilibrium in output and/or full-employment. Therefore, to them, full employment was the normal state of affairs.

The two popular versions of the quantity theory of money are; the Cambridge cash-balance approach which was promoted among other Alfred Marshall, A. C. Pigou and in early works of J. M. Keynes and the income version of Fisher's equation of exchange. The two versions are somehow similar and would arrive at the same conclusion in explaining the inflation process via the quantity theory approach.

With the Fisher's (1911) version, the quantity theory is expressed as follows:

$$MV = PY \tag{3.1}$$

Where M represents the money stock which is supplied by the monetary authority in an economy, therefore, it is exogenous. V is the velocity of money and stands for the average frequency across all transactions with which a unit of money is spent.

Given that the number of operations conducted by agents in the economy is determined by institutional arrangements that change gradually and in a predictable way, the velocity V is assumed to be constant. P stands for the general price level, and Y stands for the real aggregate income in the economy.

The Y is assumed to be set at its full employment level by the equilibrium in the real sector and given that the V is constant. Hence the monetary economist’s proposition that the quantity of money supplied (M) determines the price level (P) holds. Therefore, the price level (P) is an increasing function of money supply (M). The disequilibrium in the money market is restored by movement in the price level.

With an excess of money supply in the market, the individuals, households and firms, will seek to eliminate undesired amounts of money by going to the market and increasing the demand for goods and services. Given that the output supply is assumed to be constant the suppliers will struggle to meet the excess demand by raising the price level. Consequently, the general price level will get higher in proportion to the initial increase in the money supply. Therefore, according to the classical school, money contraction policy should be used as an instrument of solving inflation problem (Friedman and Schwartz, 1965).

Keynesian Approach

Keynes agreed with the classical economist's proposition that money supply results in 'true inflation' only when the aggregate volume of output level matching to full employment is attained. Keynes developed a demand side model for the inflation process with temporarily rigid prices in the labour market. Keynes' initial concern during the war was to provide space for the necessary increase in production in the then fully employed economy. His inflation gap concept emphasises the actions by firms to meet up the excess demand will also build pressure in the labour market that already operates at full capacity. The situation will bring about a competition among firms for the employed workers, which will bid up normal wages and then the real wages that will, in turn, lead to a more demand in the commodities market which will cause to further price increase. Inflation spiral will probably arise when the normal wages tend to lag in reaction to the excesses in demand. Keynes recommended fiscal restraint in the form of increased tax or cuts in government spending to eradicate the inflation gap. Keynes stresses the non-monetary, demand-side approach to inflation which was common in contrast to the classical proponents, which give emphasis to the monetary, demand-side approach to inflation.

The neo-Keynesians Approach

The neo-Keynesians economist like John Hicks, Franco Modigliani, and Paul Samuelson, attempted to interpret and formalise Keynes' works, which formed the mainstream of macroeconomic thought in the 1950s, 1960s and 1970s.

IS-LM model, which provided a very useful framework for analysing short run aggregate supply curve of the neo-Keynesians, dominated most of intellectual thinking during the period. There was an agreement among the 'neoclassical synthesis' about their view of General Theory as a special case of more general classical theory. Given that the downward stickiness of money wage avoids the classical's assertion of automatic adjustment to full employment, the Keynesian suggestion of government intervention to ensure a speedy return to full employment was widely recognised.

However, the neo-Keynesians held that with full employment, a rise in demand could not create a real response (output) but a nominal response (wages/prices). They suggest that as the economy approaches full employment, an increase in price would be prevalent. However, without a clear explanation that could show the relationship between demand and prices in such a situation, the analysis is still inadequate.

Consequently, the neo-Keynesians establish the connection between unemployment and the change in the rate of money wages through the Phillips' empirical work of 1958 to provide a firm basis for their approach price determination and inflation.

The neo-Keynesians employ the use of the Phillips curve to create the theory of wage and price inflation which explains the relationship between normal wage inflation and unemployment.

Initially, Phillips offered an empirical confirmation of a significant and stable negative relationship between wage inflation and unemployment rate. But Phillips' work was not aimed at presenting a theory of price determination or inflation process. Phillips' used the normal wage inflation. However, the neo-Keynesians utilise it for price inflation.

In a Phillips curve the relationship between unemployment and normal wage is depicted as follows:

$$\omega = \alpha\mu \tag{3.2}$$

Where ω denotes the normal wage inflation, α is a parameter which has to be less than zero to show the negative correlation between wage inflation and unemployment, and μ indicates the unemployment rate. When the markup pricing hypothesis is applied then the price inflation depends on money wage inflation less productivity growth which can be expressed as follows:

$$\pi = \omega - \rho \tag{3.3}$$

Where π is the inflation rate, and ρ denotes a worker's productivity growth. By substituting equation (3.3) into equation (3.2), we get.

$$\pi = \rho - \alpha\mu \tag{3.4}$$

In equation (3.4) the inflation rate is express in terms of unemployment rate, which measure the demand pressure in both the labour and the product market.

With the work of Samuelson and Solow in 1960, the neo-Keynesians viewed the relationship in Phillips curve as suggesting a long-run stable tradeoff between inflation and unemployment. Phillips' curve was considered to have provided the policy makers with a menu of potential unemployment-inflation combinations for policy choice.

It implies that an expansionary policy would result in low unemployment and high inflation rate, and vice versa. Furthermore, a reduction in the level of unemployment would lead to an increase in demand for labour in the job market as well as rising demand in the goods market. This situation depicts the real demand-side pull inflation, which is in line with Keynes' interpretation of the inflation process in his 1940 pamphlet 'How to pay for the War'.

The Phillips curve trade-off continued to get overwhelming support with the experience of various countries from the 1950s up to the mid-1960s which made the neo-Keynesian's macroeconomic a leading framework in both theorising and policy recommendations.

Monetarists Approach

The neo-Keynesian were unable to explain the recession and stagflation in various countries during the late 1960s and all through 1970s. The inflation phenomenon observed during the time might be a cost push inflation as explained by structuralist. In the 1970s monetary economist like Milton Friedman and Edmund Phelps offered a resounding explanation of the inflation period of the time.

The monetarist denied the neo-Keynesians view of a long stable trade-off between unemployment and inflation rates. Friedman was of the opinion that the Phillips curve was misspecified. Friedman said the Phillips curve relationship should be amended to substitute the nominal money wages with the change rate of real wages. Friedman maintains that the economic agents that set prices are not concerned with money wage but the real wages. The real wages negotiated by the economic actors are expected to be influenced by the expected inflation rate for the lifespan of the contract. Hence, when the higher inflation rate is expected, the agents would potentially agree to higher nominal money wages whatever the state of supply and demand in the market. For that reason, Friedman augmented the simple Phillips curve relationship by including the expected rate of inflation as an additional variable in determining the money wages' rate of change. The inclusion of the expected rate of inflation leads to the creation of the new form of Phillips curve model known as the expectation-augmented Phillips curve.

$$\pi = \rho - \alpha\mu + \beta\pi^e \tag{3.5}$$

Where π^e stands for the inflation expectations variable, and β represents a parameter that measures the size of influence of the inflation expectations on the inflation rate. To simplify the model a constant change in productivity ρ is assumed. Any positive less than one value for β implies a long-run tradeoff between unemployment rate and inflation rate. Though, the long run tradeoff is presumed to be less favorable than in the short run because of the inflation expectations. When value of β is one, then actual inflation equals the expected inflation $\pi = \pi^e$. Consequently, there would be no long run trade-off between unemployment and inflation. This implies that the agents were able to fully anticipate the actual inflation rate and that labor is no longer suffering from money illusion. In this situation the Phillips curve would be vertical and the economy would be operating at its natural level of unemployment. Also in this level, the rate of change in money wages is just equal to the rate of change in prices (Snowdon and Vane 2005).

Monetarists argue that in the expectation- augmented Phillips model, the influence on the real sector due to monetary expansion would exist only in the short run when the inflation is unanticipated. Although, in the long-run, such a rise in inflation could be entirely anticipated and considered in wage negotiation and the unemployment would go back to its natural rate. The monetarists suggest that the economic agents were wrong in their anticipations of inflation and hence allow the unemployment deviate from the natural rate. The economic agents fail to get the rate correctly because they form their expectation based on past actual inflation rate only instead of using all the available information. The gap between the expected inflation rate and the actual inflation rate allows for the for the temporary deviation of unemployment from its equilibrium. With the continuing adjustment of the expectations of inflation, the economic agents are expected to work with adaptive model (Kibritçioğlu, 2002).

$$\pi_t^e = \lambda\pi_{t-1} + (1-\lambda)\pi_{t-1}^e \tag{3.6}$$

The adaptive expectation is expressed in equation (3.6) above, where λ represents the coefficient of adaptation, which is $0 < \lambda < 1$. The expression in equation (3.6) shows that the expected inflation at time t is a weighted average of the actual inflation and expected inflation rates at a time to the actual inflation rate when λ gets bigger. As λ goes nearer to one, the more the expected inflation at time t will be subject to the earlier actual inflation rate and less on the earlier expected inflation rate. Higher values of λ indicate that expectations adjust rapidly to decrease the gap between the expected and actual inflation rates. This quick adjustment could be used to interpret the increase inflation rates in the 1970s. The adaptive model also presumes that economic agents are less knowledgeable and the government have more information than the agents. The expectation of inflation is built only on information from the past.

New Classical Approach

The New Classical school led by Robert Lucas, which in the beginning emerged from monetarists' macroeconomics and built-in some part of their approach, developed a different method of forming expectations. The New Classical school become known in the 1970s for their reaction to the failure of Keynesian economics to explain the stagflation. They assumed that economic agents apply rational expectation hypothesis when setting prices. John Muth in 1961 introduced the rational expectation hypothesis which started to influence the macroeconomics with the work of Robert Luca in the early 1970s (Snowdon and Vane 2005). In contrast to the adaptive assumption of the monetarists which assumes imperfect information, with the rational expectations hypothesis, the agents are considered to have all information about the past and current relevant information on the present and complete understanding of the economy. Consequently, there will be no systematic errors in forming the inflation expectations given that all the factors will be taken into consideration. Hence, only random shocks could affect the inflation rate and create any gap between expected and actual inflation rates. Given that, the Phillips curve will be vertical in short and the long run. The expected inflation rate under the rational expectation hypothesis can be expressed as follows:

$$\pi_t^e = \pi_t + \eta \tag{3.7}$$

Where η, stands for the random shock with a zero mean. With the rational expectation, the adjustment parameter β in equation (3.5) will be equal to one. Therefore, substituting equation (3.7) in equation (3.5) and expressing the results in unemployment rate terms will be:

$$\mu = \frac{\rho + \eta}{\alpha} = \mu^n + \eta/\alpha \tag{3.8}$$

Equation (3.8) represents Phillips curve with rational expectation where unemployment rate (μ) is equal to its natural rate equilibrium rate (μ^n) plus a random error (η/α) . Here there will be no trade-off between inflation and unemployment in both the short run and the long run. The strict interpretation of equation (3.8) is that only random shocks could lead deviation of the inflation rate from its expected rate and therefore the unemployment from its natural/equilibrium rate. Furthermore, the deviation could only be for a short term as the error will be included in the information for the next period by the agents.

The assumption of a vertical Phillips curve in the short and long run suggest that the economy is at all times in an equilibrium position attain through a persistent market clearing within a framework of competitive markets. The element of classical theory in the new classical theory is the assumption of market clearing. Likewise, the assumption that the inflation deviates from the expected rate only due random shocks is usually tied with the quantity theory of money to suggest that inflation is a monetary phenomenon in both the short-run and the long-run since the rationality rule out any consistent difference between the two (Hoover,1992).

The policy implication under rational expectations is that the authorities can not influence output and unemployment except only if they can generate a shock. Given that the macroeconomic structure of the economy is familiar to the agents, any declaration monetary stimulus policy will just create inflation and cannot have an effect on the real sector even in the short run as suggested by the monetarists. Consequently, for a policy to be of useful, it has to be unexpected, given that the absolute knowledge of the economic framework by the agent makes any announced policy to have no the real sector. Hence, the 'policy ineffectiveness proposition' of the new classical school under the hypothesis of rational expectations will take effect. Therefore, the only way for the authorities to influence the real sector is to surprise the public. The unanticipated or surprise policy will result in a short-term shock in the inflation expectation and therefore will deviate the employment from its equilibrium/natural rate (Snowdon and Vane, 2005).

On the other hand, if the authority declared a low inflation target or a disinflation policy the new classical suggest that such policy will only succeed depending on the time consistency and the credibility of the authority. However, dynamic inconsistency theories introduced by Kydland and Prescott (1977) and further extended by Barro and Gordon (1983) suggest that what seems to be an optimal policy, in the beginning, may turn out to be suboptimal in later period if the authorities renege on its action earlier announced optimal policy. With such likely surprise by the authorities to decrease unemployment lower than the natural rate using monetary stimulus, the future declared policies would be disregarded by the agents, which will make them continue to enter into contracts for high wage increases. Therefore, the authorities must cautiously consider the trade-off between immediate gains from reneging now which leads to higher output and lower unemployment and the future costs of losing credibility and higher inflation expectations.

The importance of credibility and reputation gain more significance during the aftermath of the rational expectation revolution; given that rational economic agents are aware that, because of the low credibility of the authorities. The announced policy of low inflation, especially during the election rounds, is time-inconsistent, and therefore will not take effect after the elections (Snowdon and Vane, 2005).

Consequently, due to the credibility and time inconsistency, the authorities need to establish a commitment device that will tie their hands around particular policy course, for their announced policies to be credible and time consistent (Carmignani et al., 2008). Other suggestions are fixed exchange rate regime, the independence of the central bank, and getting an official acceptance statement on the declared policy from an international institution.

New Keynesians Approach

The New Keynesians economics is a school of contemporary macroeconomics that emerged in the aftermath of the theoretical crisis of the neo-Keynesians in the 1970s. They include G. Mankiw, O. Blanchard, L. Summers, S. Fischer, G. Akerlof, E. Phelps, J. Stiglitz, and D. Romer. Their work was mainly committed to developing thorough and compelling microeconomics basis to explain the short run fixed wages and prices. Their work was primarily geared towards to addressing the theoretical inadequacies of the neo-Keynesians. They include in their model the propositions like the price-making monopolistic firms, imperfect competition and asymmetric information, both supply and demand shocks as potential sources of instability and a rational expectations-augmented Phillips curve (Snowdon and Vane, 2005).

The New Keynesians critique of the new classical macroeconomic was mainly centred on the persistent market clearing assumption, which is the keys assumption that differentiates the new classical from the Keynesians' economics. Although they agree in that the long-run inflation is a monetary phenomenon, the new Keynesians dispute that within the framework of their adjusted micro basis, wage and price stickiness in the short run can be justified on factors such as staggered wage and price changes, and small menu costs. Factors like long term contracts tend to peg wages slow down the process of general price change and therefore hinder the process of market clearing.

Furthermore, the modified micro basis of the normal price rigidity was one of the main contributions of the new Keynesians which was based the idea of imperfect competition. In an imperfectly competitive market, the existence of small menu costs to price adjustment can cause likely rigidity of the aggregate nominal price. Therefore, the small menu cost is considered to be an obstacle to price changes, especially in low inflation environments as the firms could deem it expensive to change their price always in reaction to any demand shock. On the other hand, in a higher inflation environment with imperfect competition, the wages and price rigidity as a source of inertia generating mechanism is assumed to decline given in such environment the wage contracts lengths considerably gets smaller, and menu costs is not an issue. However, the rigidity argument is associated with reasons like the overlapping degree of wages contracts could help in understanding the short-run dynamics of inflation, especially when used with the ideas that expectations could be formed economy-wide, can be forward or backwards-looking, and can come with lack of policy credibility (Kibritçioğlu, 2002).

Cost-Push vs Demand-Pull Approaches

The cost-push theorists could be traced back to late eighteen works of Sir James Steuart and mid and nineteen-century works of Thomas Tooke and Laurence Laughlin. The Costs-push theorists usually relate inflation and disinflation to some non-monetary, supply-side factors which affect the unit cost and profit markup elements of the prices of goods (Humphrey, 1998).

Steuart, in particular, argued that the price level is a non-monetary phenomenon determined by the particular forces that determine the prices of specific goods. He suggests that the forces are real and include costs and competition. Steuart is of the opinion that increased competition compels firms to decrease their prices just as declining costs reduce them. Steuart further suggests another factor as the dichotomy between movements in the money market and the general price level. He maintained that money plays no role in the determination of the price level. Steuart's other proposition is the assumption that the causation runs from prices to money, which is contrary to the monetarists' proposition. Steuart argued that the volume of money adjusts to contain the real activities at the existing prices. In other words, the changes in the money supply are only to validate the price changes caused by other factors. Therefore, money cannot be the cause but only the consequence the price changes (Humphrey, 1998).

David Ricardo who is one of the early classical economists argued that cost-push proposition for inflation is misleading as it confuses relative and absolute prices. Ricardo's explains that with the assumption that total output is fixed, a rise in the relative price of particular goods will involve workers to spend more on such goods would, in the end, leave them with little balances to spend on other goods, whose prices would accordingly drop. Therefore, the increase in the relative price of particular goods would be compensated by a decline in the other good's prices in the market that would, in turn, maintain the general price level fixed.

Thomas Tooke, who was another key proponent of cost-push inflation believed in supply shocks and factor cost theories of price determinations. Tooke said supply shocks could occur due to poor harvest, change in import cost and changes in tariff rates. While cost factors could result from wages, salaries, rents, and profit. Tooke's theory on the causes of inflation resembles some subsequent theories that relate the high inflation in the 1970s and low inflation in the 1990s, to some non-monetary supply-side factors. Tooke’s explanation of cost factors’ effect on product prices centres on interest rates movement. He suggests that declining interest rates draw down prices by reducing capital costs and on the other hand, rising rates raise prices by increasing business costs. This effect of interest rates on the prices through the production cost is deemed to be independent of the behaviour of money. Nevertheless, Wicksell in 1898 opposes the theory of interest rate and inflation. Wicksell argued that by decreasing interest rate, the cost of capital-intensive goods might drop but in turn more would be spent on other non-capital-intensive goods the rising demand of which would ultimately compensate for the increase in the prices which would maintain the general price level unchanged.

The new classical theorists in their Real Business Cycle (RBC) theories of the early 1980s reiterate the supply shocks factors offered by Tooke in explaining the inflation process. The new classical theories concentrate more on the impact of real supply shocks like productivity shocks, labour unrest, war, and natural disasters that affect agricultural output and aggregate output. The new classical theories were clearly not focused on explaining changes in the price level or inflation. Though, their prominent contribution was presenting supply shocks as the core source of aggregate instability which can be applied indirectly to explain the inflation process. For instance, a favourable supply shock like of technological advancement will boost productivity, which will, in turn, reduce inflationary pressures. With such an explanation one can argue that the RBC school indirectly supports the supply-side phenomena of inflation as suggested by the Costs-push proponent like Tooke.

Another prominent advocate of the cost-push inflation was Laurence Laughlin who in 1896 presented a version similar to that of the previous proponent of cost-push approach, explaining the connection between the change in the general price level and the rise in the relative prices but with more emphasis on structural factors such as trade unions and cartels. Laughlin suggests three mechanisms through which costs can raise relative prices and causes inflation. His first mechanism was wage-push prices, where the focus was on the role of ratchet effects and unilateral wage-setting by trade unions. His second mechanism was monopoly administrated pricing which is meant to control prices and avoid active competition. His third mechanism was ‘supply shocks’ in the form of commodity shortage like raw materials and crop failures. Laughlin claimed that shortage of goods could directly increase prices by lesser supply and indirectly through its reaction into wage demand, due to the worse purchasing power caused by increased food prices that will force the workers to demand higher pay, therefore resulting in high cost of production (Humphrey, 1998).

Irving Fisher who was a critique of the cost-push theories attacked the Laughlin's propositions. First of all, Fisher pointed out that Laughlin theories confuse changes in relative prices with changes in absolute prices. Secondly, Fisher disputes the issue of quantity identity, as he argued that influence on the price level has to be through fluctuations in the money stock, the velocity of money, or the physical volume of trade. He maintained that when the level of these variables remains constant for a considerable period, the general price level will not change. Furthermore, Fisher analysed the tendency of the Costs-push theorists emphasising on transitory shocks and random events. Fisher called the practice "the error of selecting special cases". Fisher views those events as temporary and their effect only some range of goods and therefore can not make a persistent impact on the general price level. Fisher also showed his disagreement with the Costs-push theories' suggested remedies to inflation, like wage and price controls or income policies. Fisher maintained that income policies could not help in solving inflation when money stock grows excessively (Humphrey,1998),

Recently, the cost-push theories were used to explain the low and stable inflation during the 1990s and beyond. It was argued that globalisation was the leading cause of the disinflation. Some mechanisms were offered to explain the role of globalisation in lowering inflation. Such mechanisms include the expanding international markets for goods and services, factors of production, cheap imports and greater international investment resulted in a decline in the costs of drawing down inflation rates and controlling it, without requiring contractionary policies and increasing unemployment. Likewise, more justification for the mechanism on how globalisation results in low inflation were provided. According to the opinion, globalisation creates more incentives to improve productivity due to technological advancement with more competition which led to an increase in world aggregate supply and therefore drew down pressures on international prices.

Rogoff's (2006) argument also supports the cost-push theories about the low inflation during the 1990s. Rogoff is of the view that, along with increased competition, globalisation has weakened the influence of the labour and local monopoly, therefore 'flattening the long run Phillips curve'.

In fact, the factors presented based on the low and stable inflation during the 1990s can be a seen to be a reiteration of the factors mention by of Tooke. However, the advocates of modern quantity theory are of the view that the Costs-push arguments can at best explain changes in relative prices.

For the monetarists, the explanations for the low inflation of the 1990s could include the rapid increase in output which exceeds the lagging money stock and lower expectations of high money growth. The inflation could be as a result of the improved credibility of various central banks that declared a serious commitment to low inflation targets in the 1990s (Snowdon and Vane, 2005).

The monetarists believed that the causation always runs from money to inflation thus 'money is always and everywhere a monetary phenomenon' (Friedman, 1968).

Structuralists, Neo-Marxian, and Post-Keynesians Approach

The structuralists, Neo-Marxian and post-Keynesians are more-or-less some versions of the cost-push theories. The structuralists' theory of inflation competes with the monetarists' theory since the 1940s. The structuralists relate the inflation phenomenon to a unique set of structural constraints that an economy faces, for instance, uneven distribution of income, the relative significance of some sectors of the economy, and disequilibrium in the balance of payment. In their distributional mechanism, the structuralists are of the view that changes in economic structure bring about changes in relative prices, which results in variations in the general price level (Aykut, 2002).

The structuralists' theory of inflation was built on three central factors: the relative prices which change as the economic structure changes, the downward rigidity of some money prices, and the passive money supply. Therefore, with the downward rigidity of some money prices like wages and a passive money environment, changes in the relative prices because of shifts in the economic structure will lead to an inflationary process (Canavese, 1982).

Two schools are prominent among the economist that used the structuralists' approach to inflation. One of the schools for the developed countries of Europe and the others include the Latin America countries. However, the two schools have a lot of similarities in their central ideas two schools differ on the cause of the structural change in the economy. The European school confined its studies to structural changes emanating from supply shifts, the Latin American schools reflect on structural changes coming from both demand and supply shifts.

The structuralists analysis of inflation in developing countries, especially in Latin America, maintained that some aspects of the structures of the economies make the aggregate supply to lag continually behind the aggregate demand. For instance, they argued that agriculture sector is assumed to be fixed and is predominantly not price elastic, and therefore reacts to the monetary and aggregate demand shocks with a lag. When demand for non-agricultural industrial products increases, it leads to increase in wages. Therefore it results in a greater demand for agricultural outputs. Because of the rigidity of production in the agricultural sector, the demand increase will lead to increase in prices due to the excess demand. The rise in prices in the agricultural sector will cause quest for the higher wage the sector. The increased wages will be passed into high prices for nonagricultural products, and hence a cumulative inflationary process occurs. Therefore, the inefficiency of the agricultural sector in the economy tends to ignite the relative price changes in other areas and ultimately led to inflation (Taylor, 1983).

Furthermore, the Marxists, Post Keynesians, and neo-structuralists are generally of the view that inflation is a supply side phenomena caused by inconsistent claims in income distribution. Therefore, they all maintain a similar propagation mechanism which implies changes in relative prices will, in turn, results in a persistent inflationary process (Lavoie, 2009).

Fiscalists' Approach

The fiscalists' theory of the determination of the general price level was developed during the 1990s by economists like M. Woodford, J. Cochrane, C. Sims, and E. Leeper. The fiscalists argued in their writings that the general price level is primarily a fiscal, rather than monetary phenomenon (McCallum 2003). They believe that the general price level is mainly determined by a cycle of government's deficits and surpluses. They believe that fiscal shocks affect aggregate demand by its effect on private sector budget constraints. Hence, they considered the commitment of the monetary authorities to carry out a rule-based monetary policy as inadequate to guarantee a stable and low equilibrium rate of inflation.

The New Political Macroeconomic Approach

In the conventional economics like the Keynesian, the government/policy maker is assumed to be the 'benevolent social planner' that always acts to maximise social welfare and seen as being (Snowdon and Vane, 2005).

The most of the theories discussed above generally focus on macroeconomic determinants of inflation and just pay little or no care to the role of non-economic factors such as political process, institutions, and culture in the inflation process. While it is the political forces, that choose economic policy in the real world and not the social planner. Economic policy results from a decision process that balances conflicting interests so that a common choice could emerge. The new political economy, literature offers fresh views on the relationships between timing of elections, performance of policy maker, political instability, policy credibility and reputation, and the inflation process

In the conventional approach, the assumed relationship between the policy maker(politician) and the economist was that the policy maker is expected to use the unbiased and well informed economic advice provided by the economist to maximise social welfare.

However, various studies (for example see, Alesina, 1989, Alesina and Perotti 1996, Drazen, 2000) reveal that often different positions were taken by the policy makers, especially in societies with various political parties, different classes, interest groups, and voters. In such diverse societies, the policy maker is seen to be mostly influenced by the forces of the various divisions and the impartial advice of the economist will be considered as secondary. For instance, the elected politicians tend to take economic decisions that favour the present and future interest of their ruling party. These types of economic decisions which are made on the basis partisan ideology tend to contribute to economic instability through the inefficient application of monetary and fiscal policies. For instance, an incumbent government can use the short-run Phillips curve to lower unemployment but with higher inflation so as to win an election, which might be detrimental to the economy in the campaign period and most especially after the election period. Even the rational thinking voters, can be convinced by the intentional signalling processes of the incumbent government in such a situation, considering that they lack information about the capability of the politician.

Another type of politically induced economic instability is where the incumbent governments to pursue short-sighted policies as reputational considerations are not important due to the little chance of being re-elected.

Due to these considerations, the macroeconomic studies in the last four decades were further advanced to accommodate the impact of the political system into the economy that results in the birth of the 'new political macroeconomics', which is built on some ideologies of the theory of public choice and the game theory. The new political macroeconomics attracts interest due to the impact of the relationships between the economic and political systems on macroeconomic variables like inflation, unemployment, and output (Snowdon and Vane, 2005).

It is, therefore, important to discuss the issue related to the causes of inflation and the impact of the non-economic, political and institutional aspects in the creation of inflation process. The political economy literature offers various factors in determining the inflation process which includes budgetary politics, central bank independence, political instability, political cycle, credibility and reputation, and inequality in income distribution.

It is argued that countries with higher political instability like coups, repressions, riots, frequency in the transfer of power, etc. are inclined to experience incredibly inefficient tax systems and depend a lot on inflationary financing compare to democratic regimes (Cukierman et al. 1992). Likewise, politically generated economic cycles during electoral competition tend to kindle an inflationary process. The Nordhaus' (1975) political business cycle model suggests that the incumbent politician, who is more concerned about his/her re-election prospect, tend to exploit the Phillips curve through manoeuvring the monetary or fiscal policy, to generate a positive economic outcome during the election period. Consequently, money growth and inflation will be high with lower unemployment and higher output in the run-up to the election and will drop after the campaign period so as to get ready for the next pre-election stimulation. This type of opportunistic behavioural cycle is assumed to be the same for different governments particularly when the probability of being re-elected seems to be low.

The political system can also influence the inflation process through fiscal disturbance. It was argued that expansionary fiscal policy through government spending tends to bring about monetary ease in different situations. For instance, indirect political pressure on the central bank to service government bonds that were issued to finance expansionary government policy during the pre-election economic boom. Taxes increase to fund government spending can also induce indirect monetary ease by the central bank. Such taxes increase is assumed to have a reallocation effect in resources between private and public sectors that will generate strain on the central bank to follow a monetary expansion to ease unemployment (Flemming, 1976).

In the new political economy theory, economic agents and government tend to engage in a complex dynamic game, in which any or fiscal or monetary policy announcement for low inflation rely on the government's credibility and reputation (Snowdon and Vane, 2005). The credibility and reputation issues become more significance in the aftermath of the rational expectation revolution given that rational economic agents understand that with the government's little credibility, the declared pre-election policy of low inflation is time inconsistent, as it cannot materialise after the election. Before the election, all parties are assumed to regard as it essential to declare policies that will appeal to the ordinary voter. Therefore, at such a moment the party's ideology will be secondary to improve the election prospects. Given that the voter cannot hold the elected party to its promises, the party will re-optimize by giving the ideological consideration predominance. Because of the time-inconsistent issues, the rational voter values the credibility and reputation of the candidate very much during the election process. Studies have offered different courses of actions to ascertain the credibility or reputation among voters. Some of the suggestions include fixed exchange rate regime, the independence of the central bank, and receiving an endorsement of the announced policy from international organisations.

The Central bank independence is in line with the opinion that inflation is a monetary phenomenon. The existence of such institutional factors is assumed to stop any effort by politicians to ease money for political gains. Some studies reveal that discretionary monetary authority has, on various occasions, turn out a higher than desirable inflation rate for reasons like political pressures to drive down unemployment to persuade the election process, the partisan effect and the drive associated with the financing of deficits. Therefore, the efficient means to control inflation is to assign the role of the monetary policy to an independent central bank.

Alesina (1988 and 1989) discovered a negative relationship between average long-term inflation rate and the degree of central bank independence in his empirical study of developed countries. However, he emphasised that the existence of an independent central bank does not provide an equal influence on inflation across all countries. For instance, central bank independence in countries with underdeveloped financial markets and unsound budget deficits is not likely to lead to an efficient counterbalance to inflation (Mas, 1995).

Recent uneven income distribution has been suggested as another political factor for inflation. There are various ways through which inequalities in income distribution tend to influence inflation. Sachs (1989) in his studies ascribed the economic situation in Latin American countries to the inequality in income distribution that generates political pressures on economic policies to enhance the income of lower groups which lead to weak output due to the wrong strategic decisions.

It is generally held that inequality in income distribution is a major factor for political instability, which in turn results in higher inflation which was proved through empirical studies.

3.2.2 Review of Empirical literature on Causes of Inflation

There is an extensive empirical literature on the causes of inflation. In this section, the study carries out a survey of the empirical studies on inflation. The study will attempt to quote instances of empirical studies that relate to the inflation theories discussed in the preceding section. Furthermore, considering that the political factors are more prone in the developing countries like Nigeria, the empirical studies are reviewed under two subsections the macroeconomic factors and political factors determining inflation. A summary of the discussion is provided at the end of the section.

Empirical Studies On Macroeconomic Factors Causing Inflation

Some of the research in the literature examined the influence of a particular variable on inflation while others consider the effect of some set of variables on the inflation. Some of the theories that have been widely examined include the modern quantity theory which suggests the influence of money on the domestic price level. For instance, Darrat and Arize (1990) empirically examined the determinants of inflation in twenty-five countries. They discover that inflation process was significantly connected with movements in the monetary base, real income, expected inflation, and expected currency depreciation rate. Some other early studies that established leading role for money in influencing domestic price level include Kormendi and Meguire (1985), Geweke(1986) and Poirier(1991) just to mention a few.

Grauwe and Polan (2005) examined the propositions of the modern quantity theory of money in 160 countries for the period of thirty years between 1969 to1999 and got a substantial evidence of a relationship between money growth and inflation in countries with higher high inflation. But, the relationship was found to be weak in countries with low inflation. They concluded that their result indicates the significance of money stock as a guide in directing policies for price stability in high inflation countries, although not in low-inflation countries. Likewise, Moroney (2002) confirmed that the modern quantity theory was able to explain the differences in inflation among the countries examined. Moroney established that the quantity theory to provides a full explanation of inflation in countries with high inflation. However, in countries with low inflation, the money does not adequately explain the movement in inflation. The result suggests the role of money stock as a guide in piloting policies for price stability in countries with high inflation however not in countries with low inflation.

Some other studies also have found that money was not the sole determinant of domestic price level and some other factors also play a role in the inflation process. For instance, Dhakal and Kandil (1993) studied the fundamental determinants of inflation in six developing countries in Asian. They established that inflationary pressures in the countries examined do not emanate mainly from money stock growth given that the results indicate there is no effect of money stock growth on the inflation rate in three of the six examined countries. Even in the other three countries where the money growth was significant the impact was not very high. Furthermore, they discover some variables that influence the people's willingness to hold money were responsible for the inflationary pressures in the countries examined. The variables that are found to have an effect on the inflation process include import prices and foreign nominal interest rates. They concluded that the types and efficiency of policies against inflation would vitally depend on the unique inflationary experience of every nation. For instance, they stressed the application of development plans that increase real income growth, where real income growth was found to create a substantial diminishing effect on inflation. On the other hand, they highlighted the adoption of the contractionary monetary policy in the countries, where the money stock growth creates a significant positive impact on inflation.

Likewise, the impact of external factors such as exchange rate and import prices on the domestic price level was also confirmed by numerous previous, and recent, studies. For instance, Hanson (1985) established that the local cost of imports which rely heavily on imported inputs have a substantial impact on inflation. Equally, Agenor and Hoffmaister (1997), confirmed that exchange rate shocks and money growth tremendously affect the inflationary pressures in the countries they examined. Other studies that confirmed the effect of an exchange rate change on inflation include Choudhri and Hakura (2006), Ca'Zorzi et al. (2007) and An and Wang (2011) among others.

Loungani and Swagel (2001) also found that inertial factors are significant in explaining inflation process in countries with fixed exchange rate regime. Whereas, changes in exchange rate and changes in money growth appears to be the lead in determining the inflationary process in countries with floating exchange rate regimes. Loungani and Swagel recommended that policies against inflation in countries with fixed exchange rate regimes have to emphasise on structural issues such as labour market rigidities and indexation schemes that affect the expectation relationship between the past and future inflation. Similarly, countries with floating exchange rate regimes should give higher attention to fiscal imbalances that may lead to higher inflation by triggering higher money growth or a balance of payment crisis forcing exchange rate depreciation.

Hassan and Alogeel (2008), found that foreign prices are the primary factor that drives inflation in the long-run in the highly import-dependent Gulf Cooperation Council countries, followed by exchange rate changes. The excess money supply in the countries was found to influence inflation only in the short-run and likely to dissipate very rapidly. Similarly, Guerrieri *et al.* (2008) examined a structural Philips curve with data on US traded-goods. They found that the relative price of imports is a key contributing factor for inflation. They established that changes in relative import prices are related to variations in the foreign competition.

The notion that global factors are significant in determining domestic inflation has developed over the years. Various studies found inflation process to be partly influenced by the global factors the impact which is thought have been increasing with the growing globalisation.

Morimoto *et al.* (2003), examined the impact of global supply shock on the global disinflationary trend. The study used structural VAR model to examine the relationship, for some developed and emerging economies. Their study established that global supply shocks put substantial downward pressure on domestic prices in developed countries since the mid-1990s. The study also suggests that the global supply shocks were instigated by the expansion of supply capacity in emerging economies. Furthermore, they have highlighted direct trade channels from emerging economies to developed countries in explaining the global disinflationary pressure.

Borio and Filardo (2006) also examined Phillips curve models for some industrialised countries; they found that global specific factors are more relevant in explaining domestic prices compared to other country specific measures. They specifically, found that proxies like global output gap for a world economic slack play a crucial part in determining the domestic rate of inflation.

Similarly, Ciccarelli and Mojan (2010) demonstrate that inflation in industrialised countries is a global phenomenon. The examine 22 OECD countries, in which they found that inflation in all the countries has a common factor which alone accounts for about 70 percent of their variance. Conversely, Monacelli and Sala (2009), in their study indicate that one common global factor explains about 15% to 30% of the change in the consumer product rate of inflation.

Moreso, some studies in the literature have empirically examined the impact of fiscal factors on domestic prices. For instance, Fischer *et al*. (2002) studied the link between fiscal deficit and inflation using data for over a hundred countries. Their study confirmed the positive relationship in high inflation countries in both short and long run. Likewise, in a previous study by Cottarelli *et al.* (1998) using data from 47 developed and emerging economies during 1993 to 1996, found that fiscal deficits have a significant impact on inflation, especially in countries with weak government securities market.

Similarly, Catao and Terrones (2005) studied the inflation and fiscal deficit relationship using data from over a hundred countries for the period between 1960 and 2001. Unlike the other studies, their study modelled inflation as being non-linearly related to fiscal deficits, for which they used the money supply instead of output. They found a significantly high positive link between the deficits and inflation in the high inflation developing countries. However, they cannot discover any significant link in the low inflation developed countries. Catao and Terrones' (2005) findings were in contrast to the earlier study by Click (1998), who found an insignificant impact of for government budget constraint on inflation. Other studies that have found significant of a fiscal effect on inflation include Hammermann and Flanagan (2007), Staehr (2008), Bleaney and Francisco, (2016) just to mention a few.

Lastly, some confirmations have also been found for the impact of structural changes on inflation. For instance. Staehr (2008), who investigated the primary drivers of inflation in Central and Eastern Europe during 1998 to 2007, established that high productivity growth and capital intensity in the traded sector are among the important drivers of inflation.

Empirical Studies on Political and Institutional Factors Causing Inflation

Aisen and Veiga (2005) found a positive relationship between political instability and inflation. The study used a dynamic panel-data of nearly hundred countries for the period between 1960 and 1999. Unlike earlier studies, their study used a more direct measure of political instability affecting seigniorage and inflation which also include additional explanatory variables for inflation inertia. The result of the study shows that higher degree of political instability causes higher inflation and seigniorage. They suggested that policymakers should know it is vital to reform institutions and build viable mechanisms to boost long-run price stability. More so, they recommended that effort to stabilise inflation needs to be combined with fiscal and political reforms.

Furthermore, studies have confirmed the significance of other institutional arrangements such as central bank independence, the degree of openness of the economy and exchange rate regime on the domestic inflation. For instance, Alesina and Summer's (1993), the study of some industrialised countries established that movements in inflation are negatively related to the independence of central banks. While, Ghosh et al. (1997), confirmed the relationship between inflation and exchange rate regime. Their study also and confirmed a significant negative connection between the central bank independence and inflation which implies that central bank independent lead to lower inflation in an economy.

Likewise, Carmingnani *et al.* (2008), studied the impact of the economic and socio-political environment on the de jure policies. The study establishes a significant negative relationship between inflation and central bank independence. On the other hand, Sturm and Haan (2001) could not establish any significant relationship between inflation and central bank independence as their model includes some control variables. They suggest that in the estimations, where central bank independence is significant. However, it was significant only when countries with high inflation are included in the sample. Campillo and Miron (1996) also presented similar result. Campillo and Miron's (1996) study examined inflation performance in 62 countries between 1973 and 1994. Campillo and Miron's (1996) study instead discovered the more significant impact of countries' degree of openness and political instability.

Some earlier studies suggested the role of economy's degree of openness on inflation. Notably among them is the study by Romer (1993) which examined the impact of openness on inflation in the long-run with data from over a hundred countries for the period between 1973 and 1990. The study establishes a significant negative relationship between openness and inflation. He suggested that without a pre-commitment in monetary policy, the open countries are more likely to experience lower inflation. Romer (1993) is of the opinion that open economies' monetary authority finds currency shocks due to surprises more hurting hence tend to follow more restraint than the closed economies. Based on Arellano and Bover's (1995) model Romer confirmed the causality runs from openness to lowering inflation.

Equally, Gruben and Mcleod (2004), found that more open economies are more likely to have stable prices. In a similar study which was carried out using microdata, Chen *et al*. (2004) also confirmed the connection between inflation and trade openness. The study revealed that with disaggregated data for EU manufacturing for the period between 1988 and 2000, the growing openness leads to decrease in sectoral prices due to dropping markups and rising productivity. Lein-Leon-Ledesma *et al.* (2007) also found similar results for central and eastern Europe countries.

On the other hand, Carmgnani *et al.* (2008), found a negative link between openness and inflation. Though, contrary to Romer's proposition Carmgnani *et al.* (2008) suggested that openness influence inflation via the channel of exchange rate regime. More open countries which have the interest of attracting foreign capital flow tend to employ the fixed exchange system to stabilise expectations.

Some empirical studies also confirmed the influence of the exchange rate regime choice on the inflation rate. For instance, Ghosh *et al.* (1997), reported a significant negative relationship between exchange rate regime and the inflation. Equally, a study by Alfaro (2005) revealed that fixed exchange rate regime plays a vital part in driving down inflation in the short-run. More so, De Grauwe & Schnable (2005) found similar results even after controlling for other determinants of inflation. Some other studies that found a significant relationship between the exchange rate regime choice and inflation rate among other include Edwards and Magendzo (2003), Bleaney and Francisco (2007) and Toulaboe and Terry (2013).

Some studies also identified corruption to have a significant impact inflation rates. For instance, Al-Marhubi(1999) study indicates an important connection between inflation and corruption even when controlling for other political and institutional factors. All the four proxies of corruption used were significant, which implies that ceteris paribus countries with very corrupt systems witness higher inflation compare to countries with the less corrupt system.

Likewise, Braun and Di Tella (2004) examined the connection between corruption and inflation variability with data from over seventy countries for the period between 1982 and 1994. Their study result indicates a significant positive relationship between corruption and inflation. They suggested that high variability in inflation leads to high corruption and a small investment. They also suggested the indirect impact of inflation on growth due to corruption. Though, a full causality test between the corruption and inflation variability was not carried out in their work.

A study by Desai, Olofsgard and Yousef (2003) revealed that democracy has an impact on inflation due to the inequality in income distribution. Using different panel data estimation methods with data from over a hundred countries of both developed and developing for the period between 1960 and 1999. The study reported that democracy is linked to lower inflation in lower inequality countries and with high inflation in higher inequality countries. They suggest that non-inflationary redistributive policies like a progressive tax in democratic countries with high inequality would ease political pressures on inflation.

Likewise, a previous study Beetsma and Ploeg (1996) establish a positive association between inflation and inequality in democratic countries. The study examined 56 countries for the period between period 1960 and 1985. However, they reported that their estimation could not establish a link for non-democratic countries. But, in a similar study by Al Marhubi (2000) for the period between 1975 and 1995, Al Marhubi reported that inequality is significant for both democratic and non-democratic countries.

3.3 Exchange Rate Pass-through

Goldberg and Knetter (1997) defined exchange-rate pass-through as "the percentage change in local currency import price resulting from a 1% change in the exchange rate between the exporting and importing countries". While Menon (1995) defined it as "the degree to which exchange rate changes are reflected in the destination currency prices of traded goods".

The interests of investigating the relationship between exchange rate and the price was sparked and continue to attract researchers after the move from fixed to flexible exchange rates. Some early studies Friedman in 1953 and Johnson in 1969 suggested the significance of flexible exchange rates for international price adjustments. The studies assumed that flexible exchange rates were capable of enhancing trade balances through relative price adjustment between foreign and locally produced goods. Therefore, with the end of the Bretton-Woods system in the early 1970s countries changed from the fixed exchange rate regime to flexible exchange rates regimes with the optimism of restoring their currencies to equilibrium and to ultimately enhance their trade balances (Engel, 2002).

However, the trade balances started to show some signs of recovery due to changes in exchange rates, the hope on flexible exchange rates for external adjustment began to fade (Menon, 1995). Consequently, to understand the puzzle, various studies were undertaken. Most of those studies examined the slow and incomplete pass-through of the exchange rate to the prices considering that if prices are not affected by the changes in exchange rate, then the choice of floating exchange rate regime to enhance trade balance would be unsuccessful.

The flexible exchange rate argument is on the assumption that the exchange rate pass-through is either full or considerably high (Bache 2006). Hence if pass-through of the exchange rate is incomplete, then rise in the value of the domestic currency cannot lead to a decrease in prices of imported goods. Therefore, that would mean floating exchange rate might not be the best choice exchange rate regime (Devereux and Engel, 2003).

Generally, the exchange rate pass-through studies for industrialised countries during the 1980s and 1990s indicate that the pass-through was mostly partial (Bache 2006). However, the results for the developing countries show full or substantial pass-through in most cases. However, there are some puzzling results for countries that had massive devaluations during the 1990s which also encourage further studies on the subject matter about the situation in developing countries given that most of the earlier studies used data from developed countries (Frankel et al., 2005).

Furthermore, early studies on the pass-through of exchange rate were mainly on the microeconomic basis that changed especially during the 1980s (Bache, 2006). Most of those early studies were also carried out using industry level data considering that it is more suitable to precisely trace the impact of the changes of exchange rate on the price of the particular goods(Ghosh and Rajan, 2007).

However, the exchange rate pass-through is also investigated at a macro level, for instance, examining the effect of changes in the exchange rate to consumer price index. This very effect is more relevant to monetary policy authorities which will be the focus of the subsequent sections of this chapter.

3.3.1 Theoretical Connection between Exchange Rates and Domestic Prices

The early theoretical suggestions about the relationship between exchange rate and prices date back to the fifteens and sixteenth centuries works of Salamanca School in Spain. The studies on the relation have been rekindled after the first world war by the prominent works of Gustav Cassel in 1921 about purchasing power parity (PPP) theory.

Cassel offered the PPP as a guide for the developed countries to reorganise their gold parity after the first world war.The simple version of the PPP theory proposes that the nominal exchange rate between the currencies of two countries will adjust to equate the price levels of the two currencies. This proposition implies that both the local and foreign currencies have the same purchasing power once converted into one currency. The relationship proposed by the PPP theory is mathematically expressed as:

$$P^D = EP^F \tag{3.9}$$

Where P^D represents the domestic price level, E is the bilateral nominal exchange rate between the two countries, and P^F denotes the price level of the foreign country.

Equation (3.9) is the representation of the absolute PPP theory which is based on the law of one price (LOOP). Assuming barriers to international trade like taxes, tariff and transportation costs, are removed, the LOOP states that the price of similar products in different countries should be the same once converted to the market exchange rate (McDonald, 2007). However, the main weakness of the absolute PPP theory is its assumption of constant the real exchange rate (RER) the nominal exchange rate adjusted for the difference in the national price levels should be constant, however, this not true for any real and nominal exchange rate comparison (McDonald, 2007).

Also, another condition, of the law of one price to produce the PPP between currencies of two countries is that the price indices of the two nations should comprise of indices with same goods and same weighting(McDonald, 2007). More so, the LOOP assumes no capital flows, perfect competition, no barriers to trade such that no transportation, distribution, and resale cost (Goldberg and Knetter, 1997). It is clear that these assumptions are very unlikely to hold in the real world.

Considering the problems of the assumptions of the LOOP, an alternative form of the PPP theory called the relative PPP is usually considered. The relative PPP theory states that changes in exchanges rates will adjust differences in the national price levels, Inflation rates, between two countries. It also shows that countries with relatively higher inflation rates will experience a depreciating currency (McDonald, 2007). The relative PPP theory is expressed in mathematical form as follows:

$$\%\Delta E = \%\Delta P^{D} - \%\Delta P^{F} \tag{3.10}$$

Where Δ denotes changes. The relative PPP only relates difference in the inflation rate of the two countries to the percentage changes in exchanges rate among the two nations. For instance, when inflation rate in one country rises by 5 percent, while the inflation rate in the other country increases by only 2 percent, then according to the relative PPP theory, the currency of the first country will depreciate by 3 percent to counterbalance the inflation differences between the two nations. The principal condition for the relative PPP theory to hold is that the difference between the inflation differential and the changes in the exchange rate should be zero or at least tend to centre zero (Pakko and Pollard, 1996).

In relation to the ERPT, the PPP holding implies that a change in exchanges rate will lead to a proportional shift in the domestic price level. So, the PPP theory assumes full pass-through of changes in the exchange rate to prices. Therefore, partial pass-through implies a deviation from PPP. However, full pass-through can take place although the LOOP does not hold. The failure of the LOOP will only invalidate the absolute PPP. However, partial pass-through invalidates both the absolute and relative PPP (Frankel *et al.,* 2005).

3.3.2 Channels of Exchange Rate Pass-Through

The extent of exchange rate pass-through has a significant impact on economic policy. When there is a low exchange rate pass-through, an exchange-rate-based adjustment to boost the trade balance might be less satisfactory, given that changes in nominal exchange rate do not translate into changes in real exchange rate.

The impact of exchange rate changes on prices and economic activities is one significant challenge to economic policy makers. With nominal exchange rate misalignment, there is often a reluctance to let the exchange rate to adjust for fear that the pass-through would make domestic disruptions and will counteract the anticipated international competitiveness gains. A significant price increase of imported goods from exchange rate depreciation would spill over to the other sectors of the economy, increase the overall domestic production costs, and might cause an inflationary spiral. Also, the increase in production costs would raise the price of export goods in home currency and could result to unchanged or even weakening international price competitiveness (Razafimahefa, 2012).

Among the most important factors that determine the degree of exchange rate pass-through are the market size and the level of competition in the market. Where the market for the product is large, then importing firms will be willing to absorb a proportion of the exchange rate change in order not to lose market share, particularly when the industry is very competitive. If many suppliers are selling similar goods in the market, then it provides the domestic consumers with a choice of a lot of substitutes, making them relatively price-sensitive. On the other hand, where the industry is highly differentiated, and there is no so much competition, then import prices will be to some extent less responsive to changes in exchange rate. In such a situation, the exchange rate pass-through will be higher (Knetter, 1994).

Exchange rate changes do reflect in domestic prices through two main channels, directly and indirectly.

Direct Channel

Exchange rate fluctuations affect local consumer prices directly through changes in prices of imported input like capital goods and raw material and imported finished goods. Appreciation of domestic currency will lead to a decrease in import prices of inputs and finished goods. Conversely, the depreciation of the local currency will result in an increase in import prices of inputs and finished goods which are ultimately transferred to the consumer prices. The depreciation of the local currency also encourages the importation of input which will lead to increase in the marginal cost of the producer which will, in turn, result in increased prices of goods produced locally (Hyder and Shah, 2004).

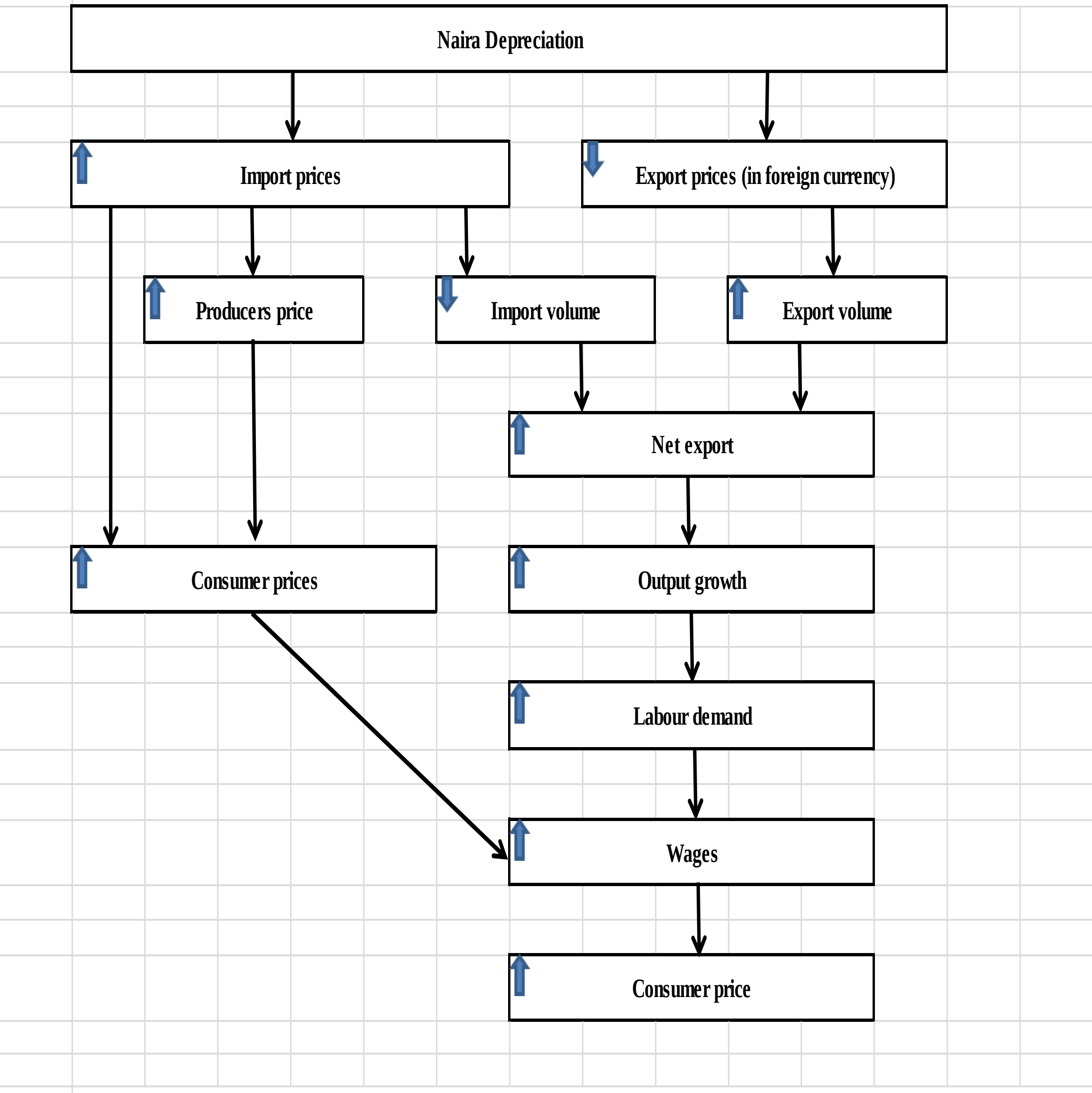
Indirect Channel

The indirect consequence of ERPT works from different channels like changes in the composition of demand or the level of aggregate demand and wages, and inflation expectations (Lafleche 1997, Taylor 2000, Aliyu *et al.* 2009). The channel through inflation expectations is initially suggested, in the proposition of Taylor (2000). According to him, the pass-through is peak once exchange rate changes seem to be persistent and prices change due to the public's expectations.

Likewise, exchange rate changes will reflect in domestic prices indirectly through goods competitiveness in the international market. When currency exchange rate depreciates, the local product prices will fall which makes it comparably less expensive to foreign buyers. The fall in price will lead to an increase in the volume of export which will, in turn, lead to an increase in aggregate demand that will ultimately increase domestic prices (Hufner and Schroder, 2002).

Nevertheless, various factors determine the speed and level of how the changes in exchange rate reflected in the local price (Hyder and Shah, 2004).

Figure 3.1: Channels Exchange rate pass-through



Note: The arrows connecting the boxes show causality, while the arrows inside the boxes indicates the direction of change of the variable.

Source: Adapted from Lafleche (1997) and Aliyu et al. (2009).

3.3.3 Determinants of Exchange rate pass-through

Microeconomic Determinants of ERPT

1. Market Share

According to Knetter (1994), exporting firms are often willing to absorb some proportion of the changes in the exchange rate to retain their market share when product export market is large, the industry is very competitive, and the firm considers the shocks as transitory. On the other hand, in the highly differentiated industry with less competition, the exporter price may be less responsive to changes in exchange rate. Therefore, pass through will be higher and pricing-to-market will be lower.

2. Pricing Behaviour of Firm

If exporting firm has higher market share, they tend to set prices in their currency, which led to higher pass-through, which is known as producer-currency-pricing (PCP). While pass through tends to be less when the imports are denominated in the currency of importer country which is known as local currency pricing (LCP) (Al-Abri and Goodwin, 2009).

Taylor (2000) hypothesises that the responsiveness of prices to exchange rate variation depends positively on inflation. The theoretical basis for this is the fact that there is a positive correlation between the level and persistence of inflation, together with a link between inflation persistence and pass-through. In other words, the more persistent inflation is, the less exchange rate movements are seen to be transitory, and thus firms might respond by price adjustments. Different studies have been carried out on this like Devereux and Yetman (2008); Choudhri and Hakura (2006); Campa and Goldberg (2005) all support Taylor’s hypothesis.

3. Trade Openness

Another primary determinant of ERPT is the degree of trade openness of a country. The more an economy is open, the more changes in exchange rates are passed on to import and consumer prices. That implies that there will be less ERPT when there are more restrictions across the border of the countries. (Ca'zorzi et al. 2007).

4. Share of Import in Consumption Basket

According to Khundrakpam (2007), the higher the percentage of imports in the consumption basket, and the larger the proportion of imported inputs in production the more significant the impact of the exchange rate changes will be on producer prices which will ultimately pass onto consumer prices. Besides the issue of the share of imports in the consumption basket, is a matter of the composition of the imports in the consumption basket. Because of the degree of pass-through according to Khundrapam (2007) differs depending on the category of imports considered. For example, pass-through to manufactured products is found to be less as compared to the energy and raw materials.

5. Exchange rate volatility

Similarly, exchange rate volatility is another key determinant of ERPT. The impact of exchange rate volatility on pass-through is dependent on whether the effects are expected to be permanent or transitory. If transitory, firms would rather fine-tune their profit margins rather than change their prices. As a result, pass-through will be minimal. However, if they think the effect is permanent, then they would change price (Akofio-Sowah, 2009).

Macroeconomic Determinants of the ERPT

The concern of whether macroeconomic factors affect exchange rate pass-through to domestic prices is relatively new. The move was mainly drawn from the new open economy macroeconomic models (NOEM) which bring in the nominal rigidities and monopolistic competition into the dynamic general-equilibrium, an open economy model with well specified micro foundations (Bailliu and Fujii, 2004).

According to the Obstfeld and Rogoff (1995) and Devereux and Engel (2003), which are critical studies that form part of the NOEM literature that the level of ERPT depends on the pricing strategies of firms. Where a firm adopts producer currency pricing (PCP), in which local nominal prices are set in producers' currencies, the ERPT to consumer prices is expected to be complete. This proposition is consistent with the traditional open-economy macroeconomic models like Mundell-Fleming and the recent Keynesian small open economy models. On the other hand, with local currency pricing (LCP), in which local nominal prices are put in importing countries currencies, no pass-through of exchange rate change to consumer prices are expected in the short run.

In other models like that of Bacchetta and Van Wincoop (2003), it is assumed that different pricing strategies are adopted in the economy. Where the exporting firm has higher market share, they set prices in their currency, therefore, causing higher pass-through, which is known as producer-currency-pricing (PCP). On the other hand, pass-through tends to be less when the imports are denominated in the currency of importer country, which is known as local currency pricing (LCP)

(Al-Abri and Goodwin, 2009). Foreign exporting firms will take PCP, and local firms will choose LCP, for instance, due to competition with domestic producers. With the combination of pricing strategies, the level aggregate ERPT is believed to be incomplete in the short-run, hence this proposition supports the evidence that suggesting varying ERPT across industries.

According to Knetter (1994), exporting firms are often willing to absorb some proportion of the changes in the exchange rate to retain their market share when product export market is large. Especially when there is high competition in the industry and the firm perceives the shocks as transitory. On the other hand, in the highly differentiated industry with less competition, the exporter price may be less responsive to changes in exchange rate. Therefore, pass through will be higher and pricing-to-market will be lower.

On the other hand, Obstfeld's (2001) model assumes that changes in exchange rate lead to 'expenditure switching effect', as the substitution between imported product and those produced locally due to the exchange rate changes is only likely to happen at the level of local producers. As exchange rate depreciates, the local producers are likely to switch to locally produced intermediate goods from the imported ones. In the Obstfeld's (2001) model, intermediate imported goods prices are set in exporting countries' currencies, and finished goods prices are set in consumers' home currencies. Therefore, full pass-through is expected to the intermediate goods and zero pass-through to consumer prices. However, Engel (2002) pointed out that the main aim of this type of models is to demonstrate that regardless of the zero pass-through to consumer prices, the economy still unprotected from the effects of exchange rate changes as the changes result in expenditure switching at the level of local producers.

In general, different factors influence the choice of optimal price-setting currency. The factors include the domestic monetary policy as suggested by Devereux and Engel, (2002), the foreign firm's market share in the importing country as indicated by Bacchetta and Van Wincoop (2003) and the level of substitutability between foreign and home products as suggested by Goldberg and Tille (2008). However, to allow for incomplete ERPT, later studies assumed that import prices are sticky in domestic currencies. That is to say, import prices are not entirely predetermined, but it takes some time to adjust (Bailliu and Bouakez, 2004). The slowness in price adjustment was suggested to happen due to factors such as costs of changing prices.

The NOEM literature also highlighted a connection between the ERPT and the inflationary environment in an economy. The relationship was based on the work of Taylor (2000), who stresses the significance of monetary environment in explaining the level of ERPT. Taylor (2000) suggests that the link between inflation and ERPT in a microeconomic model with staggered price setting and monopolistic competition. Taylor (2000) suggest that firms, which usually fixed prices in advance for some periods, respond to changes in only when the changes are believed to be persistent. The economies with high inflation are likely to have more persistent costs. Therefore, the level of ERPT will rise in high inflation environment. Hence, a more stable system with low inflation tends to have a reasonably low ERPT, whereas a system with high inflation is more likely to have higher ERPT.

The Taylor's (2000) work has ignited more theoretical and empirical studies to demonstrate the effect of inflation environment on the ERPT. The studies stressed different mechanisms responsible for the decline in ERPT due to low inflation. For instance, the drop in the expected persistence of cost and price changes as in the work of Choudhri and Hakura (2006). A decrease in the frequency of price changes as described in the study by Devereux and Yetman (2002), and a rise in the prevalence of LCP as demonstrated in the work of Devereux and Engel (2003).

Further macroeconomic factors that could affect firms' pricing strategy and the pass-through of exchange rate changes to prices include the aggregate demand and exchange rate volatility and the business cycles (Mann, 1986). The ERPT is likely to be higher when changes in exchange rates are believed to be more persistent in nature considering that the firms tend to change prices than adjusting profit margins. Conversely, ERPT is expected to be low when exchange rates and aggregate demand are more volatile as firms will be more cautious of changing prices and more prepared to adjust profit margins (McCarthy, 2000).

The impact of exchange rate volatility on pass-through is dependent on whether the effects are expected to be permanent or transitory. If transitory, firms would rather fine-tune their profit margins rather than change their prices. As a result, pass-through will be minimal. However, if they think the effect is permanent, then they would change price (Akofio-Sowah, 2009).

Krugman (1987), Froot and Klemperer (1989), and Taylor (2000) all suggest that firms are less likely to pass through a change in the exchange rate to import prices in an environment where that type of changes are frequent and transitory. More so business cycles are assumed to affect the degree of ERPT. For instance, firms are expected to be more ready to change prices instead of amending profit margin in a demand boom period. On the other hand, in the period of excess supply, the firms are less likely to raise prices (Bailliu and Bouakez, 2004). However, during a period of multiple shocks such as currency depreciation and a concurrent demand boom, the ERPT is likely to be lesser (Mann 1986).

Furthermore, the level of ERPT is also supposed to be affected by the country's degree of openness. The country's degree of openness is assumed to have an adverse impact on its inflation considering that openness ensures the availability of goods and services at globally competitive prices. Though, the effect of openness to the ERPT is hypothesised to be positive (Romer, 1993). However, there should be no inconsistency among the two hypotheses considering that the later hypothesis implies that the effect on inflation from the exchange rate depreciation is higher in a more open economy (Amitrano *et al.* 1997).

Likewise, according to Gust *et al.* (2010), the level of trade integration and relative productivities changes among countries tend to pose a substantial impact on the degree of ERPT. Gust *et al.* (2010) suggest in their model that the pricing decision of the firm depends not just on its marginal cost but also on its competitor's price. Therefore, firms will not like their prices to deviate far away from the competitor's price. Hence, they believe it is optimal to adjust their mark-up more and their prices less in reaction to changes in exchange rate. Lower cost of trade because of growing trade integration and increased productivity encourage the local producers to decrease their mark-ups in response to the fall in the foreign exporter's price, leading to drop in the mark-up among all producers, and ultimately lower ERPT. Gust *et al.* (2010) proposition, in summary, states that greater trade integration lowers firm's market power, therefore, squeezing their profit margins and causing lower ERPT.

According to Khundrakpam (2007), the higher the percentage of imports in the consumption basket, and the larger the proportion of imported inputs in production the more significant the impact of the exchange rate changes will be on producer prices which will ultimately pass onto consumer prices. Besides the issue of the share of imports in the consumption basket, is a matter of the composition of the imports in the consumption basket. Because of the degree of pass-through according to Khundrapam (2007) differs depending on the category of imports considered. For example, pass-through to manufactured products is found to be less as compared to the energy and raw materials.

3.3.4 Empirical Literature on Exchange rate pass-through

The empirical studies relating to ERPT can be roughly categorised into those carried out on a microeconomic level, and those on a macroeconomic level. Research carried out on micro level concentrate on investigating ERPT into disaggregated import prices of particular home industries. While those held on macro level examines ERPT into aggregate price indices and those are further categorised into two more groups. The first group studied the degree of pass-through into aggregate import prices while the second group examined pass-through into the consumer prices.

Some of the studies are carried out using one country while others use two or more countries. The studies seek to analyse the following. 1) To estimate the level of exchange rate pass-through to different price indices. 2) To examine the reason for partial pass-through. 3) To determine either the exchange rate pass-through is a micro or macro phenomenon. 4) To investigate the reason for lower pass-through in home prices than import prices. 5) To determine either pass-through is symmetric or asymmetric.

Menon (1995) conducted a review of ERPT literature which was mostly carried out in developed countries and mainly the United States. However, recently Aron *et al.* (2014) conducted a study which also considers developing and emerging economies. Most of the studies discover an incomplete ERPT, but the extent differs significantly among the countries. The key factors that determine the level of pass-through in the economies are the size of the economy and the openness. Also, the pass-through relationships were confirmed to be mainly steady over time. Some of the studies found asymmetric and nonlinear pass-through, which means the level of exchange rate pass-through differs during appreciations and depreciations and with small and larger change of exchange rate.

Yang (1997) examines ERPT in manufacturing industries of US. The study found a partial pass-through (32 percent in the short run and 42 percent in the long-run) and differs across industries. In a cross-sectional study, he found that ERPT is higher in industries with a high level of product differentiation and a lesser elasticity of marginal cost. Also, the study showed a negative relationship between ERPT and import share.

Similarly, Goldberg and Knetter (1997) found out that the effect of exchange rate changes on US home prices is partial. Only about 60 percent of the changes in exchange rate pass through to the import prices on average. However, the reaction of home price to changes in exchange rate varies across the sectors, and a substantial share of the muted price reaction appears to come from changes in export prices mark-ups.

Likewise, Marazzi *et al*. (2005) examined ERPT to import price in the US. The study revealed a continuous decline in ERPT to US import prices, from more than 50 percent in the 1980s to about 20 percent between 1993 and 2004. More so, McCarthy (2007) studied the Exchange rate pass-through to an aggregate level for some industrialised economies which included Belgium, France, Germany, Japan, Netherlands, Sweden, Switzerland, the United Kingdom, and the United States. The study used a VAR model with import, producer and consumer price data ranging from 1976 to 1998. The study found that exchange rates and import prices had a modest influence on home price inflation in the post-Bretton Woods period. The study further discovered that pass-through is higher in economies with a high import share. Also, the rate of pass-through was found to be positively correlated with the openness of the economy and negatively correlated with the exchange rate volatility.

Furthermore, An, (2006) examined the ERPT at different distribution stages, the import prices, producer prices and consumer prices of 8 industrialised economies: Canada, Finland, Italy, Japan, Spain, Sweden, United Kingdom and the United States. The study discovered an incomplete ERPT in various horizons. However, complete pass-through occurs occasionally. The study also revealed that the degree of pass-through declines along the distribution chain. Likewise, the time required for a complete pass through turn out to be longer along the chain of distribution.

In a wider study, Campa and Goldberg (2002) used a data of twenty-five OECD states for a period between 1975 and 1999. The result is highly in support a partial exchange rate pass-through in the short run. The study concluded that there was the prevalence of incomplete pass-through into import prices. In the same vein, the result obtained from Campa and Goldberg (2005) also supports the high ERPT.

They studied data on European states from 1989 to 2004. They examined a short run and long run pass-through in the industries in the countries. They found that the elasticity is very high in the long-run but still not complete. However, it is full for some economies with higher inflation. The study also examined the structural changes in the ERPT after the euro. They discovered fall at the estimated point elasticity for most of the industries. Hence they acknowledged the presence of significant trend of lower ERPT in manufacturing industries.

Some studies in the empirical literature examined ERPT about the behaviour of monetary policy, and Taylor (2000) pioneered the study of ERPT in an inflationary environment. Some recent research established empirical evidence proving the relationship though not very convincing.

Choudhri and Hakura (2001) examined Taylor (2000) hypothesis for seventy-one countries; the sample comprises of both developing and developed industrialised nations. The study covers the period starting from 1979 to 2000. The long-run inflation rate is used as a proxy of the aggressiveness of monetary policy reaction to short-run price fluctuations. The motivation to use this proxy is that regime that builds a stronger effort in stabilising the short-run inflation rate would be capable of sustaining low inflation rates in the long run. The study discovered strong proves of a positive relationship between the inflation rate and ERPT for most of the industrialised and developing economies. Also, the studies investigate the effect of other variables. However, they discover that average inflation dominates in explaining differences in observed ERPT.

Likewise, Devereux and Yetman (2002) examined over one hundred countries' simple aggregate pass-through coefficients. In the study, pass-through is determined by the frequency of price changes of importing firms, and this frequency is a function of the monetary policy regime. For countries with incredibly higher inflation rates, they discover, as in Choudhri and Hakura(2001) that aggregate pass-through to be almost complete. Also, the study identified that there is a non-linear relationship between the average inflation rates and the estimated pass-through coefficients. The study identifies that as inflation increases; the pass-through also increases though at a decreasing rate.

Gagnon and Ihrig (2004) examine the relationship between ERPT, inflation and monetary policy credibility in 20 developed countries for the period 1971 to 2003. In addition to the use a cross-sectional approach, like the work of Choudhri and Hakura (2001) the study also examined if pass-through decreases in the countries after a change in the inflation regime. They discover that there was a substantial reduction in the rate of predicted pass through for the countries in which either the level or the standard deviation of inflation drops significantly in the first to the second sub-sample. Their research concluded that falling ERPT in developed countries is credited to change in monetary policy with the aim of achieving stability in inflation.

Similarly, Bailliu and Fuji (2004) used panel data from 11 developed countries for the period between 1977 and 2001 to examine the effect of ERPT. Their result supports the hypothesis that ERPT falls, given a change in a monetary policy regime that creates an environment of low inflation. More specifically, their results suggest that pass-through into import, producer, and consumer price inflation declined following the inflation stabilisation that occurred in many developed countries in the early 1990s, but not following a similar episode that happened in the 1980s.

However, Bouakez and Rebei (2008) used a structural general equilibrium approach to examine the assertion that exchange rate pass-through has declined in Canada. They study the dynamic general equilibrium model for Canada over two sub-samples that are after and before and after the country's adoption of inflation-targeting regime. The study used impulse response analysis and examined the implied pass-through has diminished from one sub-sample to the other. The research showed that the move by the monetary authorities of the country towards an inflation targeting regime is mainly responsible for the lower level of pass-through to consumer prices, hence supporting the Taylor hypothesis. Takhtamanova, (2010) also supports Taylor's hypothesis with his study on fourteen OECD states: The study confirms the suggestion made by others on the decline in the ERPT during the 1990s.

On studies carried out on emerging economies, Rowland (2003) estimates the ERPT of Columbia with Vector error correction model (VECM). The study also provides an incomplete ERPT to import and home prices. The study revealed that the reaction of import prices to changes in the exchange rate is about 80 percent per annum. The response of producer and consumer prices to the change in the exchange rate are 28 percent and below 15 percent respectively. Hence the study suggested that the effect of exchange rate change on consumer price is small.

On the other hand, Ito and Sato (2006) examine ERPT in Asian countries using SVAR and discover that the level of pass-through of exchange rate changes to prices differs among the indices. The impact of the pass-through is higher on import prices, followed by producer price and lower on the consumer price. The extent of pass-through of the exchange rate changes was larger on import prices of the countries that were more affected by the Asian crises. However, the pass-through was small across all the countries except in Indonesia.

Similarly, Aziz (2009) conducted a study on the effect of exchange rate changes on the import, export and home prices of Bangladesh for the period between 1973 and 2007. His study found that the effect of exchange rate shock was enormous and complete with import and export prices. However, the pass-through to the consumer and producer prices was incomplete which means the pass-through decreases along the pricing chain. The recursive VAR conducted suggests that effect of the devaluation of the exchange rate on the home price is positive and higher in the long-run than in short-run.

More so, Ca'zorzi *et al*. (2007) test the extent of ERPT in developing countries. Their study established that ERPT is high for import prices compared to the consumer prices which mean level of pass through decreases down the pricing chain. Moreover, the study found a contrary result to the common outcome that the pass-through is higher in developing countries compared to developed ones. They discover that in developing countries with low levels of inflation, especially the Asian countries the pass-through is small just as it is in developed countries. They also examine Taylor (2000) hypothesis using simple correlation model and discover a positively correlated relationship between the ERPT and the inflation.

Bhattacharya *et al*. (2011) also examined the ERPT for India with a time series data for the period between the year 1997 and 2000. The study adopted a CVAR model with six variables: GDP, domestic price, import price, oil price, short-term nominal interest rate and exchange rate. The result of the study also produced an incomplete ERPT. The findings of the research also revealed that even though there might be no relationship between the inflation and output the presence of higher though incomplete pass-through indicates that interest rate could influence inflation via the channels of the exchange rate. Hence they concluded that exchange rate regulation is the effective means via which monetary policy controls inflation.

Diago (2011) also assess the impact of inflation targeting regime adoption on ERPT in Peru using a Structural VAR model. The study result shows that the effect of the pass-through in long-run to import and export prices have decreased over the period. The study concluded that the inflation targeting regime adoption in the country had contributed considerably to the drop of ERPT which is in line with Taylor (2000) hypothesis.

Campa and Goldberg (2002) discover that changes in the level of pass-through in OECD state are more dependent on the industry composition of trade than inflation performance. They added that even though exchange rate volatility and higher inflation are positively related with high pass through in import prices, they emphases that microeconomic factors associated with the industry composition of trade have a more vital role in explaining exchange rate pass through. In the same way, Otani *et al*. (2003) stress the significance of changing product composition as the key factors that determine explaining Japan's ERPT differentials over time.

Nogueira and León-Ledesma's (2010) study is not in line with Taylor's work. The study looked at a state-space model of a Phillips curve. The result supports the hypothesis of the previous literature that exchange rate pass-through has been declining over time. Although, the study did not maintain the Taylors proposition that better inflation environment would help in predicting a lower degree of ERPT.

Their result does not reject the macroeconomic justification for the reduction of ERPT into consumer prices.

Empirical Exchange rate pass-through studies in Sub-Sahara Africa (SSA)

Kiptui *et al.* (2005) find that exchange rate pass-through in Kenya was incomplete during the period 1972 to 2002 using cointegration and error correction approach. They concluded that an exchange rate shock leads to a drastic rise in inflation which dies out after four quarters, and the exchange rate accounts for 46% of inflation variability.

Similarly, Mwase (2006) examines the response of consumer price to the changes in exchange rate changes using Tanzanian data. The study used Structural VAR model. The study examined data starting from the year 1990 to 2005. The result showed that pass through to consumer prices is very low.

Frimpong and Adam (2010) also studied the response of consumer price in Ghana to changes in exchange rate. They used VAR models with monthly data for the period 1990 to 2009. The result shows a positive and insignificant relationship between the exchange rate and the home prices in the long run. On the other hand, the result shows a significant but low pass through in short-run. They maintain that the study indicates the openness policy adopted and tighter monetary policy of the country.

There are few studies on exchange rate pass-through in Nigeria prominent among which include Essien (2005) and Aliyu et al. (2009).

Essien (2005) studied the link between exchange rates and inflation in Nigeria. The study used quarterly data for the period 1960 to 2003. The study applied ordinary least square (OLS) and error correction model with the exchange rate and domestic price level as the variables. The study found that existence of long-run relationship between the exchange rate and domestic price level. The coefficient of the long-run static equation was 1.05 which implies full pass-through in the long-run; however, the dynamic equation suggests an incomplete and low pass-through in the short run. Although OLS is a useful and vital method, it has various weaknesses and is often not the best method to use in real world applications. Lots of restraint is required in getting the best solution from a given estimation using OLS. For instance, OLS can perform badly where there are outliers in the data.

Aliyu *et al*. (2009) studied the degree of ERPT to import and consumer prices in Nigeria between 1986 and 2007 using VECM. The study found the level of pass-through to import and consumer prices in Nigeria during the period to be incomplete and low, continual and significant in the short-run. However, their study did not give a report on the long-run exchange rate pass-through.

In the short-run, the results of both Essien (2005) and Aliyu *et al.* (2009) show incomplete and weak ERPT. However, the studies use a different method and sample period. Our study uses a sample period from when the Nigeria introduced a floating exchange rate hence our result would provide behaviour of the exchange rate, unlike Essien’s study which includes periods of a fixed regime which could distort the result. Our study also covers a longer sample period of floating exchange rate than Aliyu *et al*. (2009). As such our result could portray the ERPT behaviour under the flexible exchange rate regime better. Another important aspect of the ERPT which our study examines which both the two studies did not consider is the issue of asymmetric and nonlinear ERPT. Their results suffer a major drawback as in reality most systems are not linear. With the ever increasing evidence of asymmetries and nonlinearities from various studies, ignoring their potential effect on the ERPT will not provide an accurate result. Therefore our study would provide a more robust result by considering the asymmetries and nonlinearities with the application of a model that captures their effect.

3.4 Summary and conclusion of the review

The aim of this chapter has been to review the literature on inflation and exchange rate pass-through (ERPT). The survey of the theoretical and empirical literature shows various hypotheses have been offered and tested on causes and determinants of inflation. The survey also revealed that exchange rate movements generally affect consumer price inflation. However, the speed and magnitude of the impact of exchange rate changes on consumer price vary among countries. The literature generally suggests that the level of ERPT is higher and sometime complete in developing countries whereas, the pass through is low in developed countries.

From the review of the various theories of inflation, the theoretical causes of inflation can be grouped into four broad factors: demand-side factors, supply-side factors, inertial factors and political factors. The demand-side of inflation include nominal factors like money supply or real factors in the form of high demand for goods and low unemployment. The two sources of demand side inflation characterise the interpretation of the two principal groups of economists, the Keynesians and monetarists. Furthermore, continuing government deficits have been regarded, especially by the monetarists and new classical economists, as a fundamental demand side cause for inflation. This non-monetary view of inflation is appropriate in the economies with inefficient tax systems, political instability, and limited access to the external borrowing of which make it easier for the government to rely on inflation tax. These situations are more prevalent in developing countries like Nigeria than developed countries.

On the other hand, supply-side factors of inflation include among other things, a sudden rise in oil prices, poor crop harvest, exchange rate fluctuation and rise in import cost. These supply-side factors of inflation characterise the cost-push theory of the non-mainstream economics. However, both the Keynesian and non-mainstream economists agree on a similar propagation mechanism, which suggests changes in relative price levels that in turn lead to an incessant rise in the aggregate price level. These factors are relevant to Nigeria which is an oil producing country that suffers the effect of oil price fluctuation and movement in the price of agricultural produce and exchange rate fluctuations.

There are few studies on ERPT in Nigeria which show results that are not consistent with the general view in the literature that ERPT is significantly high in developing countries. For instance, Aliyu et al. (2009) and Zubair et al., (2013) both found results that the ERPT is incomplete, low and fairly slow which are not in line with the situations found in developing countries in the literature. Our study considers carrying out a comprehensive and up-to-date study on the on the speed and size of ERPT in Nigeria with the aim of contributing to the literature on ERPT particularly Nigeria. The goal is to fill the gap in the literature on ERPT to consumer prices in Nigeria. This study accordingly examines the degree and speed of ERPT to domestic consumer price, i.e. ‘second-stage pass-through’ in chapter six of this thesis.

Chapter 4 :
Asymmetric and Nonlinear Exchange Rate Pass-through

4.1 Introduction

This chapter critically reviews the theoretical and empirical studies that examine the presence of asymmetric[1] and nonlinear[2] exchange rate pass-through to consumer prices. After the survey of the literature on the general topic of exchange rate pass-through to consumer price inflation in the previous chapter (Chapter three), this chapter is dedicated to asymmetric and nonlinearity aspect of the ERPT. In the literature, several microeconomic and macroeconomic arguments have been put forward as potential causes of the asymmetric and nonlinear response of the domestic consumer prices to exchange rate changes.

The chapter is divided in to four sections. The second section discusses causes of nonlinear and asymmetric exchange rate pass-through to consumer prices. The review of the theoretical literature on asymmetric and nonlinear exchange rate pass-through is carried out under microeconomic and macroeconomic perspectives. In section three, a review of empirical studies on the nonlinear and asymmetric exchange rate pass-through is conducted where evidence confirming its existence is presented. The reviews cover the scope, outcome and the research approaches of the studies. In section four, summary and conclusion of the review is presented.

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[1]Asymmetric exchange rate pass-through refers to where the pass-through differs depending on the direct of the exchange rate change (depreciation or appreciation) (Khundrakpam, 2007).

[2] Nonlinear exchange rate pass-through is the disproportionate response of prices to the different size of exchange rate changes, as linear exchange rate pass-through refers to the proportionate response of price to variations in the exchange rate (Przystupa and Wrobel 2009).

4.2 Asymmetric and Nonlinear ERPT: Literature review

In the literature, various microeconomic and macroeconomic arguments have been put forward as potential causes of the asymmetric and nonlinear response of the consumer prices to exchange rate changes.

4.2.1 Microeconomic Causes of Asymmetric and Nonlinear Exchange rate pass-through

Here we discuss some microeconomic arguments, presented in the literature, which can potentially cause nonlinearity and asymmetry in exchange rate pass-through in Nigeria. The microeconomic arguments are those emanating from pricing behaviors of the importing firms in the country and those with downward price stickiness. Pollard and Coughlin (2004) showed different circumstances that cause exchange rate pass-through to be asymmetric and/or non-linear. They include market share objective, binding quantity constraints, production switching and menu cost. The factors are discussed one after the other as follows:

Market Share Objective

When the foreign firm's strategy is to build a market share in the domestic market, asymmetric ERPT could occur. Pollard and Coughlin (2004) explain that despite the depreciation of the exchange rate the importing firms would maintain their prices unchange and absorb the exchange changes in their markup. In contrast, when there is appreciation, firms who wish to expand market share may keep their markups and let their market price drop. Therefore, appreciation of the currency of the importing country might cause a higher pass-through than its depreciation. Given the trade liberalization in Nigeria from 1986, most of the foreign importing firms in Nigeria are still at initial stages of their growth, competing with one another to control market share hence this type of pricing behaviors are eminent.

Binding Quantity Constraint

According to Pollard and Coughlin (2004), a binding quantity constraint has to do with the inability of foreign firms to increase sales volume in the importing country due to capacity constraints in their distribution network. With an appreciation in the importing country's currency, firms cannot increase their sales by raising supply due to capacity constraints. The firms would rather raise their markups to keep import prices constant in the importing country's currency, intending to maintain their sales amount at the same level while increasing the profit margin. The capacity constraints would not prevent the firm raising the import prices. Therefore, the depreciation of the importing country's currency would be a potential source of asymmetry. In contrast to the market share argument, this means that pass-through is lower for appreciation than depreciation. Knetter (1994) also noted that binding quantity constraints might arise when there are trade restrictions. With trade restrictions, that limit imports, such as quotas, quantity constraints may occur due to of limitations on the ability of the firm to increase its capacity. When the foreign company is operating at full capacity, an increase in the exchange rate will not lead to lower market prices. The firm will rather increase its markup, limiting pass-through. In contrast, when the exchange rate drops, the importer will pass this through to raise market prices to preserve its profit margin.

Production Switching

According to Pollard and Coughlin (2004), there is a tendency that firms will switch to local inputs when the country’s exchange rate depreciates and switch to imported inputs when exchange rate appreciates. When a home currency appreciates, the imported inputs will be relatively cheaper, and the firm will turn to use more of imported inputs. On the other hand, when the home currency depreciates imported inputs will be relatively more expensive, and the importer will switch to using more of local input which will lead to lower or zero ERPT. Consequently, with the production switching model, pass-through is low during periods of depreciation than appreciation. This behaviour was observed in Nigeria even with the recent depreciation and devaluation of Naira exchange rate in 2015 following the fall in oil price from 2014. The importing firms switched to domestic producers of farm produce like rice which makes the sector witnessed a dramatic boast.

Menu Cost

The "menu cost" principle argues that changing product price lists does cost. According to Khundrakpam (2007), it will therefore only be worthwhile for a firm to change its price when the exchange rate change is above a certain threshold. Hence, the importers allow their markup to take up the effect of small fluctuations in the exchange rate by maintaining its export prices constant. Pollard and Coughlin (2004) noted, however, that with large changes in the exchange rate firms will adjust their policy and pass-through some part of the changes to their prices. All the other factors discussed above are potential causes of ERPT asymmetry, while the menu costs explain nonlinearity in ERPT.

4.2.2 Macroeconomic Causes of Asymmetric Exchange rate pass-through

Macroeconomic causes of asymmetric and/or nonlinear ERPT put forward by Delatte and Lopez-Villavicencio (2012) are the stage of the business cycle when the exchange rate change occurred and monetary policy which could both lead to asymmetric and/or nonlinear pass-through in the short run.

Monetary Policy

A monetary policy measures taken in response to inflation can shield consumer price inflation from the effects of exchange rate depreciation. Anti-inflationary monetary policy measures are most likely taken after exchange rate depreciation than after an appreciation. In developing countries like Nigeria in particular, when central bank manages to set up a credible low inflation regime, then ERPT declines fast. This hypothesis may be particularly relevant in countries that adopted a monetary target policy. Under this assumption, appreciation will affect prices more than depreciation in the short-run (Delatte and Lopez-Villavicencio, 2012).

Just as witnessed recently in Nigeria from November 2014 when the Central bank of Nigeria raised monetary policy rate (MPR) from 12% to 13% and 14% in response to the inflationary pressures brought about by the consistent depreciation and devaluation of the Naira exchange rate and the pass-through effect that followed. With such policy actions, it is eminent that Nigeria could experience the nonlinearities in the ERPT.

Stage of Business Cycle

According to Delatte and Lopez-Villavicencio (2012), when currency depreciation occurs during a recession, the prices would increase less than they would have reduced following a currency appreciation. Often currency depreciations are triggered by a drop in local aggregate demand. The resulting recession due to the decline in aggregate domestic demand might continue to lower domestic prices. Therefore, the home prices might not react much to the exchange rate depreciation.

Similarly, Taylor 2000 argued that low and more stable inflation could be connected with less persistent inflation itself and showed evidence which confirmed that the relatively low inflation in the United States during the 1980s and 1990s are due to the relatively low persistence of inflation. Therefore, the low inflation and the monetary policy that has brought it would lead to lower pass-through via a decline in the expected persistence of cost and price fluctuations. This hypothesis of Taylor (2000) is what is referred to as Taylor's hypothesis in the ERPT literature.

As we observed in our review of the Nigerian economy in chapter two, Nigeria witnessed a relatively low and stable inflation since 1999 which could be due to better monetary policy decision coupled with the relative stable oil price. Hence the relatively low and stable inflation in itself could be a source of nonlinearities in the ERPT in Nigeria as the pass-through during the time will be proportionally lower than the periods of higher inflation.

Nigeria generates more than 90% of its foreign exchange earnings from selling oil. Given the notorious volatility of oil price, Nigeria's economy is always hit by the effect of the oil price shock. Consequently, the Nigerian economy frequently witnesses the boom-bust cycle. Therefore, the potential nonlinearities and asymmetries in the ERPT in Nigeria are probable.

4.3 Review of Empirical Literature on Asymmetric/Nonlinear ERPT

Early studies on asymmetric and nonlinear ERPT include Feinberg's (1989) and Goldberg (1995) among others. Goldberg (1995) studied US automobile imports from Japan and Germany and discovered asymmetries in consumer prices' response to exchange rate changes. However, Feinberg's (1989) studied US import prices and could not establish any evidence of asymmetric ERPT.

Subsequently, Kadiyali (1997), Kanas (1997), Mahdavi (2002) and Olivei (2002) examined ERPT asymmetry using US data. Kadiyali's study concentrates on a particular industry. His study analysed US imports of photographic film from Japan, and his study discovered higher pass-through in the period that US dollar depreciates, in line with the binding quantity constraint theory. Similarly, Kanas' (1997) work supports the binding quantity constraint hypothesis. The study examines eight products exported from the UK to the US. The study discovered asymmetric reaction in 6 out of the 8. Four out of the six were in line with the binding quantity constraints hypothesis.

More so, Webber (2000) confirmed asymmetric pass-through into import prices in five out of seven countries examined in Asia. Whereas, Mann (1986) found higher pass-through as the local currency depreciates than when it appreciates. Mann (1986) result also confirms the hypothesis of the binding quantity constraint. Mahdavi (2002) studied the pass-through in some of US export industries. Mahdavi (2002) also provides evidence of an asymmetric reaction in some of the industries examined. Similarly, Olivei (2002) studied the pass through but in some import industries in the US. In his analysis, 9 out of 34 industries studied showed some amount of asymmetry.

Marston's (1990) work is in line with both the market share model and production switching models. Similarly, Wickremasinghe and Silvapulle (2004) in their study revealed that pass-through is higher for appreciation than depreciation. The study supports asymmetric pass-through models of the market share and production switching.

Pollard and Coughlin (2004) examined asymmetric ERPT to import prices using industry-level data from 30 manufacturing industries in the US. The study reveals evidence of asymmetric pass-through for the majority of the sectors. Also, the study shows that the majority of the industries react nonlinearly to changes in the exchange rate. They confirmed that the ERPT was higher with large change. The study also looks at both size and direction effects concurrently and discovers that the effect of size was the most dominant. Hence they concluded that both the strategic factors and menu costs are significant in determining ERPT.

Furthermore, Khundrakpam (2007) also detected an asymmetry in ERPT for India. The study examines the ERPT to domestic prices in India during the post-economic reforms introduced after a major devaluation and liberalisation in 1991. The study established that the pass-through is higher for appreciation than depreciation. In the same way, the pass-through is found to be higher for smaller changes than larger ones. Khundrakpam (2007) explained that the result might be because most of the imports in India are invoiced in exporter's currency. The foreign exporters that gradually entered the Indian market after the liberalisation faced some degree of competition from the locally produced substitutes. Hence the foreign firms' market share objective was likely to hold. Therefore the pass-through from appreciation would be higher than depreciation as explained in section 4.1.

A careful observation of Nigeria experience is very much similar to the India experience (See Section 2.2, Chapter two) as Nigeria also devalues and floats the Naira since 1986. Nigeria is also a developing country with a huge fast growing population as such India's experience could be very much applicable to Nigeria.

Karoro, Aziakpono, and Cattaneo (2009) studied ERPT asymmetry for South Africa. The study used a VECM to examine monthly data from 1980 to 2005. The ERPT is higher when the currency was depreciating than when the currency was appreciating. This result supports the binding quantity constraint theory. The study also got some evidence that ERPT is higher during small changes than during significant changes in the exchange rate. This result also supports the menu cost theory, when invoices are denominated in the exporters' currency.

South Africa a fellow sub-Saharan Africa country with so many similar features with Nigeria in term of the foreign exchange market also with the asymmetric ERPT, hence Nigeria likely to experience the asymmetric behaviour of the ERPT witnessed in South Africa in Karoro, Aziakpono, and Cattaneo (2009) studies.

On the other hand, Przystupa and Wrobel (2009) who examined nonlinearity and asymmetry ERPT using Polish data established no substantial evidence that supports non-linearity in import prices response to the exchange rate. However, the study discovers an asymmetry in consumer price reaction to the output gap. The study also found asymmetry ERPT to the exchange rate shocks. The asymmetry response is mainly noticeable following exogenous shocks. However, Nigeria and Poland did not share geographical or population size feature, but one feature that could compare Nigeria and Poland is that of their citizens residing in some countries like the UK which tend to send monies back to their countries. Such monies definitely go through the foreign exchange markets. Perhaps that feature could make us believe that the Nigeria could share the asymmetric behaviour of the consumer price to the output gap.

While, Cozmanc and Manea (2010) examined the asymmetries of the ERPT into import, producer and consumer price indices for Romanian. They used three econometric methods equipped to capture various types of asymmetries: Markov-switching vector autoregressive (MS-VAR), Threshold autoregressive (TAR) and Self-exciting threshold autoregressive (SETAR). They found significant asymmetries and nonlinearities. Cozmanc and Manea (2010) study applied methodology that incorporates and models asymmetries than most of the studies. Perhaps that is another factor that could have help in identifying the asymmetries than the models with linear basis. This study would, therefore, used one of the threshold autoregressive models- smooth transition autoregressive model in examining the situation in Nigeria.

Delatte and Lopez-Villavicencio (2012) analysed asymmetric ERPT in some key industrialised countries of Germany, Japan, UK and the US. The study found that in all the economies examined pass-through was higher during depreciation than appreciation. That outcome implies weak competition structure and supports the binding constraint theory.

Similarly, Bussière (2013) examines potential nonlinearities and asymmetries in the response of export and import prices among G7 countries. The study used standard linear single equation framework with additional terms to account for nonlinearities and/or asymmetries, such as polynomial terms and interactive dummy variables. Nonlinearity tests based on Terasvirta's (1998) model was also used. The study revealed that the linear form of the model is in line with estimates in the literature. The study concluded that nonlinear effects could not be ignored, even though the direction of the asymmetries and the magnitude of the nonlinearities vary across countries. The study found substantial evidence for asymmetries than for nonlinearities.

Since studies of asymmetric ERPT even in the developed countries of the G7 that do not have the instability features that create a frequent boom-bust cycle which fuels the asymmetries show evidence of asymmetric ERPT, it is probable that Nigeria with more severe instability could portray the asymmetric behaviour of the ERPT.

Nonlinear ERPT Studies of with STAR Model Application

In this section, we discuss in details the methods and findings of some studies which applied STAR model to examine ERPT nonlinearity and/or asymmetry. The empirical studies that employ the STAR models in investigating the level of ERPT are up to now limited despite the relevance of the STAR model in examining the evident nonlinearities in ERPT as pointed out by Herzberg, Kapetanios, and Price (2003). There are only five studies that we came across in our search that examined the ERPT non-linearity and/or asymmetry using the STAR model. They include Herzberg, Kapetanios, and Price (2003) which applied the model for the UK; Junttila and Korhonen (2012) which applied the STAR model for nine OECD countries and Shintani, Terada-Hagiwara, and Tomoyoshi (2013) which applied the model using US data. While Nogueira Jr. and Leon-Ledesma (2008, 2011) examined some six countries that adopted inflation targeting (IT) regime and Cheikh (2012) which applied the STR model to study the nonlinearity and asymmetry in ERPT for European area.

However, some of these studies mentioned examined ERPT to import prices against our study (Chapter seven) which investigate the ERPT to consumer prices. Herzberg, Kapetanios, and Price (2003) considered the ERPT into import prices, and they could not establish evidence of nonlinearity. Junttila and Korhonen (2012) examine ERPT to import prices for nine OECD countries but found some signs of nonlinear pass-through which is positively correlated with inflation environment in the importing country.

We now discuss the methods and findings of the similar core studies Nogueira Jr. and Leon-Ledesma (2008, 2011), Cheik (2012) and Shintani, Terada-Hagiwara, and Tomoyoshi (2013) which investigated nonlinearity and/or asymmetry in ERPT to consumer prices using the STR model.

Shintani, Terada-Hagiwara, and Tomoyoshi (2013)

The study used an STAR model to evaluate Taylor's hypothesis on the positive relationship between the ERPT and inflation with US data from 1975 to 2007 using monthly data. They estimate a bivariate version of an STR model specified as follow:

$$\pi_t = \emptyset_0 + \sum_{i=1}^{n} \emptyset_{1,i}\pi_{t-i} + \sum_{i=0}^{n} \emptyset_{2,i}\, \Delta(e_{t-i} + p^*_{t-i}) + \left(\sum_{i=1}^{n} \emptyset_{3,i}\pi_{t-i} + \sum_{i=0}^{n} \emptyset_{4,i}\, \Delta(e_{t-i} + p^*_{t-i}) \right) G(s_t,;\gamma) + \varepsilon_t \quad (4.1)$$

Where π_t represents the producer price index inflation rate and $\Delta(e_{t-i} + p^*_{t-i})$ represents US importer's dollar prices. Their model uses the producer price index unlike our study which adopted consumer price index. They imply that the domestic price is the price at which the final producer sells its product. The model also implies that pass-through to exchange rate is a symmetric function of the past inflation rates around zero. They use an exponential U-shaped symmetric transition function to model the characteristic of symmetric function.

$$G(s_t,;\gamma) = 1 - \exp\{\gamma s_t^2\} \quad (4.2)$$

Their study used a moving average of past inflation $s_t = d^{-1} \sum_{j-1}^{d} \pi_{t-j}$ as the transition variable in the STR model. Their study also used a different STR model which was built from a combination of two logistic functions and gives a different U-shaped transition function. Therefore, the transition function here is:

$$G(s_t; \gamma_1 , \gamma_2 , c) = (1 - exp\{-\gamma_1 \ (s_t - c_1)\})^{-1} + (1 - exp\{-\gamma_2 \ (s_t - c_2)\})^{-1} \quad (4.3)$$

In their study, they refer to this model as dual LSTAR (DLSTAR) model to stress the two logistic functions, as it is different from the STR model with "second-order" logistic function

$$G(s_t;\ \gamma\ c_1 , c_2) = (1 - exp\{-\gamma\ (s_t - c_1)(s_t - c_2)\})^{-1} \quad (4.4)$$

They credited their choice of DLSTR model (equation (4.3)) against the ESTR (equation (4.4)) to the fact that the transition function in the ESTAR model collapses to a constant as γ moves toward infinity, and therefore the model would not nest the TAR (Threshold Autoregressive) model with an abrupt transition. While, the DLSTAR model take account of the TAR model by allowing γ_1 , γ_2 tend to infinity. They also point out that the DLSTAR model can comprise of both symmetric ($\gamma_1 = \gamma_2$ and $c_1 = c_2$) and the asymmetric ($\gamma_1 \neq \gamma_2$ and $c_1 \neq c_2$) adjustments between the positive and negative regions. Hence, they suggest that the model will allow examining a symmetric relationship between the inflation rate and the ERPT.

The findings of their study reveal that the level of ERPT is bigger as the transition variable (past inflation) exceeds 2 percent. The study discovers three different high ERPT periods which include during the second oil shock episodes, during the early

1990s when the producer price index was relatively volatile and during early 2000s which are also characterised by increased volatility of inflation. Shintani, Terada-Hagiwara, and Tomoyoshi (2013) concluded by confirming Taylor's (2000) hypothesis that the period of low ERPT is related to low inflation environment, and vice versa.

Nogueira Jr. and Leon-Ledesma (2008, 2011)

Nogueira Jr. and Leon-Ledesma (2008, 2011) examine the ERPT into CPI inflation for some of the emerging and developed countries that adopted inflation targeting (IT) regime. They used monthly data for the period from 1983 and 2005 for the developed countries and period from 1992 to 2005 for the emerging market economies. They examined the relationship using the following empirical model:

$$\pi_t = \beta_0 + \sum_{j=1}^{n} \beta_{1,i}\pi_{t-j} + \sum_{j=0}^{n} \beta_{2,i}\ \Delta p_{t-j}^{imp} + \sum_{j=0}^{n} \beta_{3,i}\Delta y_{t-i} + \sum_{j=0}^{n} \beta_{4,i}\Delta e_{t-j} + \left(\beta_0^* + \sum_{j=0}^{n} \beta_{4,i}^*\Delta e_{t-j}\right) G(s_t, \gamma, c) + \varepsilon_t \tag{4.5}$$

Where π_t represents consumer prices index (CPI) inflation rate, Δp_t^{imp} represents the change in import prices change, Δy_t represents the growth in output level and Δe_t represents the exchange rate depreciation rate. Their study tests the two basic STR models of logistic and exponential. With the aim of identifying likely ERPT nonlinearities and asymmetries their study examined a number of potentially transition variables. Therefore, the study used some macroeconomic variables deemed to have influence on the ERPT which include: exchange rate, inflation rate, output growth and two measures of macroeconomic instability. They used the ESTR model to capture nonlinear ERPT due to the size of change in the exchange rate.

While, LSTR model was used with the other transition variables (inflation, output and macroeconomic stability measures) because dynamic behavior differs on every side of the threshold.

The result of Nogueira Jr. and Leon-Ledesma (2008, 2011) studies show some evidence of nonlinearities in ERPT which differs significantly among different countries. Four of the six countries examined demonstrate a positive link between ERPT and the level of inflation. Nogueira Jr. and Leon-Ledesma (2008, 2011) suggest that the adoption of IT regime in the countries examined, which resulted in low inflation has helped in drawing down the level of ERPT. The study also found that ERPT tends to rise in times of confidence crisis, which shows the significance of a stable macroeconomic environment in bringing down the level of ERPT. While using the exchange rate as transition variable in the model, only two countries show a positive association between pass-through and the degree of change in exchange rate. The ERPT was also influenced nonlinearly by output growth, as the economy grows above a certain threshold; ERPT tends to be higher in three of the six countries examined in the study.

Cheikh (2012)

The study tests for the existence of non-linearity due to the inflation environment which it represents in the model by CPI inflation rate. In other words, the study also examines the hypothesis by Taylor (2000) argues that country with the low-inflation environment due to more credible monetary policies tend to experience a lower level of pass-through. Therefore, the study considers the issue of whether the inflation regime is a cause of non-linearity in ERPT. Unlike Shintani, Terada-Hagiwara, and Tomoyoshi (2013) the study here examines the countries in the euro area (EA) as the countries in the Eurozone experienced different macroeconomic development which the study presumes would have produced a non-linear mechanism in the ERPT.

The study defines an STR pass-through equation which is an extension of Bailliu & Fujii's (2004) pass-through model. The equation has been specified as follows:

$$\pi_t = \alpha + \sum_{j=1}^{N} \lambda_{1,i}\pi_{t-j} + \sum_{j=0}^{N} \psi_j \Delta y_{t-j} + \sum_{j=0}^{N} \delta_j \ \Delta w_{t-j}^{*} + \sum_{j=0}^{N} \beta_j \Delta e_{t-j} + \left(\sum_{j=0}^{N} \phi_j^{*} \Delta e_{t-j}\right) G(s_t, \gamma, c) + \varepsilon_t \tag{4.6}$$

Where π_t stands for CPI inflation rate, Δy_t stands for the growth in output, Δw_t^{*} stands for the changes in overseas producer cost, and Δe_t represents the depreciation rate of the nominal effective exchange rate. While, $G(s_t \, \gamma, c)$ represents the logistic transition function of the non-linear model. The study uses lagged inflation rate as transition variable. The analysis in the study, centers on long-run exchange rate pass-through (LR ERPT) which is represented with the following long-run time-varying coefficients:

$$LR\ ERPT = \left(\sum_{j=0}^{N} \beta_j + \sum_{j=0}^{N} \phi_j \, G(s_t, \gamma, c)\right) \Big/ \left(1 - \sum_{j=0}^{N} \lambda_j\right) \tag{4.7}$$

The Long-run ERPT coefficient takes different values based on whether the transition variable is above or below the threshold. As $(s_t - c) \to -\infty$, the elasticity of the pass-through elasticities are equal to:

$$LR\ ERPT = \left(\sum_{j=0}^{N} \beta_j\right) \Big/ \left(1 - \sum_{j=0}^{N} \lambda_j\right)$$

While, as $(s_t - c) \rightarrow +\infty,$ the coefficient of the pass-through will be:

$$LR\ ERPT\ = \left(\sum_{j=0}^{N} \beta_j \sum_{j=0}^{N} \phi_j\right) / \left(1 - \sum_{j=0}^{N} \lambda_j\right)$$

The study used the nonlinear STR ERPT model to estimate for twelve EA countries with quarterly series for a period from 1975 to 2010.

The study confirmed the presence of non-linearity due to the inflation environment. The study revealed that the pass-through of the exchange rate is higher as inflation rate exceed some threshold. The study found that the result in eight of the twelve EA countries shows a positive connection between ERPT and inflation levels. Therefore, the study concluded that the Taylor (2000) hypothesis holds. Also, the plots of time-varying pass-through coefficients show that prices responsiveness to changes in exchange rate has declined gradually in reaction to the low-inflation regime.

4.4 Summary and conclusions

The main findings of the review of the theoretical and empirical literature of asymmetric and nonlinear ERPT into consumer prices are summarised as follows:

The situations recognised in the theoretical literature that could create asymmetric/nonlinear exchange rate pass-through include market share objective, capacity constraint, menu costs, production switching, stage of the business cycle and monetary policy reactions. As we described in the discussion, all these behavior are prevalent among importing firms in Nigeria that opened up for trades not very long ago, and most of the foreign importing firms are at early stages of growth.

The empirical studies confirmed the existence of asymmetry and nonlinearity are mainly from countries like India and South Africa that share same geographical and structural features with Nigeria.

Only very few studies examined non-linear and asymmetric ERPT using data from emerging and developing economies which might be because most developing countries have no sufficient data available. For instance, there was no research on nonlinear and asymmetric exchange rate pass-through using Nigeria data.

Considering the lack of any study of asymmetric and nonlinear ERPT on Nigeria, this study aims to fill this literature gap in Nigeria. Given the increased globalisation and Nigeria’s financial and trade liberalization policies (see Section 2.2, chapter 2) studying the asymmetric and nonlinear ERPT is essential. The foreign companies in Nigeria tend to have market share objectives, capacity constraints, and often switch their sources of input and also consider the cost of changing the menu, it is therefore imperative to examine how the behaviours of the foreign firms affect the exchange rate pass-through process. Therefore, chapter seven of this thesis examines the asymmetric and nonlinear exchange rate pass-through in Nigeria using a quarterly time series data from 1986 to 2013 by applying a STAR model to fill this study gap.

Chapter 5 :
Research Methodology

5. 1 Introduction

The aim of this chapter is to discuss the models used in this thesis, the Vector error correction model (VECM) and the Smooth transition autoregressive model (STAR) and the strength of the models. The econometric methods used to model ERPT in the literature can generally be classified into single equation models and system models. Most early studies used single equation models for the exchange rate pass-through estimation on aggregated data (for example see, Feinberg 1986, Marston 1990, Menon 1992). Some of the early ERPT studies using the single equation with non-stationary[3] data produced wrong conclusions as exchange rate and price series are often non-stationary (Aron *et al.,* 2014). However, the linear combination of non-stationary variables can still produce a valid result, if the non-stationary variables are co-integrated[4]. Most of the later studies resolve the issue of non-stationarity by differencing the data to generate stationary series. Although, with a differenced data, it implies that the study either assumes there is no long-run relationship between the variables or a test for the relationship did not show any (See Campa and Goldberg, 2005).

Most of the single equations used are based on reduced-form regressions from a partial equilibrium model, based on the assumption that exchange rates are exogenous, which suggests that changes in the exchange rate are exogenous shocks. The single equation methods have the advantage of testing asymmetries and other

[3] Using non-stationary data are likely to produce incorrect results as regression equations using non-stationary variable can produce spurious correlations (Granger, 1981).

[4] When there is at least one long-run relationship between the non-stationary variables.

nonlinearities, in the ERPT process directly using split trends and interaction effects, or with explicitly non-linear versions. On the other hand, the systems models allow the endogeneity of the exchange rate and price variables which give room for feedback effects (Aron *et al.*, 2014).

When there are no structural breaks and nonlinearities in the sample data, the Johansen systems method (Johansen & Juselius, 1990), a vector autoregressive (VAR) model system in levels, can be used to test for multiple, long-run, co-integrating relationships between the hypothetically endogenous I(1) variables (Aron *et al.*, 2014).

The VAR models are helpful as it allows for the interaction of exchange rate with domestic variables (Ito and Sato, 2006). A Cointegrated VAR (CVAR) also known as Vector error correction model (VECM) is an excellent tool for both the short and the long-run relationship analysis which also resolves the problem of endogeneity and 'reverse causality'.

In the VECM, the speed of adjustment to equilibrium is independent of the magnitude of disequilibrium. The nonlinear adjustment could be modelled using threshold autoregressive (TAR) model (Tong 1993). TAR would be suitable when there is a threshold level of the absolute deviation from equilibrium beyond which exchange rate becomes mean reverting. The nonlinear adjustment process could also have features of a smooth transition autoregressive (STAR) model (Teräsvirta, Tjostheim and Granger 2010). In the STAR model, the fixed thresholds of the TAR model are substituted with a smooth function, which is continuous and non-decreasing (Tong 1993). In this study, we thought a Smooth transition autoregressive (STAR) model is more suitable than the TAR model when examining the exchange rate pass-through to consumer prices.

The STAR models have some useful properties. For instance, the STAR model does not imply an abrupt switch from one regime to another as the TAR model. The level and speed of exchange rate pass-through depend on the importing firm's perception of the exchange rate changes (whether permanent or temporary) and other factors like menu cost, market share objective and capacity constraints of the firms. Hence a smooth transition could be more suitable. Considering a large number of firms with different objectives and perceptions their reaction to the changes in the exchange rate could not be simultaneous. Accordingly, Teräsvirta (1994) noted that regime change for aggregated processes could not be discrete but smooth. STAR models also nest linear regression model, hence a linear Lagrange multiplier (LM) tests could be used to check for linearity prior to the nonlinear model application (Teräsvirta 1994). The LM tests can also be used to choose between the alternative STAR specifications, logistic STAR (LSTAR) and exponential STAR (ESTAR). The asymmetry in response to a positive and negative change in the exchange rate can be appropriately examined by the ESTAR model, while the nonlinear response to the size of the changes in exchange rate, inflation environment and growth levels could be examined with LSTAR as described by Teräsvirta (1994).

This study uses the VECM to examine the level and speed of the transmission of exchange rate changes to consumer prices in chapter six. While in chapter seven, we use STAR model to examine the impact of asymmetries and nonlinearities in the exchange rate pass-through process in Nigeria.

This chapter is divided into three sections discussing the two models adopted for the two empirical studies and drawing a conclusion. In section one, the VECM model is introduced, and some essential econometric issues in a VECM application like stationarity, cointegration, structural break and evaluations are discussed. In the second section, the STAR model is discussed explaining the modelling approach of the model. In section three a conclusion is drawn on how to apply the models in this study.

5.2 Vector Error Correction Model (VECM)

The general VAR model is specified as follows:

$$X_t = A_1 X_{t-1} + A_2 X_{t-2} + \cdots + A_p X_{t-p} + \epsilon_t \tag{5.1}$$

Where, $X_t \equiv (n \times 1)$ vector of system endogenous variables at time (t) such as consumer price, exchange rate, import price, oil price. $X_{t-i} \equiv$ Lagged values of the system's endogenous variables, and $i = 1,2,\ldots p$. $A_i \equiv (n \times n)$ matrices of predetermined variable coefficients to be estimated, and $i = 1,2,\ldots p. \in_i \equiv (n \times 1)$ vector of innovations at time t.

Unit root tests will be conducted to determine the stationarity of all variables. The study will employ Augmented Dickey-Fuller (ADF) test, which is complemented by Phillips-Perron (PP) test, The ADF Unit Root Test use the Equation 5.2 below to test for a unit root.

$$\Delta X_t = \alpha_1 + \rho X_{t-1} + \alpha_1 t + \sum_{i=1}^{l} \beta_i \Delta X_{t-1} + \varepsilon_t \quad t = 1,2,\ldots,T. \tag{5.2}$$

Where Δ is a first-differenced operator, $\boldsymbol{\varepsilon_t}$ is the error term at time *t*, $\boldsymbol{X}$ is the variable to be tested for a unit root, and $\boldsymbol{t}$ is a deterministic trend variable. Equation (5.2) models a data generating process (DGP) include a drift term and a deterministic trend. A test results by the ADF test are more robust than those provided by any other unit root tests in the presence of autoregressive errors, as the autoregressive terms are captured precisely (Banerjee *et al*., 1993).

If we reject the null hypothesis of a unit root at the 5 % level of significance, it implies that the series has no unit root and is stationary in levels, but if we fail to reject the null hypothesis, it suggests that the series has a unit root and then is not stationary at levels. A series has to pass at least one of the four tests at 5 % and below to be regarded as stationary.

If $\boldsymbol{X_t}$ is non-stationary, we cannot estimate Equation (5.1) at levels as such estimation will produce spurious results. We could then difference the variables to attain stationarity, but estimating Equation (5.1) in differences will lead to loss of long-run information. To avoid the problems of spurious results and loss of long-run information, a cointegration test is required to reveal any long-run relationship between the system variables. Therefore, we will proceed to check for any cointegration among the system variables. If any cointegration is found Equation (5.1) is transformed as follows:

$$\Delta X_t = \sum_{i=1}^{p-1} \Gamma_i \Delta X_{t-i} + \Pi X_t + \epsilon_t \qquad t = 1,2,\dots,T. \tag{5.3}$$

Where Δ is as defined above and

$$\Gamma_i = \sum_{j=i+1}^{p} \mathrm{A}_j - I$$

$$\Pi = \sum_{i=1}^{p} \mathrm{A}_i - I$$

Equation (5.3) is the error-correction representation of the VAR process in Equation (5.1). The vector error-correction model (VECM) differs from the standard VAR as it allows for long-run “equilibrium” relationships among the variables in the system in the short run.

The rank of the matrix Π in Equation (5.3) determines the number of cointegrating vectors. If the Π matrix is of full rank, r = n, the VECM reduces to the standard VAR in levels of stationary variables. Therefore, Equation (5.3) will be estimated in levels. Where Π is a null matrix, then $r = 0$, the VECM correspond to a VAR in first differences, given that X_t ~*I(1)* (Enders, 1995). When the rank is zero, it means there is no cointegrating vector which suggests that the variables are non-stationary and not Cointegrated. But, if the rank is $0 < r < n$, it implies that there is one or multiple cointegrating vector(s).

To determine the response of consumer prices to the change in exchange rate the coefficient estimates of the cointegrating vectors are normalised on consumer prices. Thus, the coefficients on exchange rate show the degree of ERPT.

5.2.1 Identification of Structural VECM

Johansen (1988, 1991) provided a solution to the problem of testing for cointegration and estimating the cointegrating with reduced rank regression of Anderson (1951). Yet, with multiple cointegrating relations, we cannot directly interpret the estimates results without imposing some identifying restrictions. Hence, the identification problem of linear simultaneous structural relations re-emerges in vector error correction models (VECM). In VECM the relations are now embedded as error correction terms in a dynamic model (Boswijk and Doornik, 2004).

Structural identification of cointegrated system with multiple cointegrating vectors is therefore necessary for a statistical system to have a meaningful economic interpretation (Greenslade *et al.*, 2002).

To achieve a fully (over) identified vector error correction model (VECM) important choices have to be made in the order in which different restrictions are imposed on a general unrestricted VECM. The restrictions are of four type: restrictions on the cointegrating rank of Π, $r < N$; restrictions on the dynamic path of adjustment Γ_i; restrictions on the cointegrating vectors, β where $\Pi = \alpha\beta'$, and restrictions on long-run causality of the system (the exogeneity), which implies restrictions on α (Greenslade *et al.*, 2002).

The general structural vector autoregressive system (VAR) in its complete, or closed form can be expressed as follows:

$$D(L)Z_t = V_t \tag{5.4}$$

where Z is a vector with N dimensions which could be split into Zt = (Yt; Xt ;) with Y as an $K \times 1$ vector of endogenous variables and X as a $Q \times 1$ vector of weakly exogenous variables ($N = K + Q$) and $D(\cdot)$ a appropriately dimensioned matrix in the lag operator.

The VAR could then be reparameterise as a structural VECM as follows:

$$A_0 \Delta Z_t = \sum_{i=1}^{p-1} A_i Z_{t-i} + A^* Z_{t-p} + u_t \tag{5.5}$$

where Z has r cointegrating relations and r < N which means A* has rank r. Usually, the rank could be imposed by defining $A^{*} = \alpha^{*}\beta^{*\prime}$ where the α^{*} and β^{*} are N × r matrices. Note that α^{*} and β^{*} are the structurally identified loading weights and the cointegrating vectors which are the target relationships and not the unidentified ones produced by unrestricted estimation (Greenslade *et al.*, 2002).

The structural VECM in Equation(5.5) above, will usually be estimated as an unrestricted version of the reduced form given as

$$\Delta Z_t = \sum_{i=1}^{p-1} \Gamma_i Z_{t-i} + \Pi Z_{t-p} + \nu_t \tag{5.6}$$

where $\Gamma_i = A_0^{-1} A_i$, $\Pi = A_0^{-1} A^{*}$and $\nu_t = A_0^{-1} u_t$. Unlike in the traditional stationary VAR (Blanchard-Quah or Sims identification criteria), identification problem where there are cointegrating vectors has two parts. As we impose the cointegrating rank of the system r by the standard decomposition of the long-run matrix $\Pi = \alpha\beta'$, where both α and β are N × r matrices, we have consider both the identification of the long-run coefficients β and the identification of the contemporaneous coeffcient matrix A_0. Restrictions on the long-run coeffient matrix can not give any information about the identification of A_0. The information about the identification of A_0 only comes from the dynamic part of the model using information either from α or Γ_i. Likewise, the dynamic part of the model does not help in identifying the long-run coefficients, β. Hence $\Pi = \alpha\beta' = A_0^{-1}\alpha^{*}\beta^{*\prime}$, therefore even when A_0 is known it would not help in identifying β^{*} without further restrictions on β (Greenslade *et al.*, 2002).

The restrictions to be imposed in this study will be based on assumptions in our theoretical model (See Section 6.2 in Chapter six). However, according to Pesaran and Shin (1994) the identification of β^* needs knowledge of r and then the necessary condition equivalent to the order condition is that exact identification of the long-run coefficients requires $k = r^2$ restrictions. Therefore the number of restrictions necessary to identify the long run is a direct function of the number of cointegrating vectors. Pesaran and Shin (1994) also give a necessary and sufficient rank condition for exact identfication, which is also a function of r^2. Generally, when the number of restrictions $k < r^2$, the system is underidentified, When $k = r^2$ the system is exactly identified and if $k > r^2$, the system is overidentified, according to the order condition and the overidentifying restrictions could be tested. Johansen (1991), Phillips (1991) and Pesaran and Shin(1994) also proved that the standard likelihood ratio test of the overidentifying restrictions follows a $\chi^2(k - r^2)$ distribution based on their asymptotic results.

Therefore, the long run can be estimated and identified and the overidentifying restrictions verified from the unrestricted VECM without identifying the dynamic structure of the model. Asymptotically this could be correct. However, Greenslade *et al.,* (2002) argue that with the sample sizes available in practical situations, the interaction of dynamic identification with the long-run identification would have a significant effect on the size and power of the testing procedures usually used. Hence, the choice made as to the order in which restrictions should be imposed and tested is crucial.

5.2.2 Important Econometrics Issues in VECM application

5.2.2.1 Stationarity and Unit root tests

The estimation method of the standard regression model, Ordinary Least Square (OLS) method assumes that the mean and variances of the variables tested are constant over time. A variable with changing mean and variance over time is non-stationary or unit root variable. The inclusion of a non-stationary or unit root variable in estimating the regression equations with OLS method provides incorrect inferences. A stationary series has a constant mean, while non-stationary series has no constant mean. The impact of the random shock on non-stationary series tends to be permanent, and thus the series follows a random walk. A stationary data is required to derive a valid result from the estimation. Using non-stationary data in time series analysis leads to a "spurious" regression. That is a situation where an estimated regression will show a significant relationship while there is no any economic relationship between the variables (Glynn *et al.* 2007).

Hence, in time series data analysis, the concept of stationarity is very vital. Before undertaking any time series econometrics analysis, it is necessary to check the stationarity properties of the series. Augmented Dickey-Fuller test was commonly used to verify stationarity.

5.2.2.2 Structural Breaks

Time series data often contain structural breaks, either because of change in policy or a sudden shock to the economy. Hence, the tests for parameter instability and structural change in regression models used to be an essential part of applied econometric studies since the work of Chow (1960), which tested for breaks *a priori* known dates with an *F*-statistic. So many other tests for a structural break like Quandt (1960), Andrews (1993), Andrews and Ploberger (1994), Bai (1997), Bai and Perron (1998, 2003) among others were developed over the years.

The idea behind Chow (1960) test is to fit each sub-sample separately to observe if their difference is significant in the estimated equations. If the difference is significant, it means there is a structural change in the relationship. Quandt (1960) amended the Chow framework to ease the condition that the candidate break date has to be known. Quandt (1960) consider the *F*-statistic that has the largest value over all possible break dates. More so, Andrews (1993) and Andrews and Ploberger (1994) derived the limiting distribution of the Quandt and related test statistics. Furthermore, Bai (1997), Bai and Perron (1998, 2003) built on the Quandt-Andrews context and presented a test which allows for multiple unknown breakpoints.

In this study, the combination of Chow, Quandt-Andrews, Bai-Perron tests are used to check for the existence of a structural break in each of the series used and the cointegrated VAR estimation.

5.2.2.3 Cointegration

Most economic time series are often non-stationary and I(1) series. A regression containing the levels of the non-stationary series produce misleading results which spuriously show a significant relationship between unrelated series. However, Engle and Granger (1987) pointed out that a linear combination of two or more non-stationary I(1) series can be stationary I(0), where such non-stationary series are cointegrated. It means there is the long-run equilibrium relationship between the variables. The concept of cointegration is relevant because differencing a variable to make it stationary only gives the short run dynamics. However, the study also examines the long-run relationships. With CVAR models cointegration test is essential given that the VECM will only be estimated when the variables are cointegrated.

5.2.2.4 VAR Lag Length Selection Criteria

Before estimating a VAR, the maximum lag length has to be decided to generate the white noise error terms. However, this is now done automatically by some econometric packages. The optimal lag length is determined using various information criteria. The commonly used information criteria are the Akaike (1974) information criterion (AIC), Schwarz's (1978) Bayesian information criterion (SBIC) and the Hannan-Quinn information criterion (HQIC). Usually, the lag length suggested by most of the criteria is included the in the VAR system.

5.2.2.5 VAR Diagnostic tests

Some diagnostic tests were carried out after VAR models estimation. These diagnostic tests are essential to ensure that the obtained result from estimating the VARs are valid for policy analysis. The basic post-estimation test carried out on the residuals of VAR include LM test to check for serial correlation, the ARCH-LM test for heteroskedasticity in the VAR, Jarque-Bera test to check the normality and test for the stability of the VAR.

Stability Analysis

The VAR stability test is essential to ensure the result is valid for policy analysis. The stability test determines if the roots of the characteristic polynomial lie inside the unit circle. When all roots lie inside the unit circle, it indicates that the VAR is stable, and we can use it for policy analysis.

5.2.2.6 Impulse Response Function

Macroeconomic models are used for policy analysis just as are used for forecasting. When used for policy analysis, it is vital to know the sensitivity of the economy or any part of it to exogenous shocks. When researchers and policy makers use a model defining a relevant part of an economy, the often used tool for examining the impact of shocks is impulse response functions (IRF). The IRFs are also essential tools to model builders in analysing dynamic properties of models. It is also critical in the case of nonlinear models where it is not possible in most cases to work out the properties analytically Terasvirta *et al.* (2010, p.364).

IRF traces the impact of a variable on others in the system. According to Pesaran and Shin (1998), Impulse response system measures the time profile of shock's effect at a given point in time on the (expected) future values of variables in a dynamical system. Therefore, for every variable from each equation, a unit shock to the error is evaluated to define the impact on the VAR system over time. For this study, the IRF will be used to examine the sign, size, and persistence of shocks from the consumer prices, import prices, and exchange rate.

There are two methods often used to estimate impulse responses. They are the generalised impulse response function (GIRF) and the Cholesky decomposition. The Cholesky decomposition imposes a recursive causal structure from the top variables to the bottom variables but not the other way around. However, Cholesky decomposition is criticised for its sensitivity to the ordering of the variable in the model. It also means omitting an important variable would lead to distortions in the IRF.

Pesaran and Shin (1998) introduced the GIRF to avoid the problem of ordering dependence of the Cholesky decomposition IRF. The generalised impulse response does not require orthogonalization of innovations and is invariant to the reordering of the variables in the VAR (Pesaran and Shin, 1998).

5.2.2.7 Variance Decomposition

Variance decomposition measures the contribution of each type of shock to the forecast error variance. More specifically, it highlights the proportion of the movements in the dependent variables that are a result of their shocks, versus shocks from the other variables (Stock and Watson, 2001). Variance decomposition gives information about the relative importance of each random innovation to the variables in the VAR. In our case, variance decomposition shows the importance of shocks to the import and consumer prices themselves versus shocks from the exchange rate and other variables in the system.

5.3 Smooth Transition Autoregressive (STAR) Model

The STAR models are a set of nonlinear time series models which is characterized by switching regimes through continuous transition functions. The transition dynamics depends on continuous transition functions that allow for smooth changes during the transition. The standard Smooth transition autoregressive regression model has the following form:

$$y_t = \phi' z_t + \theta' z_t G(s_t, \gamma, c) + u_t\ , \tag{5.7}$$

Where:

$\phi = (\phi_0, \phi_1, \dots, \phi_m)'$ and $\theta = (\theta_0, \theta_1, \dots, \theta_m)'$ are parameter vectors of the linear and nonlinear part respectively.

$z_t = (V_t'\ , X_t')'$ is ((m+1)×1) vector of explanatory variables $V_t' = (1, y_{t-1}, \dots, y_{t-d})'$ and $\boldsymbol{X}_t = (x_{1t}, \dots, x_{kt})'$

G represents a continuous transition function usually bounded between 0 and 1. Due to this reason, the model explains not only the two extreme states but also a continuum of states that lie between the two extremes.

s_t is a transition variable which is an element of $\boldsymbol{z}_t$, and then is assumed to be a lagged endogenous variable $s_t = y_{t-d}$ or an exogenous variable $s_t = x_{kt}$, s_t is usually one of the explanatory variables or the time trend.

γ is a slope parameter which measures the speed of the transition from one regime to another.

$c = (c_1, \dots, c_k)'$ is a vector of location parameters.

$u_t \sim \text{iid}(0, \sigma^2)$ denotes a sequence of independent identically distributed errors.

There are two possible interpretations of the STAR model. The STAR model can be considered as a regime-switching model that allows for two regimes, connected with the extreme values of the transition function, $G(s_t, \gamma, c) = 1$ and $G(s_t, \gamma, c) = 0$ where the transition between the two regimes is smooth. On the other hand the STAR model can be considered as a model which allows for a ‘‘continuum’’ of regimes, each associated with a different value of $G(s_t, \gamma, c)$ between 0 and 1. This study we will use the two-regime interpretation.

The observable variable s_t determines the regime that takes place at time t and the associated value of $G(s_t, \gamma, c)$. Different regime-switching behaviour are observe based on the choices of the transition function $G(s_t, \gamma, c)$. First-order logistic function is often the choice for $G(s_t, \gamma, c)$ and the resultant model is referred to as the logistic STAR (LSTR) model expressed as follows:

$$G(s_t, \gamma, c) = [(1 + \exp\{-\gamma(s_t - c)\})^{-1}], \qquad \gamma > 0, \tag{5.8}$$

In equation (5.8) the parameter c denotes the threshold between the two regimes, so that the logistic function changes monotonically from 0 to 1 as s_t increases and $G(s_t, \gamma, c) = 0.5$. The parameter γ determines the smoothness of the change in the value of the logistic function and, hence, the smoothness of the transition from one regime to the other. As γ grows very large, the logistic function $G(s_t, \gamma, c)$ approaches the indicator function $|[s_t > c]$, defined as $|[A] = 1$, if A is true and $|[A] = 0$ otherwise, and, consequently, the change of $G(s_t, \gamma, c)$ from 0 to 1 becomes instantaneous at $(s_t = c)$. Therefore, the LSTR model in Equation (5.8) nests a two-regime threshold autoregressive (TAR) model as a special case. In the case $s_t = y_{t-d}$, this model is called a self-exciting TAR (SETAR) model (for example see Tong 1990). As $\gamma \rightarrow \infty$, the logistic function approaches a constant (equal to 0.5) and when $\gamma = 0$, the LSTAR model will, be reduced to a linear AR model with parameters $\phi_j = \frac{\phi_{1,j}+\phi_{2,j}}{2}$, $j = 0,1 \dots, p$.

With LSTAR model, the two regimes are associated with small and large values of the transition variable s_t (relative to c). This type of regime-switching can be convenient for modelling, for example, business cycle asymmetry where the regimes of the LSTAR are related to expansions and recessions (for example see Terasvirta and Anderson (1992) and Skalin and Terasvirta (2001)).

Some applications specify the transition function in a way that the regimes are related to small and large absolute values of s_t (again relative to c). This can be achieved by using, for example, the exponential function expressed follows.

$$G(s_t, \gamma, c) = \quad (1 - exp\{-\gamma(s_t - c)^2\}), \qquad \gamma > 0, \tag{5.9}$$

The exponential function has the property that $G(s_t, \gamma, c) \rightarrow 1$ both as $s_t \rightarrow -\infty$ and $s_t \rightarrow \infty$ whereas $G(s_t, \gamma, c) = 1$ for $s_t = c$. The exponential STAR (ESTAR) model has been applied with $s_t = y_{t-d}$ to real (effective) exchange rates by Michael et al. (1997), Sarantis (1999) and Taylor et al. (2001), motivated by the argument that the behaviour of the real exchange rate depends nonlinearly on the size of the deviation from purchasing power parity.

For either $\gamma \rightarrow 0$ or $\gamma \rightarrow \infty$, the exponential function (5.9) approaches a constant (equal to 0 and 1, respectively). Therefore, in both cases the model collapses to a linear model and, particularly, the ESTAR model does not nest a SETAR model as a special case. Alternatively, one can use the second-order logistic function.

$$G(s_t, \gamma, c) = [(1 + \exp\{-\gamma(s_t - c_1)(s_t - c_2)\})^{-1}], \quad c_1 \leq c_2, \quad \gamma > 0, \tag{5.10}$$

Where, $c = (c_1,\ c_2)'$as proposed by Jansen and Terasvirta (1996). Here, as $\gamma \to 0$, the model turn into linear, while as $\gamma \to \infty$, and $c_1 \neq c_2$, the function $G(s_t, \gamma, c)$ becomes equal to 1 for $s_t < c_1$ and $s_t < c_2$ and equal to 0 in between. Therefore, the STAR model with this particular transition function nests a restricted three-regime (SE)TAR model, where the restriction is that the linear models in the outer regimes are identical. The minimum value of the second-order logistic function, attained for $s_t = (c_1, +c_2)/2$, remains between 0 and 1/2, unless $\gamma \to \infty$. While interpreting the estimate from models with this particular transition function, the fact that the minimum value does not equal zero has to be considered in the latter case.

In the end, the transition functions (5.8) and (5.10) are special cases of the general nth-order logistic function which can be used to obtain multiple switches between the two regimes. The general nth-order logistic function is expressed as follows:

$$G(s_t, \gamma, c) = \left[\left(1 + \exp\left\{-\gamma \prod_{i=1}^{n} (s_t - c_1)\right\}\right)^{-1}\right], \quad c_1 \leq c_2 \leq \cdots \leq c_n\,, \ \gamma > 0, \tag{5.11}$$

STAR Modelling Approach

The modelling cycle for STAR models put forward by Terasvirta (1994) follows this approach and consists of the following steps.

1. Specify a linear AR model of order p for the time series under investigation using an appropriate model selection criterion.

2. Test the linearity against the alternative of STAR nonlinearity. If the test rejects linearity, select the appropriate transition variable s_t and the form of the transition function $G(s_t, \gamma, c)$.

3. Estimate the parameters in the selected STAR model.

4. Evaluate the model, using diagnostic tests and impulse response analysis.

5. Modify the model if necessary.

6. Use the model for descriptive or forecasting purposes.

A discussion of the three most critical stages of specification, estimation and evaluation follow below:

i. Specification stage

The specification comprises two phases. First, the linear baseline model will be specified and tested for linearity and then the appropriate transition variable s_t and type of STAR model (LSTR or ESTR) is selected. The economic theories will form the basis of variables to include in the linear model.

Following Terasvirta (1998), LM type tests are used to verify the null hypothesis of linearity against STR nonlinearity. The STR model just as with some other nonlinear model has a property that the model is only identified under alternative but not the null hypothesis of linearity (Hansen 1996). However, the problem in testing linearity could be resolved by approximating the transition function in (5.7) by a Taylor expansion around the null hypothesis $\gamma = 0$ (Lutkepohl and Kratzig, 2004). The F-versions of the LM test statistics are used considering that they have better size properties compared to the chi square variants as suggested by Van Dijk, Terasvirta, and Franses (2002).

The linearity of the predetermined transition variable is tested against an STR model. Where economic theory is not explicit about this variable the test is repeated for each of the predetermined potential transition variables, which is usually a subset of the element in $\boldsymbol{z}_t$. The test is used to test the linearity against different directions in the parameter space. If the test result was unable to reject the null hypothesis then the linear model will be accepted and the STR model will not be used. The test results are also used for model selection. If the null hypothesis is rejected for at least one model of the models the model with strongest rejection measured with p-value will be chosen as the STR model to be estimated (Terasvirta, 1998).

The linearity test is used to check if nonlinearity of the STR type exists in the model. It also aids to determine the transition variable and whether ESTR or LSTR should be employed. The following auxiliary regression is applied if $\boldsymbol{s}_t$ is an element of $\boldsymbol{z}_t$:

$$y_t = \beta_0' z_t + \sum_{j=1}^{k} \beta_j' \tilde{z}_t s_t^j + u_t^* \tag{5.35}$$

$\boldsymbol{z}_t = (1, \tilde{\boldsymbol{z}}_t)'$.

In case $\boldsymbol{s}_t$ is not part of $\boldsymbol{z}_t$

$$y_t = \beta_0' z_t + \sum_{j=1}^{k} \beta_j' z_t s_t^j + u_t^* \tag{5.36}$$

The null hypothesis of linearity is $H_0: \beta_0 = \beta_1 = \beta_2 = \beta_3 = 0$. This linear restriction is checked by applying the *F* test.

Once linearity has been rejected, the model type is to be chosen. That is whether an LSTR or an ESTR model should be specified. The choice will be based on the following test sequence:

1. Test $H_{04}: \beta_3 = 0$

2. Test $H_{03}: \beta_2 = 0 | \beta_3 = 0$

3. Test $H_{02}: \beta_1 = 0 | \beta_2 = \beta_3 = 0$

The test is based on the auxiliary regression (5.35 and 5.36) as the linearity test. Where the test sequence does not provide a clear-cut choice between the alternatives, the decision will be left to the evaluation stage.

ii. Estimation stage

After the transition variable $\boldsymbol{s}_t$ and the transition function $G(s_t, \gamma, c)$ have been selected, the next stage in the modeling cycle is estimation of the parameters in the STR model. The parameters of the STR model will be estimated by a nonlinear optimization routine. It is important to use good starting values for the algorithm to work.

Starting Values

The grid-search creates a linear grid in c and a log-linear grid in γ. For each value of γ and c the residual sum of squares is computed. The values that correspond to the minimum of that sum are taken as starting values. In order to make γ scale-free, it is divided by $\hat{\sigma}_s^K$ the kth power of the sample standard deviation of the transition variable.

$$G(s_{t-i}, \gamma, c) = \left(1 + exp\left\{-1(\gamma/\hat{\sigma}_s^K)\prod_{k=1}^{K}(s_t - c_k)\right\}\right)^{-1}, \gamma > 0. \tag{5.37}$$

The slope parameter in the equation (5.37) above is scale-free which in turn facilitates the construction of an effective grid. To maximise the conditional maximum likelihood function, once good starting values were recognised, the unknown parameters can be estimated using a form of the Newton-Raphson algorithm.

The Estimate of γ

It is hard to get an exact estimate of the smoothness of the transition between the two regimes, represented by γ, where this parameter is large. This is owing to the fact that for such large values of γ, the STAR model is like a threshold model, as the transition function draw closer to a step function. To get an accurate estimate of γ, there is need for many observations in the immediate area of c, considering that even big changes in γ only have a little effect on the shape of the transition function. The estimate of γ could therefore be quite imprecise and often turn out to be insignificant when evaluated by its t-statistic. This should, still, not be interpreted as indication for weak nonlinearity, given that the t-statistic does not have its usual asymptotic t-distribution under the hypothesis that γ = 0, owing to some identification problems. In such circumstances, the causes of a large standard error estimate are simply numerical. Moreover, because large changes in γ have only a slight effect on the transition function, high precision in estimating γ is not crucial (Van Dijk, Terasvirta and Franses, 2002).

iii. Evaluation stage

The estimated STAR model will be evaluated before using it for any forecasting or policy making. Misspecification tests are used to check the quality of the estimated model just as it is being done in linear models. Researchers use various misspecification tests in the STAR literature. However, Terasvirta (1998) considered LM test of no error autocorrelation, an LM-type test of no addictive nonlinearity and LM test of parameter constancy. Asymptotic normality and consistency of the maximum likelihood are also necessary.

Test of no error autocorrelation:

The test of no error autocorrelation applicable to the STAR models is a unique type of a general test defined in Godfrey (1988), and its application to STAR was demonstrated in Terasvirta (1998). The estimated residual $\tilde{u}_t$ is regressed on lagged residuals $\tilde{u}_{t-1} \ldots \tilde{u}_{t-q}$ and the partial derivatives of the log-likelihood function with respect to the parameters of the model. The test statistic is then

$$FLM = \left\{\frac{(SSR_0 - SSR_1)}{q}\right\} / \left\{\frac{SSR_1}{(T-n-q)}\right\} \tag{5.38}$$

Where n is the parameters in the model, SSR_0 the sum of squared residuals of the STR model and SSR_1 the sum of squared residuals from the auxiliary regression.

Test of No Additive Nonlinearity

Once the STR has been fitted, then the model must be checked for remaining nonlinearity. The test is based on the assumption that the remaining nonlinearity is also of the STR type. The alternative can be expressed as:

$$y_t = \phi' z_t + \theta' z_t G(\gamma_1, c_1, s_{1t}) + \psi' z_t H(\gamma_1, c_1, s_{1t}) + u_t \qquad (5.39)$$

Where: H is another transition function and $u_t \sim iid(0, \sigma^2)$. The following auxiliary model will be used to test the alternative:

$$y_t = \beta' z_t + \theta' z_t G(\gamma_1, c_1, s_{1t}) + \sum_{j=1}^{3} \beta_j' \widetilde{z}_t\, s_{2t}^{j} + u_t^* \qquad (5.40)$$

The test will be carried out by regressing $\tilde{u}_t$ on $(\widetilde{z}_t{}' s_{2t},\ \widetilde{z}_t{}' s_{2t}^2,\ \widetilde{z}_t{}' s_{2t}^3)'$ and the partial derivatives of the log-likelihood function with respect to the parameters of the model. The null hypothesis of no remaining nonlinearity is that $\beta_1 = \beta_2 = \beta_3 = 0$. The choice of s_{2t} can be a subset of available variables in z_t or it can be s_{1t} . It is also possible to exclude certain variables from the second nonlinear part by restricting the corresponding parameter to zero. The resulting F statistics are given in the same way as for the test on linearity.

Test of Parameter Constancy

Test of parameter constancy tests the null hypothesis of constant parameters against smooth continues change in parameters. The alternative can be written as follows:

$$y_t = \phi(t)' z_t + \theta(t)' z_t G(\gamma_1, c_1, s_{1t}) + u_t\ , \quad u_t \sim iid(0, \sigma^2) \qquad (5.41)$$

Where

$$\phi(t) = \phi + \lambda_\phi H_\phi\left(\gamma_\phi, c_\phi, t^*\right)$$

And

$$\theta(t) = \theta + \lambda_\theta H_\theta(\gamma_\theta, c_\theta, t^*)$$

With $t^* = T/t$ and $u_t \sim iid(0, \sigma^2)$ .The null hypothesis of no change in parameters is $\gamma_\phi = \gamma_\theta = 0$.

The parameters γ and c are assumed to be constant. The following nonlinear auxiliary regression is used:

$$y_t = \beta_0' z_t + \sum_{j=1}^{3} \beta_{j+3}' z_t \, (t^*)^j G(\gamma_1, c_1, s_{1t}) + u_t^* \tag{5.42}$$

The F-version of the LM test is preferred against the chi-square variants especially in a smaller sample as the latter could be oversized. The F-test results for the three alternative transition functions are given by

$$H(\gamma, c, t^*) = \left(1 + exp\left\{-\gamma \prod_{k=1}^{k} (t^* - c_k)\right\}\right)^{-1} - \frac{1}{2}, \gamma > 0 \tag{5.43}$$

Where K = 1, 2, 3, respectively and assuming $\gamma_\emptyset = \gamma_\theta$.

The standard tests carried out in the evaluation stage the three tests of no error autocorrelation, no addictive nonlinearity and the parameter constancy described above. However, further two test used include the LM-type test for no ARCH and the Jarque-Bera normality test.

5.4 Conclusions

This chapter is aimed at explaining the application of vector error correction model (VECM) and the Smooth transition autoregressive model (STAR) used in this study. The VECM has the advantage of examining both the long run and short run dynamics in the ERPT process. However, the VECM is based on linear assumption and therefore we could not capture any nonlinearity. In chapter six we examined the ERPT in Nigeria using the VECM assuming linearity. While in chapter seven we examined the presence of any nonlinearity and its effect on the ERPT using the STAR model. The STAR model has appropriate specifications that could capture the potential nonlinearities and asymmetries in the ERPT.

Chapter 6 :
Exchange Rate Pass-through to Consumer prices in Nigeria from 1986 to 2013: Evidence from Vector Error Correction Model.

6.1 Introduction

This chapter examines the degree and speed of exchange rate pass-through (ERPT) to consumer price in Nigeria using quarterly time series data from 1986Q to 2013Q4. The impact of the changes in exchange rate on the consumer prices was apparent in Nigeria during the period under review. From the adoption of floating exchange rate regimes in 1986, Nigeria witnessed fluctuations in the exchange rate and persistent consumer prices inflation (See Chapter two). It was observed from our review (in Chapter two) that greater consumer price inflation rates were witnessed during periods of high Naira exchange rate depreciation. The transmission of changes in the exchange rate to domestic consumer price is one of the challenges faced by developing countries like Nigeria. One of the main challenges of economic policy management in Nigeria since 1986 is that of maintaining a stable exchange rate and preventing the impact of exchange rate changes on the consumer prices.

There is a consensus in both theoretical and empirical literature on the fact that exchange rate changes affect the level of consumer price inflation, especially in open economies with floating exchange rate like Nigeria (for example see Menon (1995), Kara and Nelson (2002) and Devereux and Yetman (2008) among others reviewed in chapter three).

The impact of exchange rate changes in macroeconomic adjustment is mainly determined by its effect on consumer prices and the speed of its transmission. When there is a high level of pass-through, the variation in the exchange rate will affect the relative prices of goods, thus causing a quick adjustment in trade balances. For instance, when there is a high level of ERPT, imports will be expensive, the demand for imports will decline, and consumers will switch to locally-produced goods. Conversely, with a small degree of ERPT, the changes in the exchange rate will not have a significant impact on local consumer prices and trade balances (Bada *et al.*, 2016).

Considering that Nigeria just like most developing countries pursues an export-led growth strategy (see Chapter two), exchange rates policy plays a significant and vital role in the economy. Nigeria like most developing countries also imports technology and other capital goods for its exporting industries. Nigeria is also one of the major oil producing countries and generates more than 90% of its foreign exchange (forex) earnings from selling oil (see Chapter two). Given the volatility of the oil price, any shock in the international oil price affects the forex supply in the economy which reflects in the exchange rate. Then the movement in the exchange rate is ultimately transmitted to the consumer prices through direct and indirect channels (see Chapter three).

Therefore, understanding the nature of exchange rate pass-through is of great importance considering that the degree and timing of pass-through are critical to correct assessment of monetary policy impact on prices and forecasting inflation (An, 2006). It is also indispensable for policy formulation, particularly for central banks, which are in-charge of managing exchange rate and stability of price in the economy.

Although there is extensive empirical literature on ERPT, only a small number of the studies examined it from the context of developing economies. There are some empirical studies on ERPT in Nigeria, but there is no agreement on the degree and speed of the pass-through. For instance, Aliyu *et al*. (2009) and Zubair *et al*. (2013) shows a small partial and slow pass-through while Essien (2005) found a full pass-through in the long-run. However, the studies used different methods and sample periods. Hence, the need for up to date study to contribute to the literature by examining the degree and speed of ERPT in Nigeria.

The remaining sections of the chapter are organised as follows. Section two presents the theoretical model of ERPT. Section three presents the empirical model of the study. In section four we present and discuss the empirical results and Section six provides the conclusion of the chapter.

6.2 Theoretical ERPT Models

Our model is based on partial equilibrium micro-based markup equation which brings in some general equilibrium at aggregate price levels, following Campa and Goldberg's (2005) model on ERPT. We included the role of domestic costs of the importing country in our model as follows.

The import price P_m of a country can be described as the price P_X of the exporter to that country when converted to local currency using the exchange rate E.

$$P_m = P_x/E \tag{6.1}$$

When expressed in logs, represented by lower case letters we get:

$$p_m = p_x - e \tag{6.2}$$

Expressing the exporter's prices P_x as a mark-up (MU_x) over the exporter's marginal costs MC_x.

$$P_x = MU_x\, MC_x \tag{6.3}$$

When expressed in logs, represented by lower case letters, and substitute Equation (6.3) into Equation (6.2), we get:

$$p_m = mu_x + mc_x - e \tag{6.4}$$

It is assumed that the markup, is inversely related to the price elasticity of demand in the destination market, hence, depends on the shape of the demand curve. The markup is a function of the real exchange rate and other macro-variables. The relationship between the markup and the real exchange rate described as the nominal rate modified by the price of unit labour costs in the exporting country (w_x) and expressed in logs, can be simply approximated by:

$$mu_x = \mu + \varphi(e - w_x) \tag{6.5}$$

The value of φ ranges between 0 and 1: when φ = 0 there is producer currency pricing (PCP); and when φ = 1 there would be complete local currency pricing (LCP) where the markup varies one-for-one with the exchange rate given that marginal costs were fixed. The constant is represented by μ in the equation. To simplify, equation (6.5) exclude the influence of other factors, like demand conditions in the importing country. The marginal costs of the exporter are assumed to increase by a weighted average of market wages in the exporting country, w_x, and other commodity prices like oil prices, $poil_x$, and with the demand conditions in the exporting country, y_x, and the demand conditions in its destination market, y_m. This is expressed in logarithmic form as follows:

$$mc_x = \partial_1 w_x + (\,1 - \partial_1)poil_x + \partial_3 y_x + \partial_4 y_m \tag{6.6}$$

From the equations above, import prices at the point of entry to the destination country, prior to the further cost of distribution and local taxes, can be specified as:

$$p_m = \mu - (\varphi)e + \partial_1 w_x + (\,1 - \partial_1)poil_x + \partial_3 y_x + \partial_4 y_m \tag{6.7}$$

Equation (6.7) generalises the model by including the importing country's domestic costs into the markup function, and exogenous commodity costs into the exporter's marginal cost function. It is important to note that this illustrates a long-run relationship and is not concerning temporary price stickiness.

The long-run ERPT coefficient is $\beta = -(\varphi)$, capturing the exchange rate elasticity of import prices. When $\varphi = 1$ which means $\beta = -1$, there is producer currency pricing (PCP). It means the import price varies one-for-one with the exchange rate; therefore, there is full ERPT. At the other extreme, when $\varphi = 0$, and $\beta = 0$, then, there is zero ERPT to prices. Hence, there is a complete local currency pricing (LCP), where the exporters fully absorb any exchange rate changes by cutting down their mark-ups, giving importers a stable price.

A long-run ERPT to import prices log-linear regression specification can be expressed as follows:

$$p_{mt} = \lambda + \eta e_t + a_1 w_{xt} + a_2 poil_{xt} + a_3 y_{xt} + a_4 y_{mt} + \varepsilon_t \tag{6.8}$$

where p_m is the domestic currency import price, λ is a constant, e is the (nominal) exchange rate, w_x is a control variables representing exporter costs, $poil_x$ captures a further element of exporter's costs stemming specifically from commodity prices, like oil prices, and y_x and y_m are control variables for demand in the exporter's market and the destination market.

Equation (6.8) captures the ERPT to import price known as Stage 2 ERPT. While Stage 2 ERPT, is from import prices to consumer prices.

To arrive at the consumer price through the distribution chain, we add a further local currency cost variable as inputs into the production of goods or retailed directly to the consumer or for domestic wholesale and retail prices. The resulting reduced-form equation for overall ERPT to consumer prices can be expressed as follows:

$$p_{cpi,t} = \lambda + \eta e_t + \zeta r_{mt} + a_1 w_{xt} + a_2 poil_{xt} + a_3 y_{xt} + a_4 y_{mt} + \varepsilon_t \qquad (6.9)$$

6.3 Empirical Model Specification and Identification

6.3.1 Empirical Model Specification

This section starts with specifying the empirical model followed by the identification of the structural VECM. Based on our theoretical model developed in the last section, we will examine the speed and degree of ERPT in Nigeria during 1986 to 2013 using quarterly data. A VECM model is applied to examine the short-run and long-run ERPT. To start with a five-variable vector autoregressive (VAR) model is set up based on the theoretical model presented in the previous section.

The five-variable VAR is expressed as follows.

$$x_t{}' = (cpi_t,\ er_t, ulc_t, oilp_t, y_t\ ) \qquad (6.10)$$

Where cpi_t denotes the natural log of consumer prices, mpi_t is natural log of import price, er denotes the natural log of the nominal exchange rate, ulc_t is the natural log of importers cost, $oilp_t$ is the natural log of oil prices and y_t is natural log of real output. For detailed data descriptions and sources see Appendix A.6.1.

The study tests the stationarity of the variables, and apply cointegration test to check ensure there are long-term relationships between the variables. We use Johansen test for cointegration test of the system of variables. With the 2 lags suggested by parsimonious Schwarz criteria the VAR(2) model can be presented in matrix form as follows:

$$\begin{bmatrix} cpi_t \\ er_t \\ ucl_t \\ oilp_t \\ y_t \end{bmatrix} = A_0 + A_1 \begin{bmatrix} cpi_{t-1} \\ er_{t-1} \\ ucl_{t-1} \\ oilp_{t-1} \\ y_{t-1} \end{bmatrix} + A_2 \begin{bmatrix} cpi_{t-2} \\ er_{t-2} \\ ucl_{t-2} \\ oilp_{t-2} \\ y_{t-2} \end{bmatrix} + \begin{bmatrix} u_{1,t} \\ u_{2,t} \\ u_{3,t} \\ u_{4,t} \\ u_{5,t} \end{bmatrix}$$

Or as:

$$x_t = A_0 + A_1 x_{t-1} + A_2 x_{t-2} + u_t \tag{6.11}$$

where $x_t' = (cpi_t,\ er_t, ulc_t, oilp_t, y_t)$

The VAR(2) Equation (6.11) will be re-parameterized into vector error correction model(VECM), as follows:

$$\Delta x_t = \Gamma_1 \Delta x_{t-1} + \Gamma_k \Delta x_{t-2} + \Pi x_t + \mu + \ \Psi D_t + \varepsilon_t \tag{6.12}$$

Where x_t is a (5×1)vector of I(1) endogenous variables; μ is a constant term; $D_t$is a vector of deterministic variables (intervention dummies variable and weakly exogenous variables); and ε_t is a (5×1) vector of identically and independently distributed errors $\varepsilon_t \sim iid\ N_p(0, \Omega)$, where Ω is the variance-covariance matrix of the disturbances.

The VECM model comprises of the short-run and long-run information of the data. The matrix Π carries the long-run information while Γ holds the short-run properties. $\Pi = \alpha\beta'$ with a reduced rank r. The matrices α and β are of dimension (5×r), α show the speed of adjustment, and β stand for the cointegrating vectors. The Johansen procedure estimates equation (6.12) based on the hypothesis that Π has a reduced rank r < 5.

6.3.2 Structural Identification of model

We could draw two cointegration relationships from our theoretical model. The two cointegration relationships in the model are, one for consumer price (cpi), the second is for exchange rate (er). Based on our micro-based partial equilibrium theoretical model of exchange rate pass-through consumer prices, the following restrictions are imposed in the two equations. After normalisation restrictions, zero restrictions are imposed on consumer prices(cpi) and unit labour cost(ulc) in the exchange rate (er) equation. Hence, the long-run parsimonious structural (static) forms of the equations (variables in natural logs) are that consumer prices(cpi) depends on exchange rate(er) and unit labour cost (ulc), oil prices (oilp) and domestic demand proxied by output level (y). While exchange rate (er) depends on the oil prices (oilp) and domestic demand proxied by output level (y). The parsimonious consumer prices(cpi) and the exchange rate (er) equations are expressed in (6.13) and (6.14) respectively.

$$cpi = \theta_0 + \theta_1 er + \theta_2 ulc + \theta_3 oilp + \theta_4 y \quad (6.13)$$

$$er = \psi_0 + \psi_1 oilp + \psi_2 y + \qquad (6.14)$$

The models in equations (6.13) and (6.14) are static, therefore denotes the long-run equilibrium of the system. The dynamic adjustment to the long-run equilibria is determined by lags in the equation in consumer prices are due to market share objectives of the importing firm, pricing behavior of the firm among other (see section 3.3.3 in Chapter three for details).

The dynamic model can be expressed as described in Chapter five section 5.2.1, as a dynamic VECM for the conditional model, so

$$\Delta Y_t = A(L)Y_{t-1} + B(L)X_t + \Pi Z_{t-1} + V_t \qquad (6.15)$$

Where $Y_t = (cpi; er; ulc; oilp; y)$; $X_t = (f\_y)$; $Z = (Y; X)$; $A(L)$ and $B(L)$ are matrices of polynomials in the lag operator (L) while Π is a 2 × 2 matrix.

Our Cointegration analysis focuses on the first cointegrating vector (6.13). Following Beirne and Bijsterbosch (2011) and Cheikh (2013) the study tests restrictions on the particular long-run parameters to analyse specific hypotheses on the exchange rate pass-through. The restricted hypotheses are as follows:

H1: Complete ERPT to consumer prices with other long-run parameters unrestricted

Variables	cpi	er	ulc	$oilp$	y
θ_i'	1	1	θ_2'	θ_3'	θ_4'

H2: Complete ERPT to consumer prices with zero constraints on other parameters

Variables	cpi	er	ulc	$oilp$	y
θ_i'	1	1	0	0	0

H3: Zero ERPT to consumer prices while other long-run parameters are unrestricted,

Variables	cpi	er	ulc	$oilp$	y
θ_i'	1	0	θ_2'	θ_3'	θ_4'

H4: Zero ERPT to consumer prices zero constraints on other long-run parameters

Variables	cpi	er	ulc	$oilp$	y
θ_i'	1	0	0	0	0

If H1 or H2 holds, it would indicate that there is a full exchange rate pass-through to consumer prices. On the other hand, if H3 or H4 holds, it means there no exchange rate pass-through to consumer prices.

Analyses of impulse response function on the VECM are later carried out. The analysis helps in evaluating the magnitude and the speed of the pass-through in Nigeria. The study used the generalised impulse response functions as proposed by Pesaran and Shin (1998) where the ordering of the variables is irrelevant. Variance decompositions are also used to assess the relative importance of external shocks in explaining variations in consumer prices. Furthermore, historical decompositions will be used to evaluate the role and the significance of external shocks on consumer price inflation in Nigeria during different episodes.

6.4 Results

This section presents the estimation results and analysis, including unit root tests, cointegration analysis of the baseline and the restricted VECM results. Impulse response functions (IRF) and variance decomposition (VDC) analysis are also carried out.

6.4.1 Unit root test

Using the unit root tests to differentiate trend and difference stationary data is now an indispensable tool in every study. To estimate the model using the VECM method, we first carried out a unit root tests on the variables to determine their order of integration. This is to check whether the variables are integrated of proper orders, which is necessary (see discussion in chapter five) for VECM analysis. All variables are in logs.

There are various unit root tests available; the commonly used ones include Augmented Dickey-Fuller (ADF), Phillips-Perron (PP), and Kwiatkowski, Phillips, Schmidt, and Shin (KPSS) tests.

However, Perron (1989) argues that the conventional unit root tests like the ADF and PP are biased towards a false unit root null if the series is trend stationary with a structural break. In response to that, some unit root tests that remain usable in the presence of a break were developed (see Hansen, 2001).

In this study, we used Augmented Dickey-Fuller (ADF) test and Phillips-Perron (PP) test to ensure robustness. We also used unit root with break test to check if there are breaks and whether they affected the series and induced the non-stationarity of the series in levels. The unit root with break test is a modified augmented Dickey-Fuller tests that allow breaks which are based on the Perron (1989) framework. The results of unit root test are presented in Table 6.1 below.

Table 6.1: Unit root test

Augmented Dickey-Fuller (ADF) Unit Root						
At Level						
	cpi	**er**	**oilp**	**y**	**ulc**	**f_y**
With Constant	0.177	0.316	0.883	0.968	0.114	0.689
With Constant &	0.648	0.742	0.265	0.724	0.127	0.889
Without Constant	0.855	0.937	0.923	0.999	0.566	0.992
At First Difference						
	d(cpi)	**d(er)**	**d(oilp)**	**d(y)**	**d(ulc)**	**f_y**
With Constant	0.073*	0.000***	0.000***	0.002***	0.000***	0.007***
With Constant &	0.043**	0.000***	0.065*	0.013**	0.000***	0.018***
Without Constant	0.085*	0.000***	0.000***	0.005***	0.000***	0.009***
Unit Root with Break Test						
At Level						
	cpi	**er**	**oilp**	**y**	**ulc**	**f_y**
Innovation Outlier	0.990	0.930	0.534	0.373	0.307	0.533
Additive Outlier	0.982	0.969	0.563	0.990	0.124	0.609
At First Difference						
	d(cpi)	**d(er)**	**d(oilp)**	**d(y)**	**d(ulc)**	**f_y**
Innovation Outlier	0.010**	0.000***	0.032**	0.047**	0.000***	0.073**
Additive Outlier	0.012**	0.001***	0.001***	0.000***	0.000***	0.014***
Phillip-Perron (PP) Unit Root Test						
At Level						
	cpi	**er**	**oilp**	**y**	**ulc**	**f_y**
With Constant	0.133	0.133	0.949	0.999	0.495	0.284
With Constant &	0.932	0.581	0.760	0.679	0.203	0.979
Without Constant	0.996	0.976	0.990	1.000	0.571	0.999
At First Difference						
	d(cpi)	**d(er)**	**d(oilp)**	**d(y)**	**d(ulc)**	**f_y**
With Constant	0.054*	0.000***	0.002***	0.004***	0.000***	0.000***
With Constant &	0.027**	0.000***	0.009***	0.021**	0.000***	0.002***
Without Constant	0.097*	0.000***	0.000***	0.005***	0.000***	0.007***
Notes: Null Hypothesis: the variable has a unit root, (*) Significant at the 10%; (**) Significant at the 5%; (***) Significant at the 1%, Lag Length based on SIC, Probability based on MacKinnon (1996) one-sided p-values.						

Both the ADF, Unit root with break and the PP unit root tests indicate that all the variables are non-stationary at levels as the probability values of the test statistic fail to reject the null hypothesis of a unit root at 5% level of significance.

Both the test show that all variables are stationary at first difference, given that the probability values of the test statistics reject the null hypothesis of a unit root at 5% level or less in either the test with constant, with constant and trend or without constant and trend.

Therefore, the results show that the data generation process of all the variables is of order I(1).

Having satisfied the necessary condition for cointegration as all variables are integrated in the same order I(1). We proceeded to carry out the tests for cointegration to check for the existence of any long-term relationship among the system variables.

6.4.2 Cointegration Analysis

The cointegration analysis is conducted within the framework of maximum likelihood Johansen (1988). We started with estimating an unrestricted VAR in $x_t' = (cpi_t,\ er_t, ulc_t, oilp_t, y_t\ )$ using sample period 1986Q4-2013Q4. The model contains proxy for foreign market demand as presented in the theoretical model. This is necessary as described in the ERPT literature (see Aron *et al*., 2014). Considering that foreign markets demand is exogenously determined variables, we accordingly included a proxy for the demand of US (y_t) which is a major trade partner to Nigeria as exogenous variables in our model. US GDP growth was used as the proxy for the demand in US. We also carried out structural break test to ascertain the stability of the sample data used. We used Quandt-Andrew tests to check for any structural break in the series. Chow test for the Structural break was also used to confirm the existence of the structural break (See the test results in Appendix A.6.3.2). The result of the tests shows breaks at 1994Q4 in the exchange rate series. The breaks coincide with the beginning of four-year fixed exchange rate regime during the political and economic crisis of the 1990s in Nigeria. As discussed in (Section 2.3.2, Chapter two) the Nigeria authorities introduced a fixed exchange rate system where the Naira was pegged to the US dollar at N22 in 1994 up to 1998. The objective of the policy was to stabilise the Naira exchange rate and halt the inflationary spiral due to the continued depreciation of the Naira which was pass-through to the domestic consumer price. The pegging was abandoned in 1998 with reversion to the managed floating. The study, therefore, includes a dummy variable (D94) for the period between 1994Q4 and 1998Q4 of the fixed regime. Non-inclusion of the shift dummy provides a result which does not make any economic meaning. But with the inclusion of the shift dummy which captures the exchange rate policy change, it improves the model specification. The inclusion of dummy helps to restore the stability of the cointegrating vectors. The shift dummy and the exogenous variable foreign market demand (proxied by US GDP) are therefore included in the vector of deterministic variables (D) in Equation (6.12).

Before Johansen cointegration test was carried out to check the presence of long-run equilibrium relationships among the variables, the lag structure for the VECM was assessed using the Schwarz information criterion (SC) of VAR lag order selection which suggested two lags.

We then assessed the validity of the fitted model by preliminary checks on the nature of correlation of the VAR residuals, and we observed that most of the off-diagonal elements in the models are near zero, which indicates that the model ignores no contemporaneous correlations (See the residual correlation matrix in Appendix A.6.3.3). Check on the Roots of Characteristic Polynomial show no root lies outside the unit circle which shows the model satisfies the stability condition (see Appendix A.6.2.2).

We then test for cointegration among the variables of the model with no restriction. The null hypothesis of no cointegration was rejected as two cointegration rank identified by both the Trace and Max-Eigen statistics. As multiple cointegration vectors are found, we have to address the issue of identification. As the Johansen procedure only gives information on the uniqueness of the cointegration space, it is, therefore, necessary to examine the unique character of each cointegrating vector.

In our cointegration analysis, this study focuses on the first cointegrating vector. According to Johansen and Juselius (1992), the first cointegrating vector has the highest eigenvalue and is therefore “most associated with the stationary part of the model”. Table 6.2, below presents the result of the trace and maximum likelihood statistics in the cointegration test.

Table 6.2 : Johansen cointegration test with no restriction

Hypothesized No. of CEs	Eigenvalue	Trace statistic		Max-Eigen statistic	
		Statistic	0.05	Statistic	0.05
None	0.60	148.79*	69.82	95.17*	40.07
At most 1	0.27	53.62*	47.86	32.63*	33.87
At most 2	0.14	20.99	29.78	16.09	27.58
At most 3	0.04	4.89	15.49	4.85	21.13
At most 4	0.00	0.05	3.84	0.05	14.26

Denotes rejection of the hypothesis at the 0.05 level.

In Table 6.2 above, both the Trace statistics and the Max-Eigen statistics show the presence of two cointegrating equations. Having found cointegrating equations which are necessary to carry out VECM estimation (as discussed in Section 5.2.2, Chapter 6.2) we, therefore, proceeded to estimate the VECM model. The VECM was estimated with one lag as the optimal lags suggested by Schwarz Criteria for the unrestricted VAR were 2 lags.

6.4.3 Identification of the VECM

To identifying and impose restrictions on the cointegrated system, we consider our micro-based partial equilibrium theoretical model of exchange rate pass-through to consumer prices. As mentioned above the study considers the following variables: cpi: consumer price, ulc: unit labour cost, oilp: oil prices, y: local demand proxy - output level, d94: dummy variable for exchange rate shifts which is zero except unity between 1994(1) and 1998(4) and f_y which controls for the foreign demand proxied by US GDP. The study uses quarterly data over the sample period 1986(4) – 2013(4).

Following Beirne and Bijsterbosch (2011) and Cheikh (2013), we specify a VAR(2) for $X_t = (cpi_t, er_t, ulc_t, oilp_t, y_t)$ with deterministic variable $q_t = (d94_t, f\_y_t)$. Our cointegration test shows two cointegrating rank $r = 2$. The unrestricted estimates of α and β with normalizations on cpi, and er ($\beta_{11} = \beta_{22} = 1$) imposed are as follows:

Table 6.3: Unrestricted estimates of α and β with normalisation on cpi, and er.

Cointegrating Equations	**CointEq1**	**CointEq2**
cpi	1.000	-0.975
er	-1.006	1.000
ulc	3.039	-2.976
oilp	-0.263	0.489
y	-0.308	-0.092
c	-2.634	13.929

Error Correction:	***cpi***	***er***	***ulc***	***oilp***	***y***
CointEq1	-0.257	0.127	-0.628	0.065	-0.257
CointEq2	-0.214	0.115	-0.673	0.065	-0.214

No standard errors are reported for the estimates of $\boldsymbol{\alpha}$ *and* $\boldsymbol{\beta}$ *, as the parameters are not identified yet.*

6.4.3.1 Weak exogeneity

The study test for weak exogeneity of each of all the variables in the model. Based on the cointegration test result that there are 2 vectors, the hypothesis that the consumer price, the exchange rate, the unit labour cost, oil price and output are each weakly exogenous are rejected, except for the output as shown

in Table 6.4. Based on this evidence, we then assume that the output is weakly exogenous and set up a system with 5 endogenous variables and 1 exogenous variables.

Table 6.4: Weak exogeneity test

	$\boldsymbol{\chi^2(3)}$	**Probability**
cpi	19.79	0.000
er	69.23	0.000
ulc	8.39	0.015
oilp	26.63	0.000
y	2.54	0.279

As shown in Table 6.4 above we obtain a test statistic of $\chi^2(2)$ = 2.54 (probability 0.279) for the hypothesis that in the long-term output is weakly exogenous, which indicates that the hypothesis is accepted at the 95% level of testing. We therefore concluded that output could be treated as weakly exogenous.

6.4.3.2 Testing the cointegrating rank

The study the applied the standard Johansen tests for the number of cointegrating vectors in the system (cpi, er, ulc, oilp, y,) assuming that the output is weakly exogenous. The test confirms the at least 2cointegrating rank. Table 6.5 presents the Johansen eigenvalue and trace tests, which indicates that with the 95% critical values given in brackets.

Table 6.5: Cointegration test with weak exogeneity restriction imposed.

Hypothesized No. of CEs	Eigenvalue	Trace statistic		Max-Eigen statistic	
		Statistic	**0.05**	**Statistic**	**0.05**
None	0.60	148.79*	69.82	95.17*	40.07
At most 1	0.27	53.62*	47.86	32.63*	33.87
At most 2	0.14	20.99	29.78	16.09	27.58
At most 3	0.04	4.89	15.49	4.85	21.13
At most 4	0.00	0.05	3.84	0.05	14.26

6.4.3.3The dynamic model

The general model could then be expressed as follows:

$$cpi_t = \beta_{10} + \beta_{11}cpi_{t-i}+\beta_{12}\mathrm{er}_{t-i} + \beta_{13}\mathrm{ulc}_{t-i} + \beta_{14}\mathrm{oilp}_{t-i} + \beta_{15}\mathrm{y}_{t-i} + \psi_1 D_t + v_t^{cpi} \quad \textbf{(6.16)}$$

$$er_t = \beta_{20} + \beta_{21}cpi_{t-i}+\beta_{22}\mathrm{er}_{t-i} + \beta_{23}\mathrm{ulc}_{t-i} + \beta_{14}\mathrm{oilp}_{t-i} + \beta_{25}\mathrm{y}_{t-i} + \psi_2 D_t + v_t^{er} \quad \textbf{(6.17)}$$

$$ucl_t = \beta_{30} + \beta_{31}cpi_{t-i}+\beta_{32}\mathrm{er}_{t-i} + \beta_{33}\mathrm{ulc}_{t-i} + \beta_{34}\mathrm{oilp}_{t-i} + \beta_{35}\mathrm{y}_{t-i} + \psi_3 D_t + v_t^{ucl} \quad \textbf{(6.18)}$$

$$oilp_t = \beta_{40} + \beta_{41}cpi_{t-i}+\beta_{42}\mathrm{er}_{t-i} + \beta_{43}\mathrm{ulc}_{t-i} + \beta_{44}\mathrm{oilp}_{t-i} + \beta_{45}\mathrm{y}_{t-i} + \psi_4 D_t + v_t^{oilp} \quad \textbf{(6.19)}$$

$$y_t = \beta_{50} + \beta_{51}cpi_{t-i}+\beta_{52}\mathrm{er}_{t-i} + \beta_{53}\mathrm{ulc}_{t-i} + \beta_{54}\mathrm{oilp}_{t-i} + \beta_{55}\mathrm{y}_{t-i} + \psi_5 D_t + v_t^{y} \quad \textbf{(6.20)}$$

The cointegrating vectors enter each equation in this reduced form of the model where e_i are the just-identified form of the relevant cointegrating vector in each case. Then, the study proceeds to test from this model. However, there is no unique way of reducing the model, when restricting the dynamics and the long-run relations ($\mathbf{\Gamma}$ and $\boldsymbol{\beta}$) (Greenslade *et al.*, 2002). The study used data-based simplifications of the dynamics and tests of the derivative homogeneity. Then the test of the over-identifying restrictions on the long-run relationships is carried out.

6.4.3.4 Tests of long-run restrictions

Here we applied the over-identifying restrictions on each of the long-run equations, in order to give them structural interpretation in-line with economic theory. In total we apply 4 exclusions following Pesaran and Shin (1994), we imposed $k = r^2$ restrictions (r = 2, 4 restrictions). We imposed the restriction that excludes consumer price and unit labour cost from the exchange rate equation. Next, we apply the restrictions required to ensure that the levels relationships are homogeneous. This involves 2 restrictions in the consumer price equation and 3 in the exchange rate equation. With the 2 normalization restrictions, we have 11 restrictions all together, which imply 5 over-identifying restrictions. The likelihood ratio test is not rejected (LR test statistic 2.82, $\chi^2(5)$).

We could then carry out further tests on the $\boldsymbol{\alpha}$ matrix. However, our estimation shows that our entire remaining cointegration vectors are significant (with t-ratios of 2 or above).

6.4.4 Long-run ERPT to consumer prices

Here we focus on the first most statistically significant cointegrating equation to measure the level of ERPT in the long-run. The objective here is to analyse the degree of ERPT to consumer price in the long-run from the estimation of the unrestricted cointegrating vectors with normalisation on the consumer price (cpi_t). The coefficient of the exchange rate variable shows the degree of exchange rate pass-through. In Table 6.6, below we present the results of the VECM estimates of the cointegrating relationship coefficients normalised on consumer price (cpi_t).

Table 6.6: Normalised cointegration coefficients (β)

cpi_t	er_t	ulc_t	$oilp_t$	y_t	constant
1.000	-0.836*	- 0.412*	0.797*	-.870*	39.771
-	(-20.264)	(4.325)	(2.989)	(-4.207)	-
0.000	1.000	0.000	8.228*	-13.090*	373.50
-	-	-	(7.103)	(-7.507)	-

*The parentheses ( ) denote t-statistics. * denotes significance at 5 percent levels.*

From the Table 6.6 above, we could write the ERPT equation as follows:

$$cpi = -39.771 + 0.836er + 0.412ulc - 0.797oilp + 0.870y \qquad (6.15)$$

The first cointegration equation in Table 6.6 above, where normalisation is in the consumer price (cpi) is our equation of interest as we analyse the impact of the exchange rate on consumer price in Nigeria. The coefficients of the exchange rate (er), unit labour cost (ulc) oil price (oilp) and output level (y) are all statistically significant at 5% level. The signs of the exchange rate (er_t) and output (y_t) which are positive imply that increase in these variables is associated with higher consumer prices.

The exchange rate coefficient which represents the ERPT for the sample period, in the long run, is (0.84), and is highly significant and correctly signed. This result implies that 1% increase in the exchange rate (er_t) (depreciation in Naira) will lead to increase in the consumer price (cpi_t) by 0.84%. Therefore, in the long run, the ERPT to consumer price is substantially high in Nigeria. In other words, a greater proportion of changes in the exchange rate is transmitted to the consumer price in the long run. This implies that the higher the rate of Naira depreciation will lead to higher consumer price inflation in the long-run. Given the persistent consumer price inflation in Nigeria following the Naira depreciation especially after the 1986 exchange rate regime change that brought a floating exchange rate regime as observed from our review of the exchange rate and inflation in chapter two this result of substantial ERPT, in the long run, does not come as a surprise.

The output level (y_t) coefficient is significant at 5% level. The coefficient is 0.87 which implies that 1% increase in the output level leads to 0.87% rise in consumer price. The increase in output level will result in an increase in both the aggregate demand and supply side in the economy. Therefore, in this instance, it could be that the effect on aggregate demand has exceeded that of supply as the increase in output leads to increase in consumer price due to the excess demand during the sample period in Nigeria.

The oil price ($oilp_t$) coefficient is 0.78 and highly significant; however, the sign is negative which was not as anticipated. This means every 1% rise in oil price leads to 0.78% decrease in consumer price in Nigeria during the sample period. The impact of the changes in oil price on the consumer price will not come as a surprise considering that Nigeria is an oil producing country. Apart from the contribution of any oil price increase in the cost component through the direct and indirect channels of ERPT (See discussion in chapter three), any increase in oil price will also provide more revenues to the government and the oil industry. Consequently, the boost in oil price leads to increase in production in the economy which in turn leads to excess supply and push the prices down. The rise in aggregate demand and increased money supply would lead to production expansion which will eventually crash the consumer price. This is evident from our review of the performance of the Nigeria economy in Chapter two where the GDP grew significantly during high oil price especially in the mid-1970s. However, surplus cash inflow was expected to fuel the demand for both local and foreign goods and services and therefore create the higher inflation environment. However, this result does not imply that. This could be attributed to the fact that income distribution in Nigeria is not equitable. Therefore, even with increase output, it might not reflect the income of the majority of the population.

The unit labour cost (ulc) coefficient is 0.41 and also significant at 5% level. As expected the sign is positive which implies that increase in unit labour cost leads to increase in consumer price. The result indicates that 1% increase in unit labour cost leads to 0.41% rise in consumer price in the long run in Nigeria during the sample period.

The result that the ERPT in Nigeria is high is in contrast to the findings of earlier studies like Aliyu *et al.* (2009) and Bada et al. (2016) who found low ERPT in the long-run. The low pass-through reported by those studies could be attributed to the fact that those studies ignore the structural break in the sample due to the period of fixed exchange rate regime during the political and economic crisis of the 1990s in the country. This study carefully checked for the breaks in the sample and applied appropriate remedies which we presume make our results more robust than those of the previous studies.

6.4.5 Restricted VECM Full and Zero long-run ERPT Hypothesis Testing

We apply some restrictions on the baseline VECM model to check for full exchange rate pass-through and/or zero exchange rate pass-through. The analysis of the estimation results with the constraints imposed on the cointegrating long-run parameters as proposed above (in section 6.3) are presented here. So, we explore the hypotheses of full exchange rate pass-through H1 and H2 and those of Zero exchange rate pass-through H3 and H4. The tests results of restrictions on the long-run parameters are presented in Table 6.7.

Hypothesis H_1 is that there is full ERPT to consumer prices with no restrict on all other variables in the baseline VECM equation.

Hypothesis H_2 proposes full ERPT to consumer prices when all other variables in the baseline equation (unit labour cost oil price and GDP) are restricted to zero.

Hypothesis H_3 proposed a zero ERPT when no restriction imposed on the variables in the equation.

H_4 proposed zero ERPT when all other variables in the equation are restricted to zero.

Table 6.7: Restrictions on long-run parameters

	Full ERPT Hypotheses		Zero ERPT Hypotheses	
	H_1	H_2	H_3	H_4
	H1: Full ERPT to with no restrictions on all other variables.	H2: Full ERPT to when all other variables are constrained to zero.	H3: Zero ERPT to with no restrictions on all other variables.	H4: Zero ERPT to when all other variables are constrained to zero.
Chi-squared	11.560	46.973	33.226	51.897
P- values	(0.1159)	(0.0000)	(0.0000)	(0.0000)
Comment/Decision (Accept/Reject)	Accepted	Rejected	Rejected	Rejected

Restrictions based on Likelihood Ratio tests with a chi-squared distribution p- values in brackets.

The results of likelihood ratio tests with chi-square distribution presented in Table 6.7 shows all p-values significant at 5% level except for hypothesis H_1.

This implies that there is full ERPT with the influence of the other variables in the equation (oil price, output level and unit labour cost).

The test rejects hypotheses H_2, H_3 and H_4, as the probability values of their test are significant at 5%.

The test result of the restricted long-run hypothesis suggests that the pass-through is full in Nigeria with the influence of the other factors in the equation. This result is in contrast with studies like Aliyu *et al*. (2009) and Bada *et al.* (2016) whose findings show partial and low pass-through in the long run.

However, the result is in line with what is generally found in the empirical ERPT literature which indicates that the ERPT is low in industrialised developed countries, whereas it is high and often full in the emerging and developing countries (For instance, see Gagnon and Ihrig 2004). The argument in the literature is that in the developed countries the importing firms usually control tiny market share as such have no much influence on setting prices. The markets in the developed countries are more competitive with more close substitute products. As such the importing firms with much interest in controlling their market shares, operating within a competitive environment will keep absorbing the exchange rate movements in their markup up to a certain threshold. The fact that the exchange rate is also less volatile in the developed countries compared to the developing countries like Nigeria the rate of changes in the exchange rate is relatively smaller compared to those of the developing countries. That also makes it easier for the importing firms to absorb the change in their markup. However, in developing countries like Nigeria, few firms control high market shares which enable them to have some influence on setting their commodity prices. The market environments in developing countries like Nigeria are less competitive hence they have an inelastic price elasticity of demand. The exchange rate volatility is also very severe that most often the importing firm's markup cannot absorb the exchange changes hence the higher or full pass-through to the domestic consumer prices. Due to the persistent inflation in developing countries, it is also easier to pass-through the exchange rate changes to the consumer price compared to the developed countries.

It would be puzzling to find a result with low ERPT in the long run in Nigeria considering the country's history of continued exchange rate depreciation which goes in hand with the higher inflation rate. The importing firms tend to change their menu and pass-through the exchange rate changes only when they perceive that the change is permanent. Otherwise, when they think that the change is transitory, they would not change price due to the cost of the menu change. Hence, no pass through will take place. But in developing countries like Nigeria where the exchange rate persistently depreciates (See section 2.3.3 in Chapter two). Therefore, the importing firms tend to perceive any change in the exchange rate as permanent and change their menu and pass-through the changes to consumer prices.

It is, therefore, puzzling to find a low ERPT in the long run in Nigeria, and our result that found full pass-through, in the long-run, will be more consistent with the realities on the ground.

6.4.6 Short-term ERPT to consumer prices

Table 6.8, below presents the adjustment coefficient (short-run dynamics) which is the speed of adjustment to the long-run equilibrium.

Table 6.8: Short-term VECM coefficients

cpi_t	er_t	yt	$oilp_t$	ulc_t	US_y_t	D94	ecm
0.638*	0.020	-0.210	0.053	0.109	0.023	0.035	-0.048*
(9.733)	(0.646)	(-0.918)	(-1.405)	(0.899)	(1.13)	(3.35)	(-4.66)
R^2 = 0.78, Adjusted R^2 = 0.76, DW = 2.11,							
S.E. of regression 0.0182, RSS = 0.0319,							
LM-χ^2(1) = 0.5953[0.4404], LM-F (1, 95) = 0.5416[0.4636],							
HT-χ^2(1) = 19.932[0.068], HT-F (12, 92) = 1.7964 [0.060],							
ARCH(1) = 0.1452[0.704], ARCH(2) = 0.1798 [0.836]							
JB = 380[0.00],							

*The parentheses ( ) denote t-statistics. * denotes significance at 5 percent levels.*

Diagnostic tests are carried out to check the validity of the model. A residual serial correlation LM tests, heteroscedasticity and normality tests are performed, and the results are presented in Table 6.8 above.

LM-χ^2(1) and LM-F are chi square and F-statistics Breusch-Godfrey Serial Correlation LM Test respectively. HT-χ^2 (1) and HT-F are the chi square and F-statistics Breusch-Pagan-Godfrey heteroscedasticity test respectively. ARCH(1) and ARCH(2) are the first and second order F-statistics autoregressive conditional heteroscedasticity test respectively. JB is Jarque-Bera Normality test. Probability values are reported in the square brackets.

The diagnostic tests show that there is no serial correlation as the Breusch-Godfrey Serial Correlation LM Test result fails to reject the null hypothesis of no serial correlation. The result of the diagnostic test also shows that residuals are homoscedastic as both the Breusch-Pagan-Godfrey heteroscedasticity test and the autoregressive conditional heteroscedasticity test fail to reject the null hypotheses of no heteroskedasticity. But, there is a non-normality problem as the Jarque-Bera Normality test result shows rejection of the null hypothesis of normality

However, Normality is not a necessary condition for the validity of most statistical procedure related to VAR models. Though, non-normality of the residuals may show some model deficiencies like structural change and nonlinearities (Lutkepohl and Kratzig, 2004 P46).

The study used appropriate intervention dummies to control the structural breaks noticed in the data as discussed above in this chapter. The exchange rate series show breaks at 1994 and 1999. As discussed in Chapter two section 2. , the Naira was pegged to US dollar at a fixed rate from 1994 to late 1998 during the economic and political crisis at the time. Due to rising consumer price inflation during the period when Nigeria witnessed the record high inflation rate of 70 percent in 1993(See Chapter two section 2.2.3), the authorities were compelled to adopt fixed exchange rate policy. It was perceived that the exchange rate depreciation was transmission to the consumer prices confounded the inflation problem then.

The issue of potential nonlinearities is what is not considered in this estimation as the basis of the model is linear. Nevertheless, the study on asymmetry and nonlinearity of the exchange rate pass-through which is presented in chapter seven of this thesis is aimed at investigating the existence of asymmetry and nonlinearity in the ERPT in Nigeria.

In Table 6.9, we show the adjustment coefficients which show the weak adjustment to the long-run equilibrium. The coefficient of the error correction term is 0.048 and significant at 5% level of significance. However, the coefficient is very low (0.048). This result implies that when the consumer price inflation deviates from the long run equilibrium, only 4.8% of the deviation adjusts in one-quarter.

The short-run ERPT elasticity is not significant at the 5 percent level in the first quarter. The insignificance of the ERPT in the short run could be because importing firms usually don't immediately change their price menus and pass-through the exchange rate changes to consumer price due to the cost of changing the menu. The importing firms also do not perceive every change in the exchange rate as a permanent change immediately. As such, they usually take a 'wait and see' attitude to ensure that the change in exchange rate is not a temporary shock. Hence, the ERPT in the short-run could be insignificant. We also know that the importing firm with markets share objectives do not change their price to pass through changes in the exchange rate in the competitive market for fear of losing their market share. Hence they tend to absorb small changes in their markup up to a certain threshold (See Chapter three for the review of ERPT determinants). However, in Nigeria where the exchange rate almost always depreciates since the adopted of the managed floating from 1986 could come as a surprise as the firm might be expected to perceive any change as permanent. However, effects of other factors like the market share objective most have exceeded the perception of the exchange rate change.

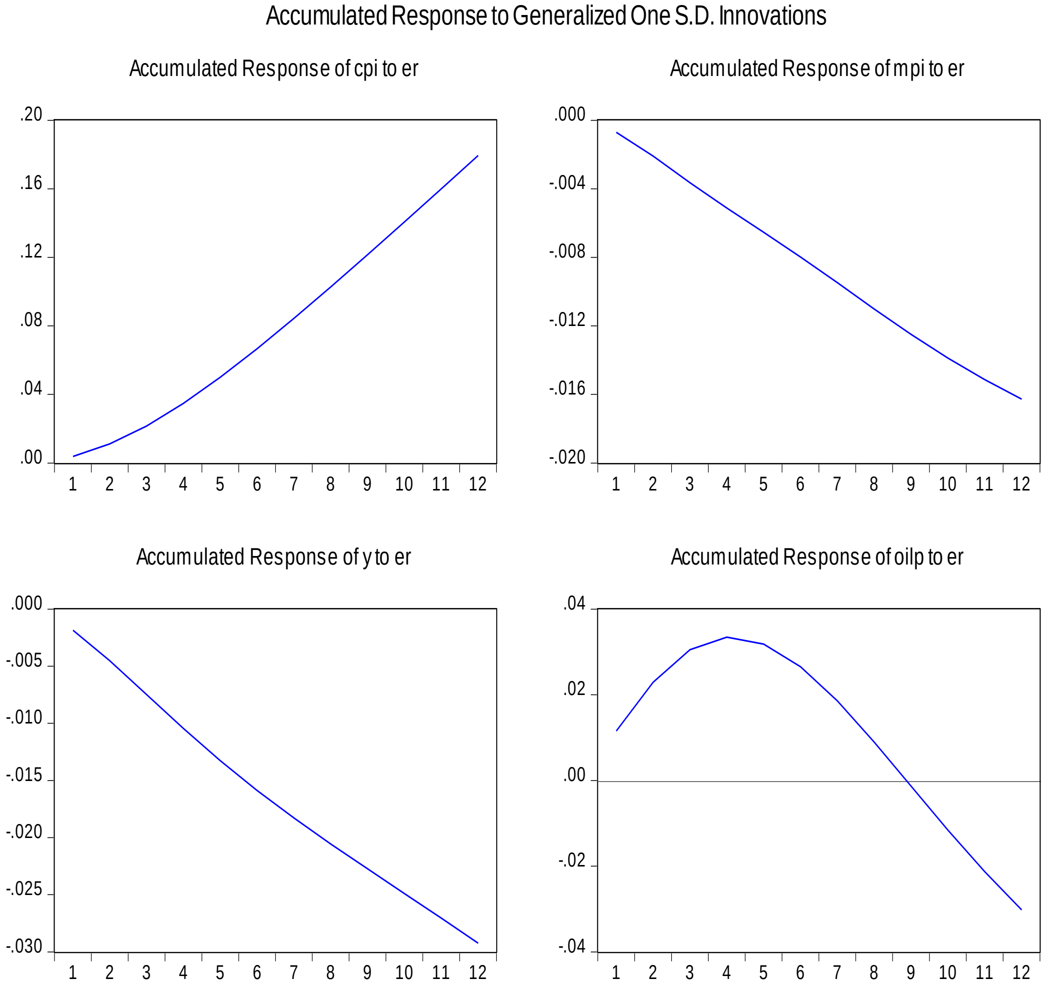
The US output level (f_y_t) which is proxy variables for foreign demand included in the VECM equation as an exogenous variable is also not significant in the short-run. However, consumer Price's (cpi_t) own coefficient which is 0.76 is highly significant, Which implies that the past values of the consumer price have an impact on its current value.

The shift dummy variable (D94) included for the break in the exchange rate series due to the four-year fixed exchange rate regime during the political and economic crisis of the 1990s is statistically significant at 5 percent level. It is imperative to note that when the D94 was not included the estimation does not show any economically meaningful result.

6.4.7 Impulse Response Analysis

An impulse response analysis was conducted as the model passed all the necessary diagnostic tests. The baseline model was analysed with generalised impulse response functions. The generalised impulse responses are presented over a 12 quarters time horizon. The estimates of the generalised impulse response functions for consumer prices, import price, exchange rate and oil price to one standard deviation shocks in the exchange rate is presented in figure 6.1 below.

Figure 6.1: Response to Generalised one S.D. exchange rate innovation



From Figure 6.1 above it can be observed that the impulse responses of consumer price to the exchange rate shock show a positive reaction. The response kept on increasing considerably from first up to a twelveth quarter. However, the responses of import price and output level to the exchange rate shocks were negative throughout the period and continued to increase up to the twelfth quarter. The reaction of oil price to the exchange rate shock was positive and kept rising until it reached a peak of 0.033 in the fourth quarter and started to drop and at ninth quarter it reaches zero, and the dropping continued into negative values up to the twelveth quarter. The response is in consonance with the result of the cointegration analysis. The reaction of the consumer price to the exchange rate shock is positive as expected, though the response is weak. As explained in the cointegration analysis that could be due to the slow response of the importing firm to exchange rate price changes. Conversely, currency exchange rate depreciation can influence consumer prices indirectly via changes in the demand composition or in the levels of aggregate demand and wages. Exchange rate depreciation makes domestic goods relatively low-priced for foreign buyers, and as a hence exports and aggregate demand will rise and stimulate an increase in the domestic price level. Likewise, the rise in domestic demand would create a high demand for labour and, possibly, raise wages, which will, in turn, be reflected in higher consumer prices. Thus, it is likely that exchange rate change would have an impact on consumer price as shown by our results.

6.4.8 Variance decomposition

The impulse responses trace the effects of a shock to one endogenous variable on to the other variables in the VECM system, which enabled us to estimate the effect of exchange rate and import price shocks on consumer prices. However, the impulse responses do not allow us to verify the significance of the external shocks for domestic price fluctuations over the sample period. We, therefore, analysed the import prices and consumer prices using variance decompositions. Variance decompositions split the variation in an endogenous variable into the component shocks to the VECM system. Hence, the variance decomposition gives us information about the relative significance of the impact of each random shock in the variables in the system. The Variance decompositions show the amount of contribution of each shock to the variance of the t-step ahead forecast errors of the variables. As a result, the significance of every external shock for the development of the consumer price indices could be evaluated.

In Tables 6.9 below, we present summary results on the variance decompositions consumer prices over a forecast horizon of 2, 4, 6, 8 and 10 quarters.

Table 6.9: Variance decomposition of cpi

Variance Decomposition of CPI:						
Period	S.E.	cpi	er	oilp	y	ulc
2	0.032	86.872	11.003	1.155	0.763	0.043
4	0.061	77.088	17.512	4.505	0.239	0.020
6	0.087	65.842	23.482	9.233	0.151	0.100
8	0.111	55.778	28.025	14.580	0.121	0.181
10	0.132	47.972	31.106	19.444	0.093	0.199
12	0.152	42.573	33.108	23.031	0.078	0.183

Cholesky Ordering: oilp y ulc er cpi

The variance decomposition analysis for the consumer prices indicates that in the second horizon, an exchange rate shock contributes 17.5 percent variation to the consumer price series. Output level and oil price contribute 0.76 % and 1.55 % respectively in the second horizon. It is the impact of the exchange rate kept increasing and reaches 33% contribution in the twelfth horizon. The variance decomposition analysis shows that the effect of changes in exchange rate on consumer price is substantially consistent with the long-run cointegration analysis.

Likewise, the external sector variables show that shocks from global markets could have a severe consequence on consumer price inflation and other economic activities in Nigeria. Therefore, the monetary authority may gauge appropriate monetary policy responses to pass through effects by ensuring exchange rate stability, anchoring inflation expectations and minimising fluctuations in economic activities.

6.5 Conclusion and Policy Recommendations

In this chapter, we examined the exchange rate pass-through to consumer prices in Nigeria during 1986Q4 to 2013Q using VECM model. The models capture long-run ERPT and the speed of adjustment to the long-run equilibrium. The analysis also measures the level of short-run ERPT. The results show high and statistically significant ERPT in the long-run in Nigeria during the sample period. When we imposed restriction and test the full ERPT hypothesis, the result failed to reject the hypothesis of complete ERPT. Therefore the result even suggests full ERPT in the long-run in Nigeria. However, the short-run estimate shows no significant ERPT in Nigeria. A review of the adjustment coefficients shows an extremely slow adjustment of consumer price to its long-run equilibrium in Nigeria. This might explain the insignificant ERPT estimates in the short-run. The impulse response analysis also supports the result of the cointegration analysis showing the near zero response of the consumer price to the exchange rate shock. The variance decomposition demonstrates the contribution of external shocks whereby the exchange rate shocks made some modest contribution to the domestic consumer prices during the period 1986Q4 -2013Q4.

This results could be explained by the behavior of the importing firms like market share objective and menu cost discussed (in Chapter 3, Section 3.3.3). The result suggests that importing firms in Nigeria might have objectives of controlling their market share. As such they do not pass-through the exchange rate change when it is so small that it can be absorbed by their profit margin and maintain their price unchange to control their market shares. The firms might also not effect changes in price for every change in exchange rate. They have to ensure that the change in the exchange rate is significant enough to warrant a change in price due to the cost of changing menus. The firms also do not effect change in prices, to pass-through the exchange rate change as they often see the exchange changes as temporary shocks considering the unstable nature of the exchange rates in Nigeria. Considering that Nigeria generates over 90% of its foreign exchange earning from sales of oil, the volatility of the oil price affects the Nigerian foreign exchange market. Therefore, it takes the importing firms sometime to decide on changing price due to all the three reasons mentioned. Hence, the insignificant ERPT in the short run. But the result suggests that they pass-through the changes in the exchange rate when they are settled that the change is permanent and reaches the level that is significant enough to warrant menu change and they could not absorb it in their profit margin anymore. Hence the significant and full exchange rate pass-though in the long-run.

The policy implication of this result is that the monetary policy actions which are more relevant in the short run might not be effective. For example, the role of the floating exchange rate system as a tool for price adjustment could not properly work when the prices do not adjust quickly to the changes in exchange rate. Therefore, the policy makers need to bring policies which encourage the other non oil sectors of the economy to develop and start contributing to foreign exchange earnings. This will diversify the supply to the foreign exchange market, which would stabilise the exchange rate and build the confidence of the importing firms to start perceiving a change in the exchange rate as a permanent change and reacting quickly.

This result is in contrast with the findings of Aliyu *et al*., (2009) which suggested an incomplete and low exchange rate pass-through in Nigeria in the long-run. As we maintained above, such findings are really mystifying with Nigeria's history of continued exchange rate depreciation which goes in hand with the higher inflation rate.

The exchange rate stability is, therefore, important in maintaining the domestic consumer price stability. The over-dependency of Nigeria on one commodity (oil) for it foreign exchange earning (See Section 2.2, Chapter two) have to be reviewed. Whenever there is a shock in the global oil market the foreign exchange supply drops, and consequently the exchange rate is severely affected which also impacts on the consumer price in the long-run, via the effect of exchange rate pass-through. Some other sectors of the economy need to be developed to complement the oil industry as a dominant source of foreign exchange earning to reduce the effect of the global oil price shock transmission into the domestic consumer price.

However, the complete insignificance of the exchange rate to the consumer price in the short run is puzzling. The behavior of the importing firm describe above also suggest some nonlinearities as the firms pass through the exchange rate changes when the change in bigger. The limitation of the VECM model used here is that it is based on linearity assumption. Therefore it might be possible that such nonlinearities were not properly captured. When a nonlinear model is used, it is likely that such nonlinear phenomenons could be captured and have some significant pass-through even in the short-run. Hence, in chapter seven we use nonlinear smooth transition autoregressive model to examine the potential nonlinearities and the short run ERPT again.

Appendix:

A.6.1 Data Description and Data Sources

Data Description

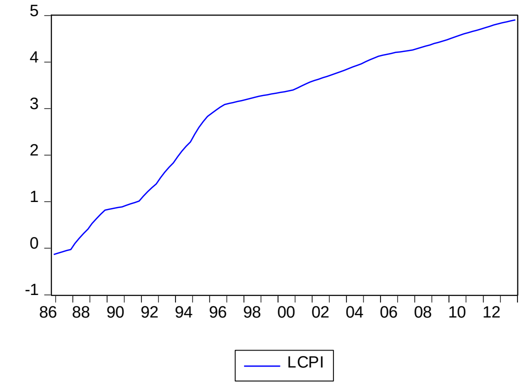
The study makes use of quarterly series for the period 1986Q4 to 2013Q4 for all variables. cpi - consumer price index with 2010 base year. er - Nominal exchange rate which is a bilateral Naira per US Dollar exchange rate is a three-month average. Oilp - Oil price which is the quarterly average price of OPEC reference basket. y - Nigeria real gross domestic product (GDP). Ulc - unit labour cost used as a proxy for import cost f_y - US real gross domestic product (GDP). Ulc - unit labour cost used as a proxy for import cost. D94 - a dummy which takes one from the fourth quarter of 1994 to the last quarter of 1998 and otherwise it takes zero. The dummy captures the four-year fixed exchange regime period during the political and economic crisis of the 1990s in Nigeria.

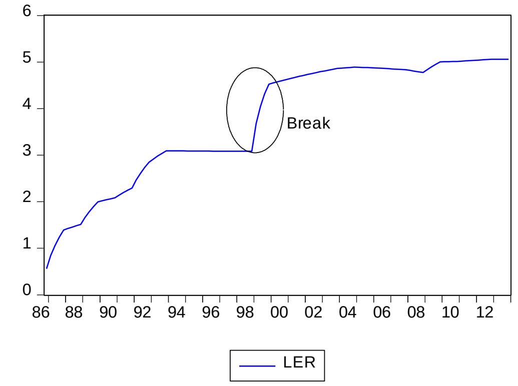
Data Sources

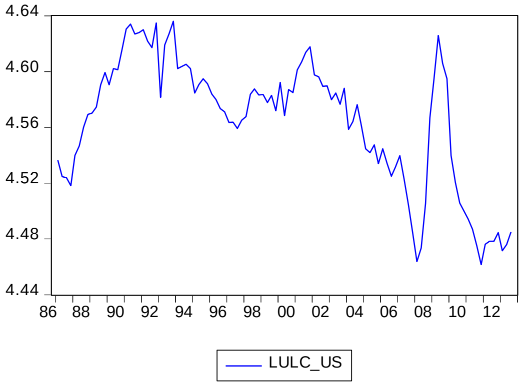
Data were obtained from three sources including World Bank’s World development indicators database, Penn World Table, and OPEC website. The nominal exchange rate, consumer price index, Nigerian Real GDP, US real GDP and unit labour cost was generated from World Bank’s World development indicator database. The Oil price data is derived from OPEC website. Import price was derived from Penn World Table 8.1.

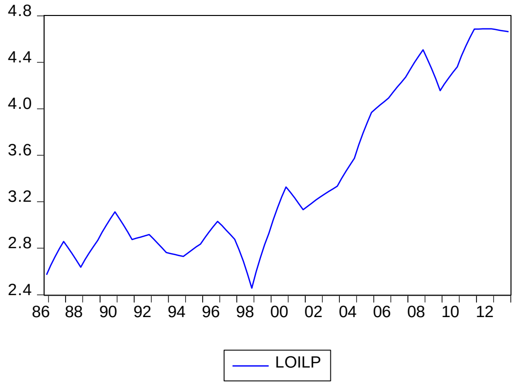
A.6.2 Figures

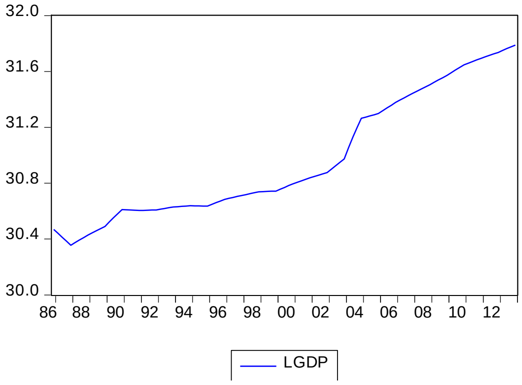
A.6.2.1: Graphs of variables in level.









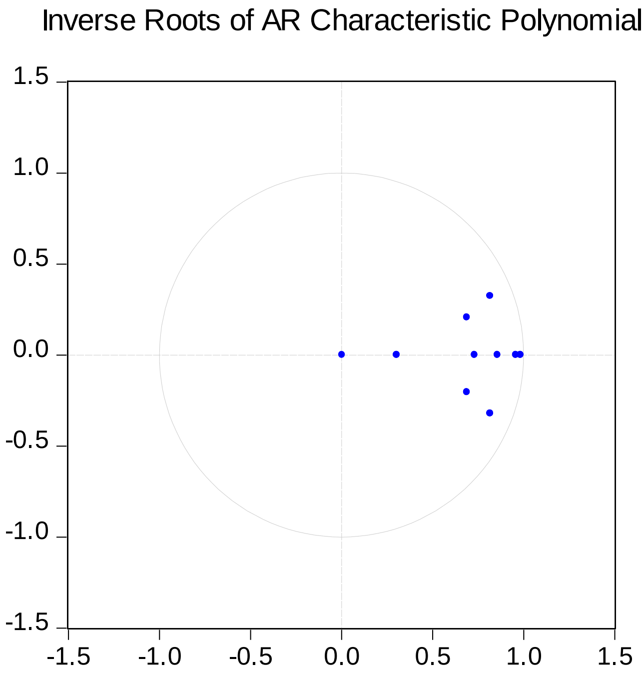


A.6.2.2: Roots of Characteristic Polynomial

Roots of Characteristic Polynomial
Endogenous variables: LCPI LER LULC_US LOILP LGDP
Exogenous variables: D_94Q1_98Q4 LUS_GDP
Lag specification: 1 2
Date: 09/21/17 Time: 16:59

Root	Modulus
0.984898	0.984898
0.960414	0.960414
0.818405 - 0.322575i	0.879682
0.818405 + 0.322575i	0.879682
0.858417	0.858417
0.733473	0.733473
0.691506 - 0.204680i	0.721162
0.691506 + 0.204680i	0.721162
0.304731	0.304731
0.005098	0.005098

No root lies outside the unit circle.
VAR satisfies the stability condition.



A.6.3.2 Breakpoint test

Quandt-Andrews unknown breakpoint test

Null Hypothesis: No breakpoints within 15 percent trimmed data Varying regressors: LER Equation Sample: 1986Q4 2013Q2 Test Sample: 1991Q1 2009Q2 Number of breaks compared: 74		
Statistic	Value	Prob.
Maximum LR F-statistic (1994Q4)	102.6140	0.0000
Maximum Wald F-statistic (1994Q4)	102.6140	0.0000
Exp LR F-statistic	48.09152	0.0000
Exp Wald F-statistic	48.09152	0.0000
Ave LR F-statistic	22.01665	0.0000
Ave Wald F-statistic	22.01665	0.0000

Chow Breakpoint Test: 1994Q4

Chow Breakpoint Test: 1994Q4 Null Hypothesis: No breaks at specified breakpoints Varying regressors: All equation variables Equation Sample: 1986Q4 2013Q2			
F-statistic	73.9400	Prob. F(6,95)	0.0000
Log likelihood ratio	185.6633	Prob. Chi-Square(6)	0.0000
Wald Statistic	443.6402	Prob. Chi-Square(6)	0.0000

A.6.3.3 Residual correlation matrix

	CPI	ER	OILP	Y
CPI	1.000000	0.200413	0.074086	0.083205
ER	0.200413	1.000000	0.310663	-0.226878
MPI	-0.102264	-0.085329	0.208749	-0.079020
OILP	0.074086	0.310663	1.000000	-0.053335
GDP	0.083205	-0.226878	-0.053335	1.000000

A.6.3.4 VAR Lag Order Selection Criteria

VAR Lag Order Selection Criteria						
Endogenous variables: cpi er oilp y						
Exogenous variables: D94 US_ppi US_y						
Sample: 1986Q4 2013Q4						
Included observations: 99						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	328.0843	NA	1.23e-09	-6.324936	-5.931736	-6.165846
1	1186.349	1577.819	6.04e-17	-23.15856	-22.11003	-22.73432
2	1358.129	298.4458	3.13e-18*	-26.12381*	-24.41994*	-25.43442*
3	1363.879	9.409426	4.68e-18	-25.73492	-23.37572	-24.78039
4	1373.714	15.10117	6.50e-18	-25.42857	-22.41404	-24.20889
5	1422.636	70.17110	4.16e-18	-25.91185	-22.24198	-24.42701
6	1461.485	51.79751*	3.31e-18	-26.19161	-21.86641	-24.44163
7	1470.686	11.33969	4.91e-18	-25.87245	-20.89192	-23.85732
8	1486.728	18.14780	6.52e-18	-25.69147	-20.05561	-23.41119
* indicates lag order selected by the criterion						
LR: sequential modified LR test statistic (each test at 5 percent level)						
FPE: Final prediction error						
AIC: Akaike information criterion						
SC: Schwarz information criterion						
HQ: Hannan-Quinn information criterion						

Chapter 7 :
Nonlinear and Asymmetric Exchange Rate Pass-Through to Consumer Prices In Nigeria: Evidence from a Smooth Transition Autoregressive Model.

7.1 Introduction

The aim of this chapter is to examine the presence of asymmetry and nonlinearity in the ERPT[5] to consumer prices in Nigeria using quarterly data from 1986Q4 to 2013Q4 to assess its possible effect on the short-run ERPT in Nigeria. Our review (in Chapter two) revealed that the ERPT effect of the Naira depreciation after 1986 introduction of the floating exchange rate system seems more profound than the effect seen during the re-introduction in 1999 which could be due to nonlinearity and/or asymmetries in the ERPT. In 1986, Nigeria was in recession, and the Naira exchange rate was past depreciating, and the effect of the Naira depreciation on the consumer price inflation was obvious as the inflation rates kept increasing persistently. In 1999, when the floating exchange rate system was re-introduced the Naira exchange rate suddenly drops but stabilises afterwards and the GDP growth and the inflation rate were also relatively stable. That seems to suggest that the periods of high exchange rate movements, high inflation rate and unstable growth induce asymmetric and nonlinear ERPT. Therefore, it is important to examine the potential nonlinearities and asymmetries in the ERPT in Nigeria. The aim is to see if the inflation rate, the exchange rate changes and the output growth rate induce the nonlinearities and asymmetries in the ERPT and impact on the level and speed of ERPT in Nigeria. Accordingly, in this chapter, we examined the asymmetry and nonlinearity in ERPT in Nigeria. The relevance of understanding the dynamics of

[5] The transmission of changes in the exchange rate to domestic prices is known as exchange rate pass-through (ERPT).

ERPT and most especially of the asymmetric and nonlinear pass through of exchange rate which was not much explored in the literature is essential.

The standard assumption in the ERPT literature is that the pass-through of the exchange rate changes to consumer price is linear, proportional and symmetric. Most studies assume the linearity, proportionality and symmetry without testing for it. However, it is apparent some situations like importing firm's capacity constraint, market share objective, production switching and menu cost (see Section 4.2.1, Chapter 4 for a detailed discussion) could cause asymmetric and nonlinear reaction of prices to exchange rate changes, which a linear modelling approach cannot capture.

The empirical studies in this area are still relatively few. However, recently the issue of nonlinearities and asymmetries in ERPT seems to have started receiving the attention of researchers and policymakers as some empirical evidence confirm its existence. (For example see Pollard and Coughlin (2004), Bussiere (2007, 2013), Nogueira Jr. and Leon-Ledesma (2011), Ben Cheikh (2012) and Shintani, Terada-Hagiwara and Yabu (2013)).

These possible causes of ERPT nonlinearity and/or asymmetry mentioned in the literature could be the factors that influence the pricing behaviour of the importing firm which leads to different responses according to the direction of change in the exchange rate and non-proportional response of price to various proportions of the exchange rate changes.

Some of these factors identified as potential causes tend to suggest a different effect on the ERPT process. For instance, appreciation in importing country's currency leads to higher pass-through according to market share hypothesis whereas binding quantity constraint hypothesis suggests the contrary.

The empirical studies also confirmed the existence of asymmetry and nonlinearity. However, the empirical studies also tend to produce conflicting results which might be because even hypothesis suggested conflicting outcomes. For instance, Gil-Pareja (2000), Mahdavi (2002) and Pollard and Coughlin (2004), among others, found evidence of asymmetry and nonlinearity. However, other studies, for example, Herzberg *et al.* (2003) and Marazzi *et al.* (2005) could not find any evidence of nonlinear or asymmetric behaviour. Hence, there are conflicting results even from the few available studies that consider the possibility of nonlinear and asymmetric ERPT.

Only very few studies that examined nonlinear and asymmetric ERPT using data from emerging and developing economies like Nigeria. For instance, we could not find any research on nonlinear and asymmetric exchange rate pass-through using Nigeria data. Nigeria embraced a policy of trade and financial liberalisation from 1986 (See Section 2.2.3, Chapter 2). Consequently, various foreign firms are operating in the economy who exhibits all those behaviours that are potential causes of nonlinearity and asymmetry in the ERPT process like market share objective, production switching and menu cost (discussed in Section 4.2.1, Chapter 4).

This thesis started by examining the ERPT in Nigeria using a VECM model (in Chapter Six) which is base on linear assumptions. The result shows substantially high ERPT in Nigeria in the long run while no significant ERPT is observed in the short-run. The diagnostic tests carried out on the study show that there is no serial correlation and residuals are homoscedastic. But, there is a non-normality problem.

Even though, Normality is not a necessary condition for the validity of most statistical procedure related to VAR models. The non-normality of the residuals could be an indication of some model deficiencies like structural change and nonlinearities (Lutkepohl and Kratzig, 2004 P46). The study used shift dummy to capture the effect of the identified structural break. But as for the potential nonlinearities, the VECM model could not capture it since the model is based on linearity assumption. Hence the need to examine the possible nonlinearities and its effects on the ERPT in Nigeria.

Considering the lack of any study of asymmetric and nonlinear ERPT using Nigeria data, and the concern that the non-normality in the VECM model could be a pointer to nonlinearities in the ERPT in Nigeria this chapter aims to examine the asymmetric and/or nonlinear ERPT in Nigeria using the same data quarterly data from 1986Q4 to 2013Q4. Given that almost all the potential cause of nonlinearities are relevant to Nigeria and most developing countries. This study will contribute to the literature on ERPT in developing, and emerging markets, particularly Nigeria as the linear models like the VECM could not capture the asymmetric and nonlinear dynamics in the ERPT process. It is important to fill this study gap looking at the persistent inflation figures in Nigeria (see Section 2.1, Chapter 2) understanding very well the dynamics of ERPT is necessary for design and implementation of appropriate exchange rate policies.

In the empirical literature on the nonlinear and asymmetric aspects of ERPT(reviewed in Section 4.3, Chapter 4), different econometric models have been used, but many studies follow Pollard and Coughlin (2004), for example, see, Khundrakpam (2007) and Busseire (2013). The study by Pollard and Coughlin

(2004) used threshold dummy variables to differentiate small and large changes in the exchange rate. Their study also used an arbitrary threshold value of 3 % for all US industries; they defined small and large changes as below 3 % and at least 3 %, respectively.

The use of arbitrary values for the threshold level by Pollard and Coughlin (2004) may not be appropriate. For more accuracy, the threshold level should be determined from the data. Therefore, an appropriate econometric model is required. Alternatively, a nonlinear regime-switching model where a grid search is used to select the appropriate threshold could be employed. In the class of nonlinear regime-switching models, there are two traditional nonlinear models – the threshold regression model and the Smooth transition autoregressive regression (STAR) model. The threshold regression model has characteristics of abrupt change across regimes, while with the Smooth transition autoregressive regression model the regime-switching process is 'smooth'. This study applies the Smooth transition autoregressive regression (STAR) model to examine the presence of nonlinearity and asymmetry in the ERPT in Nigeria. The model is applied to quarterly data from 1986Q4 and 2013Q4 as mentioned earlier.

The remaining sections are as follows. Section two presents the theoretical model of nonlinear and asymmetric ERPT. Section 3 presents the empirical model. Section 4 presents and discusses the empirical results. Section 5 provides a conclusion.

7.2 Theoretical Model on Asymmetric/Nonlinear ERPT

This section presents the theoretical basis of this study. The theoretical model will demonstrate the likely causes of nonlinearity in ERPT. Consider a foreign firm which produces and exports product i to the importing country. With perfect competition, a profit maximizing firm which set prices in currency of the importing country will set a price P_i.

$$\boldsymbol{P_i = E\,W_i^*} \tag{7.1}$$

Where: W_i^* is the marginal cost of the firm in the exporting country's currency, E is the exchange rate, expressed as the importing country's currency value of a unit of the exporting country's currency. When the assumption of perfect competition is relaxed profit maximization will introduce a mark-up π_i on the marginal cost W_i^*.

$$\boldsymbol{P_i = E\,\pi_i W_i^*} \tag{7.2}$$

The expression in equation (7.2) shows that the local currency price of the product can vary due to change in the exchange rate, a change in the firm's marginal cost, and/or a change in the importers' markup. Note also that the marginal cost and markup of the firm can change independently of the exchange rate. For instance, the marginal cost can shift due to change in the cost of a locally provided input in the exporting country. Also, the level of demand in the importing country can alter the exporter's markup. It is, therefore, imperative to take into account movements in these other determinants of the price while estimating pass-through to appropriately isolate the effects of exchange rate changes on consumer prices.

Following Bailliu and Fujii (2004), Campa and Goldberg (2005) and Nogueira Jr. and Leon-Ledesma (2011), the study assumes that the demand pressures in the importing country influence the markup: $\pi_i = \pi(\mathrm{Y})$ where, Y is the output level in the importing country which is use as proxy for demand pressures.

A log-linear approximation to equation (7.2) provides a basis for the standard ERPT regression often used throughout the ERPT literature (see for example Goldberg and Knetter (1997) Bailliu and Fujii (2004), Campa and Goldberg (2005) and Nogueira Jr. and Leon-Ledesma (2011)).

$$\boldsymbol{p_t = \alpha + \beta e_t + \delta y_t + \varphi w_t^* + \varepsilon_t} \qquad \textbf{(7.3)}$$

In equation (7.3), the ERPT coefficient is given by β and is expected to be bounded between 0 and 1. When β = 1, the price does not respond to variation of the exchange rate, price is set in the exporting country's currency which is a strategy known as producer-currency pricing (PCP) and so there will be complete pass-through. When β = 0, the pass-through is zero, given that the foreign firm decide not to change the prices in the importing country currency and absorb the variation in their markup. This is the strategy called local-currency pricing (LCP).

However, the pricing strategies of the foreign firm may not depend exclusively on demand conditions in the importing country. It can be argued that the foreign firm's pricing strategies could be influenced by some macroeconomic factors other than the demand conditions. For example, Taylor (2000) argued that the inflation environment could have an effect on the level of ERPT. Taylor (2000) suggested that ERPT would be higher in a high inflation environment than in an environment with stable inflation. So, the foreign firm is more likely to implement an LCP strategy when there is a stable inflation environment in the importing country. Then the foreign firm can absorb the exchange rate changes within markup, which will lead to low level of pass-through. Whereas, when there is high inflation in the importing country, the foreign firm will adopt a PCP strategy which leads to greater or full pass-through.

As discussed in (Section 4.2.2, Chapter 4), the business cycle is another important determinant of the ERPT. The business cycle could lead to the nonlinear transmission of changes in the exchange rate to consumer prices. The firms are more willing to pass-through cost increase resulting from exchange rate change to the prices during the economic boom than a recession. Hence, it is expected that the pass-through would be higher during the boom than during the recession. (See, for example, Delatte and Lopez-Villavicencio (2012)).

Likewise, the presence of menu costs is also another factor which compels the foreign firm to adjust prices nonlinearly according to the size of the change in the exchange rate. As discussed (in Section 4.2.1, Chapter 4), due to the menu costs the foreign firm may not adjust the price in the importing country when exchange rate change is small. The foreign firm only changes the price when the change in exchange rate exceeds a certain threshold. Hence, the ERPT varies with the size of the exchange rate change.

More so, where the foreign firm's aim is to maintain a market share, the importer would adjust markup to absorb the change when the importing country's currency depreciates. However, the foreign firm passes through the changes to the price when the importing country's currency appreciates. Hence the appreciation of the importing country's currency would lead to higher ERPT than the depreciation.

Based on these arguments it is assumed that the foreign firm's pricing strategy depends nonlinearly on the macroeconomic environment and the demand shocks in the importing country. This study followed Nogueira Jr. and Leon-Ledesma (2011) and Cheikh (2012), to considers $\omega(m)$ as a function of the macroeconomic determinants such as inflation level and output growth. This macroeconomic dependence is perceived as a foreign firms' strategic decision on the amount of the exchange rate changes to transmit to the prices considering different macroeconomic scenarios in the importing country.

Consequently, incorporating the macroeconomic factors mentioned above, the foreign firm's markup can be rewritten as follow:

$$\boldsymbol{\pi_i = \pi\left(Y, E^{\omega(m)}\right), \qquad \omega(m) \geq 0}, \tag{7.4}$$

Where: Y represents the demand pressures in the importing country which is proxied by output level in the economy. As stated earlier the mark-up is affected nonlinearly by the macroeconomic stability in the economy which is represented by a component m. A higher value for m shows higher inflation level, hence, m is a measure of economic stability. This study assumed that the mark-up and marginal cost can change independently of the exchange rate. For instance, change in cost of locally sourced input in the exporting country may shift the marginal cost. So also change in demand in the importing country could affect the firm's mark-up.

Substituting equation (7.4) for π_i in (7.2), a log-linear approximation of equation (7.2) can be expressed as follows:

$$\begin{aligned} \boldsymbol{p_t} &= \boldsymbol{\alpha + \beta e_t + k y_t + \omega(m) e_t + \varphi w_t^*} \\ &= \boldsymbol{\alpha + [\beta + \omega(m)]\, e_t + k y_t + \varphi w_t^* + \varepsilon_t} \end{aligned} \tag{7.5}$$

Where: the lower case letters in equation (7.5) are logarithms of the upper cases in equation (7.2). Equation (7.5) shows the two ERPT channels: direct and indirect. The direct channel is denoted by β, which is to be bounded between 0 and 1. The indirect channel denoted by the function $\omega(m)$ which is influenced by the macroeconomic environment. While, w_t^* represents the costs and y_t stands for the output level.

Following Korhonen and Juntilla (2010) and Nogueira Jr. and Leon-Ledesma (2011), we assume that there is some threshold m^* that defines the extreme regimes of higher inflation which is represented by higher values of m on one hand; and low inflation which is represented by lower value of m on the other.

$$\boldsymbol{\omega(m) = \begin{cases} 0; m \leq m^* \\ \psi > 0; m > m^* \end{cases}} \tag{7.6}$$

For the two regimes, there will be different levels of pass-through. When the importing country is in the period of higher inflation, the ERPT will be equal to $\alpha + \psi$. Whereas when the importing country is in the period of lower inflation the ERPT will be equal to α. Hence ERPT is higher during higher inflation as $\alpha + \psi > \alpha$.

Consequently, the ERPT is different depending on whether the macroeconomic determinant is below or above some threshold. For instance, as discussed in (Section 4.2.2, Chapter four) higher inflation environment raises ERPT, while there will be low ERPT with a stable inflation environment. Therefore, equation (7.5) appropriately describes the changing behaviour in the exchange rate pass-through nonlinearly.

7.3 The model Assumptions

We use a Smooth transition autoregressive regression (STAR) model for empirical application with the following assumption about the data generating process (DGP) following Amemiya (1974) and Areosa et al. (2011).

7.3.1 Data Generating Process Assumption

The series $\{y_t\}_{t=1}^{T}$ is generated by

$$\boldsymbol{y_t} = \boldsymbol{\beta}'_{\mathbf{01}}\widetilde{\mathbf{X}}_{\boldsymbol{t}} + \boldsymbol{\beta}'_{\mathbf{02}}\widetilde{\mathbf{X}}_{\boldsymbol{t}}\boldsymbol{f}(\boldsymbol{s_t};\boldsymbol{\gamma_0},\boldsymbol{c_0}) + \boldsymbol{u_t}, \tag{7.7}$$

Where $f(s_t;\gamma_0,c_0)$ is the logistic or exponential function given by:

$$\boldsymbol{f}(\boldsymbol{s_t};\boldsymbol{\gamma_0},\boldsymbol{c_0}) = \frac{\mathbf{1}}{\mathbf{1} + \boldsymbol{e}^{\gamma_0(s_t - c_0)}}, \tag{7.8}$$

$\widetilde{\mathbf{X}}_t = \left(1, \mathbf{X}'_{L,t}\right)$, $\mathbf{X}_t = \left(\mathbf{X}'_{L,t}, s_t\right)' \in \mathbb{R}^{qX}$ is the vector of covariates, $\mathbb{E}(u_t|\mathbf{X}_t) \neq 0$, and $\mathbb{E}(u_t^2) = \sigma_0^2 < \infty$.

In this case, $g(\mathbf{X}_t;\psi_0) \equiv \beta'_{01}\widetilde{\mathbf{X}}_t + \beta'_{02}\widetilde{\mathbf{X}}_t f(s_t;\gamma_0,c_0)$ and $\psi_0 = (\beta'_{01},\beta'_{02},\gamma_0,c_0)'$ $\in \mathbb{R}^K$. The structural parameters to be estimated are ψ_0 and σ_0^2.

The STAR model will be a regime-switching model which allows for two limiting regimes related to the extreme values of the transition function, $f(s_t;\gamma_0,c_0) = 0$ and $f(s_t;\gamma_0,c_0) = 1$, where there is smooth transition from one regime to the other. The parameter c represents the threshold between the two regimes; such that the logistic function changes monotonically from 0 to 1 as s_t increases and $f(c;\gamma,c) = 0.5$. The parameter γ defines the how smooth the transition is, from one regime to the other. As γ grows larger, the logistic function $f(s_t;\gamma_0,c_0)$ moves toward the indicator function and, therefore, the change of $f(s_t;\gamma_0,c_0)$ from 0 to 1 becomes sudden at $s_t = c$.

The following assumptions are made in respect of the parameters of the model.

7.3.2 Identification Assumption

The parameter vector ψ_0 is interior to a compact parameter space $\boldsymbol{\Psi}$. In addition, $\gamma_0 > 0$ and c_0 is interior, backing the probability distribution of s_t . Where the distribution of s_t has boundless backing, then $-\infty < \underline{c} < c_0 < \overline{c} < \infty$. This assumption is a standard assumption for the identification of STAR models. The constraint on γ_0 circumvents the lack of identification owing to the symmetric nature of the logistic function.

The vector of endogenous variables follows a linear reduced form, as in the following assumption.

7.3.3 Reduced form Assumption

$\mathbf{W}_t \in \mathbb{R}^{qw}$ is a vector of exogenous variables such that:

(1) $\mathbf{X}_t = \boldsymbol{\Theta}_0 \mathbf{W}_t + \mathbf{V}_t$;

(2) $\mathbb{E}(\mathbf{u}_t | \mathbf{w}_t) = 0, \forall t$;

(3) $\mathbb{E}(\mathbf{v}_t | \mathbf{w}_t) = 0, \forall t$;

(4) $\mathbb{E}(\mathbf{v}_t | \boldsymbol{\mathcal{F}}_{t-1}) = 0$, Where $\boldsymbol{\mathcal{F}}_{t-1}$ is the σ-field generated by

$\{\mathbf{X}'_{t-j}, \mathbf{w}'_{t-j}, \mathbf{u}_{t-j} : j \geq 1\}$; and

(5) Set $\mathbf{e}_t = (\mathbf{u}_t \mathbf{v}'_t)'$. $\mathbb{E}(\mathbf{e}_t \mathbf{e}'_\tau) = \delta_{\tau t} \Sigma$, where

$$\delta_{\tau,t} = \begin{Bmatrix} 1 & if\ \tau = t \\ 0 & if\ \tau \neq t \end{Bmatrix}\ and\ \Sigma = \begin{pmatrix} \sigma_0^2 & \Sigma'_{uv} \\ \Sigma_{uv} & \Sigma_v \end{pmatrix}$$

The model also deems that there is a range of valid instruments that satisfy the assumption below.

7.3.4 Instruments Assumption

$\mathbf{Z} = [\boldsymbol{z}(\boldsymbol{w}_1), \dots, \boldsymbol{z}(\boldsymbol{w}_T)]'$ is a $(\mathrm{T} \times \mathrm{q_z}), q_z > K$ matrix of instruments, such that:

(1) $\mathbf{Z}_t \equiv \mathbf{z}(\mathbf{w_t}): \mathbb{R}^{qw} \longrightarrow \mathbb{R}^{qz}$ is a linear or nonlinear function of $\boldsymbol{w}_t$, such that $\mathbb{E}(|\mathbf{Z}_t|) < \infty$;

(2) $\underset{T\to\infty}{\text{plim}} \frac{1}{T}\mathbf{Z}'\mathbf{Z}$ exists and is nonsingular;

(3) $\frac{1}{T}\mathbf{Z}'\dot{\mathbf{g}}(\mathbf{X};\boldsymbol{\psi})$ converges in probability uniformly $\boldsymbol{in\psi} \in \mathbf{N}(\boldsymbol{\psi_0})$ Where $\mathbf{N}(\boldsymbol{\psi_0})$ is a neighborhood of $\boldsymbol{\psi_0}$; and

(4) $\underset{T\to\infty}{\text{plim}} \frac{1}{T}\mathbf{Z}'\dot{\mathbf{g}}(\mathbf{X};\boldsymbol{\psi_0})$ exists and is of full rank.

Also, the error term is such that:

7.3.5 Error Term Assumption

$\{\mathbf{u}_t\}_{t=1}^{T}$ is a martingale difference series, such that $\mathbb{E}(\mathbf{v}_t|\boldsymbol{\mathcal{F}}_{t-1}) = 0$, where $\boldsymbol{\mathcal{F}}_{t-1}$ is defined as in reduced form assumption.

7.3.5 Stationarity Assumption

The sequence $\{Y_t\}_{t=1}^{T}$ where $Y_t = y_t, x_t', z_t'$, is stationary and ergodic.

Following Caner and Hansen (2004) the model assumes that the threshold variable is exogenous. When the transition variable is exogenous, the reduced form of y_t can be expressed as follows:

$$\mathbf{y_t} = \boldsymbol{\pi}'_{\mathbf{01}}\widetilde{\mathbf{w}}_\mathbf{t} + \boldsymbol{\pi}'_{\mathbf{02}}\widetilde{\mathbf{w}}_\mathbf{t}\boldsymbol{f}(\boldsymbol{s}_t;\boldsymbol{\gamma_0},\boldsymbol{c_0}) + \boldsymbol{\xi}_t \qquad \textbf{(7.9)}$$

Where $\widetilde{\mathbf{w}}_t = 1, w_t{}'$, with $\tilde{x}_t = \widetilde{\boldsymbol{\Theta}}_0\mathbf{w}_t + \tilde{\mathbf{v}}_t$, $\tilde{\boldsymbol{v}}_t = (0, \mathbf{v}_t')'$, $\pi_{01} = \widetilde{\boldsymbol{\Theta}}_0\boldsymbol{\beta}_{01}$, $\pi_{02} = \widetilde{\boldsymbol{\Theta}}_0\boldsymbol{\beta}_{02}$ and the error term is given by $\xi_t = u_t + \beta_{02}'\tilde{v}_t f(s_t;\gamma_0,c_0)$.

Hence, under the reduced form assumption $\mathbb{E}[\xi_t \widetilde{\mathbf{w}}_t f(s_t; \gamma_0, c_0)] = 0$ and the parameters of (7.9) can be estimated by nonlinear least squares (NLS). In addition, γ_0 and c_0 are both identified. Therefore it is possible to carryout two-step estimation: first compute estimates $\hat{\gamma}_0$ and $\widehat{c}_0$, for γ_0 and c_0 respectively, using (7.9), then substitute $\widehat{\gamma}_0$ and $\hat{c}_0$ in (7.7) and estimate $\boldsymbol{\beta}_{01}$ and $\boldsymbol{\beta}_{02}$. As proposed by Caner and Hansen (2004) the advantage here is that, with $\hat{\gamma}_0$ and $\hat{c}_0$, the STAR model is now a nonlinear-in-variables model.

7.4 Empirical Model Specification and Data sources

7.4.1 Empirical Model Specification

The empirical specification similar to those employed by Nogueira Jr. and Leon-Ledesma (2011), Cheikh (2012) and Shintani, Terada-Hagiwara and Yabu (2013) is based on the theoretical model and model assumptions described in sections 7.2 and 7.3 respectively. The STAR pass-through equation is expressed as a nonlinear backward-looking Phillips curve has the following form:

$$\begin{aligned}\Delta \boldsymbol{cpi_t} = \boldsymbol{\beta_0} + \sum_{\boldsymbol{i=1}}^{\boldsymbol{n}} \boldsymbol{\beta_{1,i}} \Delta \boldsymbol{cpi_{t-i}} + \sum_{\boldsymbol{i=0}}^{\boldsymbol{n}} \boldsymbol{\beta_{2,i}} \Delta \boldsymbol{mpi_{t-i}} + \sum_{\boldsymbol{i=0}}^{\boldsymbol{n}} \boldsymbol{\beta_{3,i} \Delta y_{t-i}} \\ + \sum_{\boldsymbol{i=0}}^{\boldsymbol{n}} \boldsymbol{\beta_{4,i} \Delta e_{t-i}} + \left(\boldsymbol{\beta_0^*} + \sum_{\boldsymbol{i=0}}^{\boldsymbol{n}} \boldsymbol{\beta_{4,i}^* \Delta e_{t-i}} \right) \boldsymbol{G(s_t, \gamma, c)} + \boldsymbol{\varepsilon_t}\end{aligned} \tag{7.10}$$

Where Δcpi is CPI inflation rate, Δmpi is change in import price, Δy is output growth, Δe change in exchange rate, $G(s_t, \gamma, c)$ is a nonlinear function, ε is an error term (See appendix B.7.1 for detailed data description and sources). It is also a common practise in the nonlinear modelling to include a time trend if it shows significance (see Clifton *et al.* 2001).

The ERPT test produces two results. It is either; the transition variable is far below from the threshold for the LSTR model or close to the threshold for the ESTR model in which case the ERPT is given by the linear parameters $\sum_{i=1}^{n} \beta_{4,i}$ or the transition variable is far away from the threshold for the ESTR model, or far beyond it for the LSTR model in which case the coefficient is the sum of the linear and nonlinear parts of the model $\sum_{i=1}^{n} \beta_{4,i} + \sum_{i=1}^{n} \beta_{4,i}^{*}$. For the LSTR specification there is a third possible outcome: when the transition variable is equal to the threshold the ERPT is given by $\sum_{i=1}^{n} \beta_{4,i} + \sum_{i=1}^{n} \beta_{4,i}^{*} /2$.

7.4.2 Properties of the data

All the series were checked for non-stationarity using ADF-test and Phillips-Perron (PP) which test the null hypothesis unit root. The stationarity checks show that the variables are integrated of order I(1) (see Table 7.1 below). The study chose to follow standard practice in the literature and estimated the model in differences (for example see, Nogueira, Jr. and León-Ledesma, 2011; Shintani, Terada and Yabu, 2013; Cheikh, 2012). Furthermore, the choice is based on the fact that the analysis here concentrates on short-term dynamics and not long-term equilibrium relationships between the variables.

Table 7.1: Unit root tests

Augmented Dickey-Fuller (ADF) Unit Root				
At Level				
	cpi	**mpi**	**er**	**y**
With Constant	0.1774	0.535	0.316	0.968
With Constant & Trend	0.6481	0.369	0.742	0.724
Without Constant & Trend	0.8545	0.281	0.937	0.999
At First Difference				
	d(cpi)	**d(mpi)**	**d(er)**	**d(y)**
With Constant	0.073*	0.004***	0.000***	0.002***
With Constant & Trend	0.042**	0.021***	0.000***	0.013**
Without Constant & Trend	0.084*	0.000***	0.000***	0.005***
Unit root with Break test				
At Level				
	cpi	**mpi**	**er**	**y**
Innovation Outlier	0.990	0.121	0.930	0.373
Additive Outlier	0.982	0.145	0.969	0.990
At First Difference				
	d(cpi)	**d(mpi)**	**d(er)**	**d(y)**
Innovation Outlier	0.010**	0.017**	0.000***	0.047**
Additive Outlier	0.012**	0.000***	0.001***	0.000***
Phillip-Perron (PP) Unit Root Test				
At Level				
	cpi	**mpi**	**er**	**y**
With Constant	0.133	0.924	0.132	0.998
With Constant & Trend	0.931	0.586	0.580	0.678
Without Constant & Trend	0.995	0.999	0.976	1.000
At First Difference				
	d(cpi)	**d(mpi)**	**d(er)**	**d(y)**
With Constant	0.053*	0.000***	0.000***	0.003***
With Constant & Trend	0.027**	0.000***	0.000***	0.021**
Without Constant & Trend	0.096*	0.000***	0.000***	0.005***
Notes: Null Hypothesis: the variable has a unit root, (*) Significant at the 10%; (**) Significant at the 5%; (***) Significant at the 1% and (no) Not Significant, Lag Length based on SIC, Probability based on MacKinnon (1996) one-sided p-values.				

All the variables are non-stationary at levels in both the ADF, Unit root with break and the PP unit root tests as the probability values of the test statistic fail to reject the null hypothesis of a unit root at 5% level of significance.

All variables are stationary at first difference, considering that the probability values of the test statistics reject the null hypothesis of a unit root at 5% level or less in either the test with constant, with constant and trend or without constant and trend in both the ADF, Unit root with break test and PP test.

Hence, the data generation process of all the variables is of order I(1).

Under stationarity applications, the covariates have been presumed to be weakly exogenous with respect to the parameters of interest. Under the assumption of exogeneity, the standard method of estimation is nonlinear least squares, and the asymptotic properties of the estimators have been discussed in Arranz and Escribano (2000), Suarez-Fariñas et al. (2004), and Medeiros and Veiga (2005), among others. Nonlinear least squares (NLS) is equivalent to the quasi-maximum likelihood or, when the errors are Gaussian, with conditional maximum likelihood.

We estimated a two stage least squares (TSLS) and used Durbin-Wu-Hausman test and assess the endogeneity of the variables.The objective of the Durbin-Wu-Hausman test here is to check and ensure that our regressors free from endogeneity. Our consumer price (cpi) equation can be expressed as follows:

$$\boldsymbol{cpi = \beta_1 + \beta_2 er + \beta_2 mpi + \beta_2 y + u} \qquad \textbf{(7.11)}$$

Where *er* is exchange rate, *mpi* is import price, and *y* is output growth and β_1 is a constant variable. For the estimation of the TSLS, we used the lagged values

er_{t-1}, mpi_{t-1} and y_{t-1} of our regressors *er, mpi* and *y;* as instruments and regress for each of the three regressors in (7.11) as follows:

$$\widehat{\boldsymbol{er}} = \boldsymbol{\gamma_0} + \boldsymbol{\gamma_1 er_{t-1}} + \boldsymbol{\gamma_2 mpi_{t-1}} + \boldsymbol{\gamma_3 y_{t-1}} + \boldsymbol{v_1} \quad \textbf{(7.12)}$$

$$\widehat{\boldsymbol{mpi}} = \boldsymbol{\lambda_0} + \boldsymbol{\lambda_1 er_{t-1}} + \boldsymbol{\lambda_2 mpi_{t-1}} + \boldsymbol{\lambda_3 y_{t-1}} + \boldsymbol{v_2} \quad \textbf{(7.13)}$$

$$\hat{\boldsymbol{y}} = \boldsymbol{\Phi_0} + \boldsymbol{\Phi_1 er_{t-1}} + \boldsymbol{\Phi_2 mpi_{t-1}} + \boldsymbol{\Phi_3 y_{t-1}} + \boldsymbol{v_3} \quad \textbf{(7.14)}$$

We then replaced the regressors in (7.11) by the fitted values $\widehat{er}$, $\widehat{mpi}$ and $\hat{y}$ from (7.12), (7.13) and (7.14) and estimate the equation. The Durbin-Wu-Hausman Test checks if any of the endogenous variables are actually exogenous. The test is conducted by running a secondary estimation where the test variables are treated as exogenous instead of endogenous, and then compare the J-statistic between the original and the secondary estimation.

The Durbin-Wu-Hausman endogeneity test result for the three regressors in the model is presented in Table 7.2 below.

Table 7.2: Durbin-Wu-Hausman endogeneity Test

Regressors	**Difference in J-Stats value**	**Probability**	**Comment/Decision**
er	1.3720	0.2415	Null hypothesis accepted
mpi	0.5409	0.4621	Null hypothesis accepted
y	2.1676	0.1409	Null hypothesis accepted

Note: The null hypothesis of the test is that the regressor is exogenous.

The result shows that the test fails to reject the null hypothesis at 5% significance level in the Durbin-Wu-Hausman endogeneity test for all the three regressors.

The result implies that the regressors are exogenous and therefore their regression will be consistent and unbiased.

Considering that the endogeneity test result shows no problem of endogeneity, we proceeded with implementing the Smooth transition autoregressive regression based on the approach discussed in chapter five.

7.5 Empirical Results

7.5.1 Baseline Linear Autoregressive (AR) Model

The results analysis starts with a baseline linear AR model of the ERPT. The model is the linear part of the nonlinear STAR model in equation (7.10). The result of the linear AR model will be used to compare the outcome of the nonlinear STAR models. The statistical test result of the coefficient of determination ($R^{2)}$, the sum of squared residuals (SSR) and Akaike Information Criterion (AIC) will be used to compare the performance of the two models. The linear AR model is as follows.

$$\Delta \boldsymbol{cpi_t} = \boldsymbol{\beta_0} + \sum_{\boldsymbol{i=1}}^{\boldsymbol{n}} \boldsymbol{\beta_{1,i}} \Delta \boldsymbol{cpi_{t-i}} + \sum_{\boldsymbol{i=0}}^{\boldsymbol{n}} \boldsymbol{\beta_{2,i}} \Delta \boldsymbol{mpi_{t-i}} + \sum_{\boldsymbol{i=0}}^{\boldsymbol{n}} \boldsymbol{\beta_{3,i}} \boldsymbol{\Delta y_{t-i}} + \sum_{\boldsymbol{i=0}}^{\boldsymbol{n}} \boldsymbol{\beta_{4,i}} \boldsymbol{\Delta e_{t-i}} + \boldsymbol{\varepsilon_t} \qquad \textbf{(7.15)}$$

Table 7.3, below presents the estimation result of the linear AR model in Equation (7.15) above.

Table 7.3: Linear AR Model

Variable	Coefficient	Std. Error	t-Statistic	p-values
$\Delta \boldsymbol{cpi_t}$	0.8602	0.0501	17.1576	0.0000
$\boldsymbol{\Delta e_t}$	0.0055	0.0237	0.2335	0.8159
$\Delta \boldsymbol{mpi_t}$	-0.0039	0.1434	-0.0272	0.9784
$\boldsymbol{\Delta y_t}$	-0.0992	0.1262	-0.7861	0.4336
c	0.0075	0.0039	1.9417	0.0549
$R^2 = 0.75$	SSR = 0.037		AIC = -5.046	
LM-$\chi^2(1)$ = 0.34[0.55]		LM-F (1, 101) = 0.33[0.57]		

LM $_{ARCH}$(1) = 0.37[0.54]	LM $_{ARCH}$(2) = 0.41[0.66]
JB = 838[0.00]	

LM-χ^2(1) and LM-F(1) are first order chi square and F-statistics Breusch-Godfrey Serial Correlation LM test respectively. LM $_{ARCH}$ (1) and LM $_{ARCH}$ (2) are the first and second order F-statistics autoregressive conditional heteroscedasticity test respectively. JB is Jarque-Bera Normality test. Probability values are reported in the square brackets.

The diagnostic tests show that there is no serial correlation as the Breusch-Godfrey Serial Correlation LM Test fails to reject the null hypothesis of no serial correlation. The result also indicates that residuals are homoscedastic as the autoregressive conditional heteroscedasticity test fail to reject null hypotheses of no heteroskedasticity. But, there is a non-normality problem as the Jarque-Bera Normality test result shows rejection of the null hypothesis of normality.

As mentioned in the result of the VECM model the non-normality of the residuals could be a pointer of some model deficiencies such as structural change and nonlinearities (Lutkepohl and Kratzig, 2004). Hence, the nonlinear smooth transition autoregressive (STAR) model estimation.

The estimated result shows that the probability values of all the estimated coefficient except that of past CPI inflation are not significant at 5 percent level which implies that all variables except the past CPI inflation have no statistically significant effect on the consumer price in Nigeria during the period 1986Q4 to 2013Q4 in the short run. This result is consistent with the result of the short-run part of the VECM model in Chapter six.

7.5.2 Linearity Test Result

We begin by first testing the baseline AR model for linearity against Smooth transition autoregressive regression (STAR) nonlinearity (as described in Section 5.3.1, Chapter five). We then choose the transition variable to be included in the STAR model among the potential transition variables. Usually, the variable which gives the strongest rejection of the null hypothesis of linearity is selected from the possible transition variables. However, economic intuitions coupled with the sequence of null hypotheses are used in practice. The choice of the transition variable in this study is based on the potential ERPT asymmetry and/or nonlinearity which could be brought about by 1) the inflation environment in the economy (Taylor's Hypothesis), 2) disproportionate response of the consumer price to the direction and size of exchange rate change, and 3) nonlinear response of price due to the stage of business cycle at which the ERPT takes place. Therefore, we choose CPI inflation ($\Delta \boldsymbol{cpi}$), change in exchange rate ($\boldsymbol{\Delta e}$) and change in output level ($\boldsymbol{\Delta y}$) as transition variables in separate estimations to identify the appropriate transition function (logistic or exponential STAR). With the choice of the three variables as the transition variables the result would show the effect of the high inflation environment, changes in exchange rate and the output level on the domestic consumer prices in Nigeria during the period under review.

Table 7.4: Linearity test result

Transition Variable	H_0	H_4	H_3	H_2	Suggested Model
$\Delta \boldsymbol{cpi_t}$	0.0000	0.0000	0.55111	0.0000	LSTR
$\boldsymbol{\Delta e_t}$	0.0018	0.0453	0.2126	0.0029	LSTR
$\Delta \boldsymbol{mpi_t}$	0.0001	0.0056	0.1367	0.0018	LSTR
$\boldsymbol{\Delta y_t}$	0.9482	-	-	-	Linear

The H_0 column shows the p-values of the test of linearity against the alternative of STAR nonlinearity. The H_4, H_3 and H_2 columns are the p-values of the sequential test for choosing the appropriate transition function. The decision rule is as follows: If the test of H_3 provides the strongest rejection of the null hypothesis, we choose the exponential STAR (ESTR) model; otherwise, we select the logistic STAR (LSTR) model. The last column reports the selected model.

The result of the linearity test in Table 7.4, above shows nonlinearities in the variables as we could observe in the H_0 column, all the potential transition variables except output growth ($\boldsymbol{\Delta y_t}$) have probabilities values significant at 5% level. This result implies rejection of the null hypothesis of linearity. As the linearity has been rejected, the sequence of nested null hypotheses is carried out to choose the appropriate transition function (logistic or exponential STAR). The chosen transition functions are report in the suggested model column in the Table 7.4 above. However, the investigation for the effect of ERPT nonlinearity due to size of the exchange change is supposed to be by exponential transition function. Therefore, we tried imposing the exponential transition function to see the outcome of the estimation.

7.5.3 Nonlinear STAR Model Estimation Results

Following Nogueira Jr. and Leon-Ledesma (2011) and Cheikh (2012), the nonlinear STAR ERPT model presented in equation (7.7) was estimated. The estimation of the parameters of the STAR model was conducted using a nonlinear lease squares (NLS). The suggested STAR type to use while using consumer price inflation or the output gap as transition variable is the logistic Smooth transition autoregressive regression (LSTR). When using the exchange rate as transition variable either of the

LSTR or the exponential Smooth transition autoregressive regression (ESTR) could be adopted. LSTR model can analyse asymmetric exchange rate pass-through with the currency appreciations and depreciations episodes. On the other hand, the ESTR is appropriate for examining the nonlinearity in exchange rate pass-through due to the size of the change in the exchange rate (Nogueira Jr. and Leon-Ledesma, 2011). The models are tested for misspecification using tests of no remaining nonlinearity, parameters constancy, no error autocorrelation, no conditional heteroscedasticity and non-normality.

7.5.3.1. Consumer Price Inflation($\Delta \mathrm{cpi}_t$) as Transition Variable

According to Taylor (2000), the fall in ERPT witnessed over the last three decades as reported by various studies were due to low inflation caused by the adoption of monetary policy regime like inflation targeting. Nigeria also used different monetary policy regimes aimed at controlling inflation (see Section 2.4, Chapter two). In this section we investigate the Taylor's (2000) hypothesis in Nigeria, to find out if the inflation environment in Nigeria during the period under review has led to nonlinearity in the ERPT process. We present the results of the estimation using the model specified in Equation (7.10).

The linearity tests carried out showed rejection of the null hypothesis of linearity and LSTR model is suggested as the relevant specification for this ERPT nonlinearity. Table 7.5 presents the result non-linear least squares estimation of the LSTR model. We first estimated the full LSTR model using least squares and a two-dimensional grid for the slope variable (**γ**) and threshold variable (***c***) as suggested in Van Dijk, Teräsvirta, and Franses (2002) to get reasonable starting values and then re-estimated the model using nonlinear least squares. The estimated LSTR model was checked using misspecification tests. The critical diagnostic tests of no error autocorrelation, no conditional heteroscedasticity and normality were carried out. A further test of no remaining nonlinearity and parameter constancy were also conducted.

Table 7.5: Estimation result of LSTR model with CPI inflation (Δcpi_t) as transition variable

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Threshold Variables (linear part)				
Δcpi_{t-1}	0.8597	0.0267	32.165	0.0000
Δer_t	0.0244	0.0245	0.9970	0.3213
Δmpi_t	-0.0953	0.1227	-0.7768	0.4392
Δy_t	0.0771	0.0428	1.8023	0.0746
Threshold Variables (nonlinear part)				
Δcpi_{t-1}	-1.1395	0.0517	-22.057	0.0000
Δer_t	2.6491	0.1341	19.762	0.0000
Δmpi_t	14.741	0.3455	42.661	0.0000
Δy_t	0.7925	5.4669	0.1450	0.8850
Slopes				
Slope (γ)	210.97	50.879	4.1465	0.0001
Thresholds				
Threshold (c)	0.1296	0.0034	37.547	0.0000
R^2 = 0.9051	SSR = 0.0140	AIC = -5.9181		
LM-$\chi^2(1)$ = 0.15[0.70]	LM-F (1, 96) = 0.14[0.71]			
LM $_{ARCH}$(1) = 0.16[0.69]	LM $_{ARCH}$(2) = 0.17[0.84]			
JB = 0.27[0.21]				

R^2 denotes the coefficient of determination, SSR is the sum of squared residuals, and AIC is the Akaike Information Criterion. LM-$\chi^2(1)$ and LM-F(1) are the first order chi-square and F-statistics Breusch-Godfrey Serial Correlation LM Test respectively. LM $_{ARCH}$(1) and LM $_{ARCH}$(2) are the first and second order F-statistics autoregressive conditional heteroscedasticity test respectively. JB is Jarque-Bera Normality test. Probability values are reported in the square brackets.

The diagnostic test result also presented in Table 7.5, above show no error autocorrelation in the disturbance as the probability value of the chi-square and F-statistics Breusch-Godfrey serial orrelation LM test are both not significant at 5% level. There is also no ARCH effect as the first and second order F-statistics of autoregressive conditional heteroscedasticity test have probability values statistically not significant at 5% level. The Jarque-Bera test of normality also indicates normality. The result of further nonlinear STAR test of parameter constancy and no remaining nonlinearity show rejection of the null hypotheses of no constant parameter and addictive nonlinearity (see the test result in Appendix B.7.5.3 and B7.5.4).

The result of the nonlinear ERPT model estimate in Table 7.5 shows a probability value significant at 5% level for the threshold variable ($\boldsymbol{c}$) with 0.13 coefficient. This implies that inflation rate level of 13 CPI point is estimated as the threshold level of inflation at which the regime switching takes place. When inflation increases above the threshold of 13 CPI inflation points, the exchange rate transmission becomes higher (see Figure 7.1). The probability value of the speed of transition variable (**γ**) was also statistically significant at 5% level, and the coefficient is relatively moderate (210.97)[6] which is an indication of the smooth transition between the inflation regimes (see Figure 7.1).

Just as in the linear AR model the linear part of the STAR estimation presented in Table 7.5 show no significant variable except the past CPI-inflation (Δcpi_{t-1}). But the nonlinear part of the STAR estimation which captures the nonlinearity which shows that all variables having probability values which are statistically significant at 5% level except for output growth. The coefficient of the exchange rate variable which represents the nonlinear ERPT in the short run is highly significant. This implies that there is significant ERPT even in the short run in Nigeria during the sample period with the application of the nonlinear model.

There was high consumer price inflation during the sample period especially in the late 1980s and 1990s in Nigeria (See Section 2.2, Chapter two). The high consumer

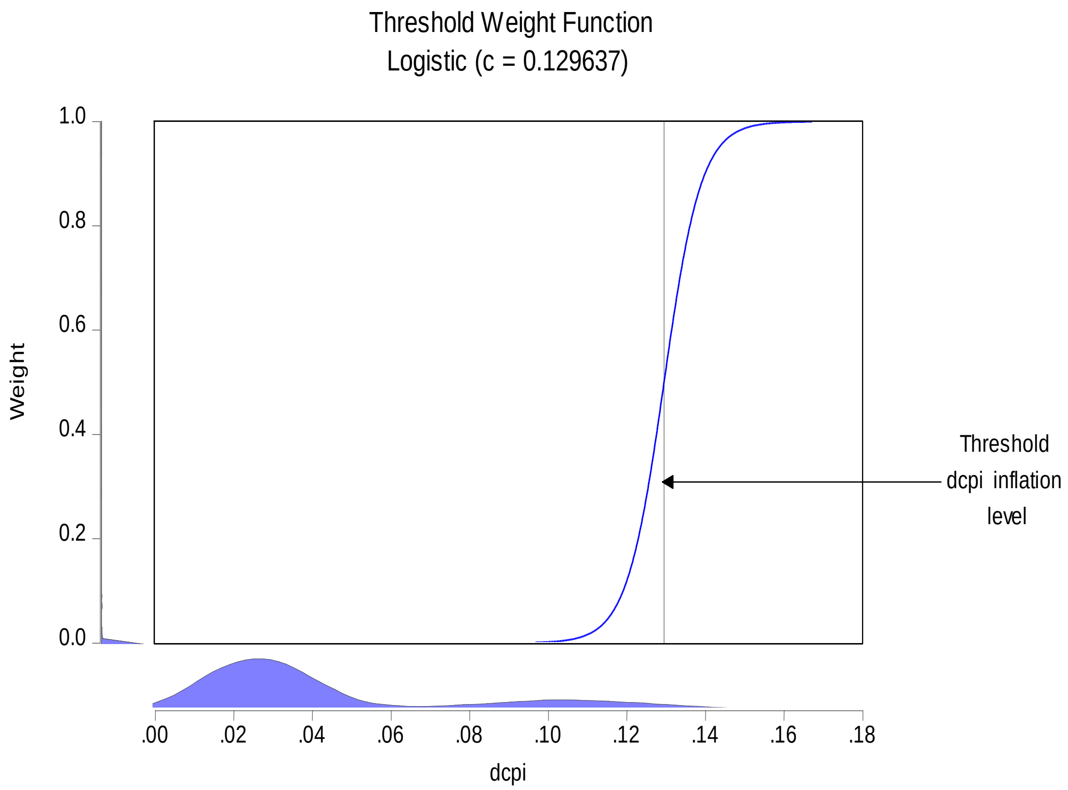
[6] The bigger the coefficient is getting, the steeper the transition from one regime to the other becomes.

prices inflation which exceeds the threshold led to the exchange rate being transmitted to the consumer prices nonlinearly. The linear models (both the VECM and the AR model) could not capture the nonlinearity aspect of the ERPT process considering that the models assume linearity, while in reality there is nonlinearity in the ERPT process as depicted in this STAR model estimation result.

The comparison of the statistical test result of the coefficient of determination (R^2), the sum of squared residuals (SSR) and Akaike Information Criterion (AIC) indicates that the nonlinear STAR model performs better than the linear AR model. The STAR model shows $R^2 = 0.9051$, SSR = 0.0140 and AIC = -5.9181 compared to that of the Linear AR model $R^2 = 0.75$, SSR = 0.037 and AIC = -5.046.

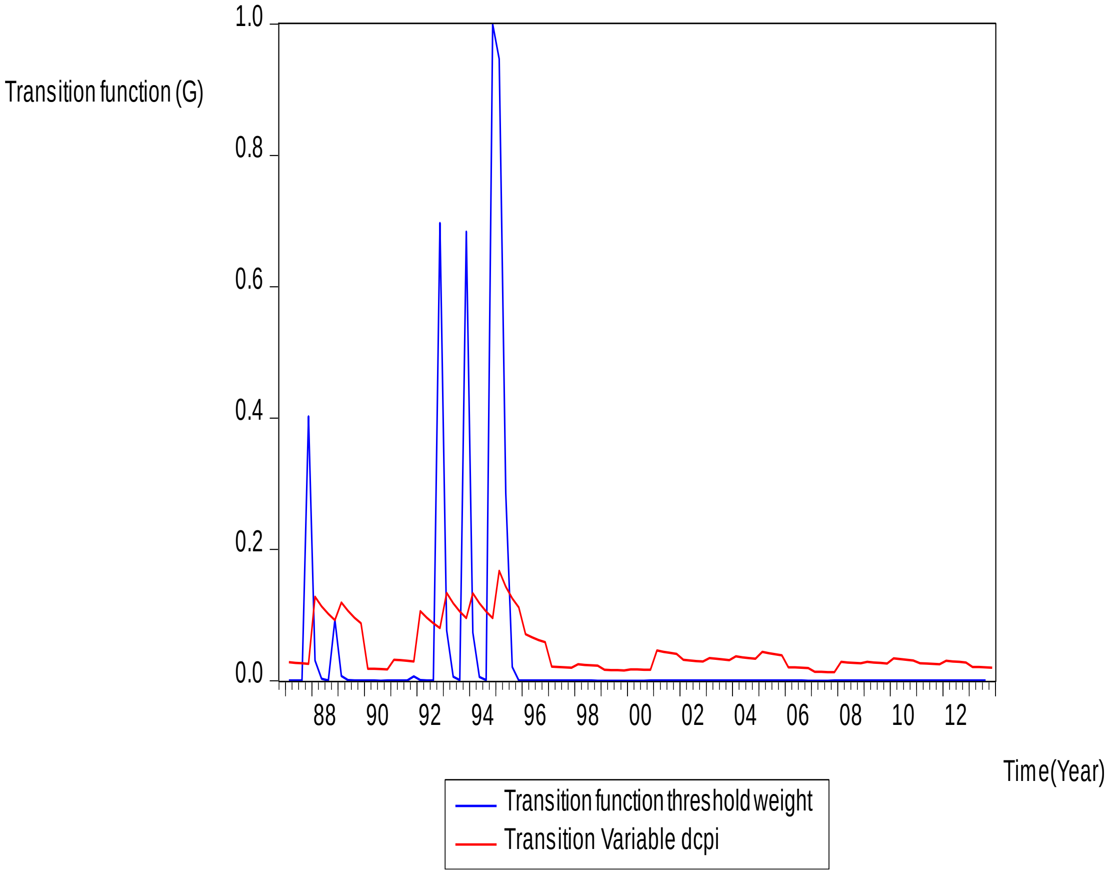
Generally, the results are consistent with Taylor's (2000) hypothesis that response of prices to changes in exchange rate depends positively on the inflation environment. This result could be due to the importing firms' willingness to set prices in the currency of importing country with stable inflation environment. Hence the exchange rate pass-through will be lower with low inflation. However, when the firms perceive higher inflation, they switch from pricing with importing country currency to producer country pricing which would have higher ERPT. Considering that Nigeria's adoption of trade policies that encourage international trade since 1986, which removed trade restrictions in the economy (see Section 2.5, Chapter two), the foreign firms in the country exhibit such behaviour of switching pricing policy. The result here is in-line with the findings of previous studies by Nogueira, Jr. and León-Ledesma, (2011), Shintani, Terada and Yabu (2013) and Cheikh (2012) who also confirmed the existence of the nonlinear ERPT in their respective studies.

Figure 7.1: Estimated transition function as a function of past CPI inflation rates in Nigeria



The plot of the estimated transition function and the transition variable (CPI inflation) over the sample period shows clearly the inflation regime dependence of the exchange rate pass-through. However, it can be observed that the density of the consumer price inflation is higher below the threshold level where the nonlinearity is not prevalent. It can be observed clearer from the Figure 7.2, below that the nonlinear ERPT was greater during higher inflation times of the late 1980s and the 1990s as described in (Section 2.2, Chapter 2). The inflation rate exceeded the threshold during those periods, which leads to higher ERPT to the consumer price nonlinearly.

Figure 7.2: Plot of transition function and transition variable - CPI inflation (Δcpi_{t-i})



7.5.3.2. Exchange Rate Change (Δe_{t-i}) as Transition Variable

Here the change in exchange rate ($\boldsymbol{\Delta e_{t-i}}$) is used as transition variable. When consumer price responds disproportionately to appreciation and depreciation episodes of exchange rate changes an asymmetric ERPT occurs. The logistic Smooth transition autoregressive regression (LSTR) specification is appropriate in modelling the situation in which the pass-through differs whether the transition variable is below or above a certain threshold (Nogueira Jr. and Leon-Ledesma, 2011). Hence, the study uses the LSTR model to analyse the ERPT asymmetry during currency appreciations and depreciations episodes, particularly where the threshold level of ($\boldsymbol{\Delta e_{t-i}}$) is near zero.

The other situation to be examined is the nonlinearity due to the size of exchange rate change. Due to some factors like menu cost the importing firms tend to absorb small changes in exchange rate and only change prices and pass-through the changes when the change in exchange rate exceeds a given threshold. This type of decision by the importing firms leads to nonlinear pass-through of exchange rate changes. The ESTR specification is more relevant in modelling the ERPT nonlinearity due to size than the LSTR (Nogueira Jr. and Leon-Ledesma, 2011). The linearity tests as reported in Table 7.4 shows the evidence of nonlinearity with the exchange rate in Nigeria. As the linearity has been rejected, the study uses the sequence of null hypotheses for selecting the relevant transition function either LSTR or ESTR model. Following Van Dijk, Teräsvirta, and Franses (2002), Nogueira Jr. and Leon-Ledesma (2011) and Cheikh (2012) the study examined the impact of the direction as well as the size of the exchange rate changes in causing asymmetry and nonlinearity by applying LSTR and ESTR specification respectively. The choice is based on the fact that this study aims to analyse the nonlinearities and asymmetry in ERPT due to direction and size of the change in exchange rate.

Logistic STAR model

Here the study considers the change in exchange rate ($\boldsymbol{\Delta e_{t-i}}$) as the factor causing asymmetric ERPT and therefore the transition variable. Table 7.6 below presents the estimation result of the nonlinear STAR model.

Table 7.6: Estimation result of LSTR model with changes in exchange rate ($\boldsymbol{\Delta e_t}$) as transition variable

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Threshold Variables (linear part)				
Δcpi_t	0.9134	0.0580	15.7460	0.0000
Δe_t	-0.0005	0.0261	-0.0205	0.9837
Δmpi_t	0.1798	0.2378	0.7562	0.4514
Δy_t	-0.0214	0.1823	-0.1171	0.9070
Threshold Variables (nonlinear part)				
Δcpi_t	-0.0624	0.0846	-0.7375	0.4626
Δe_t	0.1412	0.0597	2.3627	0.0202
Δmpi_t	-0.1081	0.3161	-0.3420	0.7331
Δy_t	0.1411	0.2870	0.4917	0.6240
Slopes				
Slope (γ)	8663.496	70386.12	0.1230	0.9023
Thresholds				
Threshold (c)	0.0172	0.0013	13.141	0.0000
R^2 = 0.76	SSR = 0.036	AIC = -4.963		
LM-χ^2(1) = 1.16[0.28]	LM-F (1, 94) = 0.14[0.30]			
LM $_{ARCH}$(1) = 0.17[0.68]	LM $_{ARCH}$(2) = 0.32[0.72]			
JB = 64[0.12]				

R^2 denotes the coefficient of determination, SSR is the sum of squared residuals, AIC is the Akaike Information Criterion, LM-χ^2(1) and LM-F(1) are first order chi-square and F-statistics Breusch-Godfrey serial correlation LM test respectively. LM $_{ARCH}$(1) and LM $_{ARCH}$(2) are the first and second order F-statistics autoregressive conditional heteroscedasticity test respectively. JB is Jarque-Bera Normality test. Probability values are reported in the square brackets.

The diagnostic test results in Table 7.6 show no error autocorrelation is present in the disturbance as the probability value of the chi-square and F-statistics Breusch-Godfrey Serial Correlation LM Test are both not significant at 5% level. There is also no ARCH effect as the first and second order F-statistics of autoregressive conditional heteroscedasticity test have probability values that are statistically not significant at 5% level. The Jarque-Bera test of normality still shows normality. The test of parameter constancy and no remaining nonlinearity show rejection of the null hypotheses of no constant parameter and addictive nonlinearity (see the test result in Appendix B.7.6.3).

The result of the nonlinear ERPT model estimation in Table 7.6 shows that probability value for the threshold variable ($\boldsymbol{c}$) is statistically significant at 5% level with 0.017 coefficients. This implies that change in the exchange rate of 0.017 is the estimated threshold level of exchange rate change. When exchange rate changes above the threshold of 0.017, exchange rate transmission becomes higher (see Figure 7.3). The probability value of the speed of transition variable ($\boldsymbol{\gamma}$) appears insignificant. Because the estimate of γ could be quite imprecise and often turn out to be insignificant when evaluated by its t-statistic. This would, still, not be interpreted as indication for weak nonlinearity, given that the t-statistic does not have its usual asymptotic t-distribution under the hypothesis that γ = 0, due to some identification problems (See discussion in Section 5.3.1, Chapter five). The coefficient of the γ is high (8663) which is an evidence of the more abrupt transition between the exchange rate regimes as the transition from one regime to the other becomes steeper as the coefficient gets bigger (see Figure 7.3 below).

The linear part of the LSTR estimation presented in Table 7.6 show no significant variable except the past CPI-inflation (Δcpi_{t-1}). However, the, nonlinear part of the estimation which captures the nonlinearity shows a probability values which is statistically significant at 5% level for the exchange rate ($\boldsymbol{\Delta e_t}$). This implies that there is a significant asymmetric response of consumer price inflation to the changes in exchange rate in Nigeria during the sample period. The coefficient of the exchange rate ($\boldsymbol{\Delta e_t}$) variable shows the asymmetric ERPT in the short run. The movement in the exchange rate which are often depreciation than appreciation during the sample period (See Section 2.2, Chapter two) in Nigeria create asymmetric ERPT. Considering that the importing firms will act reluctantly especially during appreciation as compared to depreciation of the exchange rate.

It can also be observed from the depiction in Figure 7.4 below, that as the exchange rate depreciates above a given threshold level (0.017), the ERPT becomes higher. Hence this implies that there is greater ERPT with a higher rate of depreciation of the Naira, and lower pass-through with small exchange rate depreciation and in appreciation episodes. This result is in line with the capacity constraints hypothesis (reviewed in Section 4.2.1, Chapter four). As the quantity supplied by the importing firms is restricted due to their ability in the short run, they cannot increase sales as importing country's currency exchange rate appreciates. Hence, they would allow the prices to increase by transmitting the exchange rate changes to the prices.

It can be observed that the nonlinear LSTR models provide a better fit to the data than the linear AR model considering the R-square and SSR. The LSTR model shows R^2 = 0.76, which is slightly higher than R^2 = 0.75 of the linear AR model. The LSTR model's SSR and AIC are 0.036 and -4.963 respectively compared to that of the Linear AR model SSR = 0.037 and AIC = -5.046.

Figure 7.3: Estimated transition function (LSTR) as a function of exchange rate change

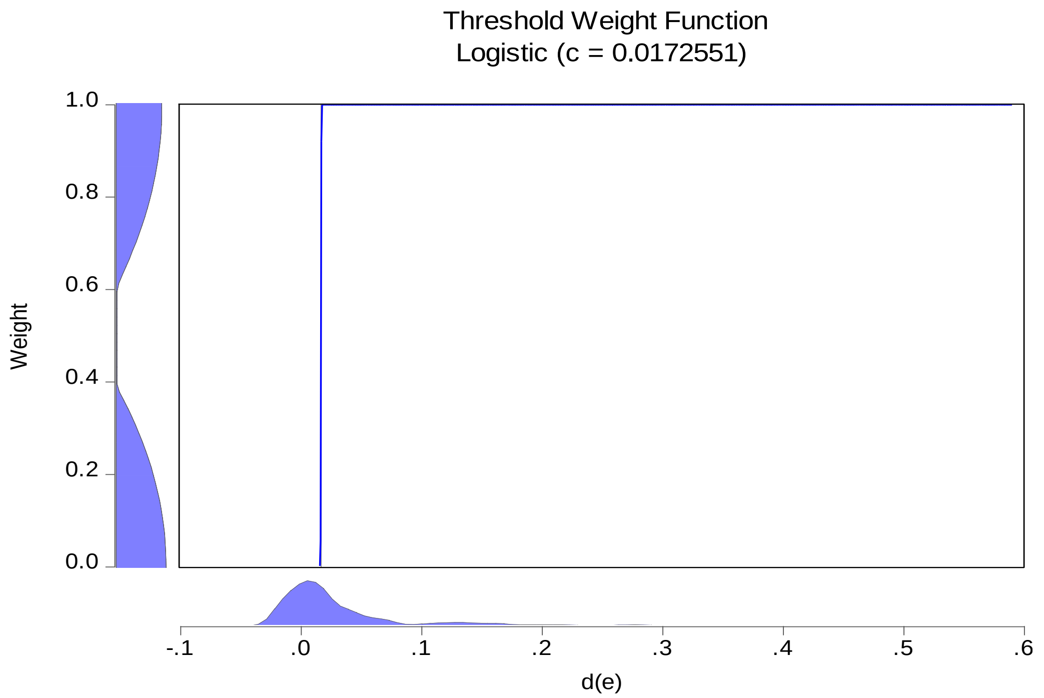
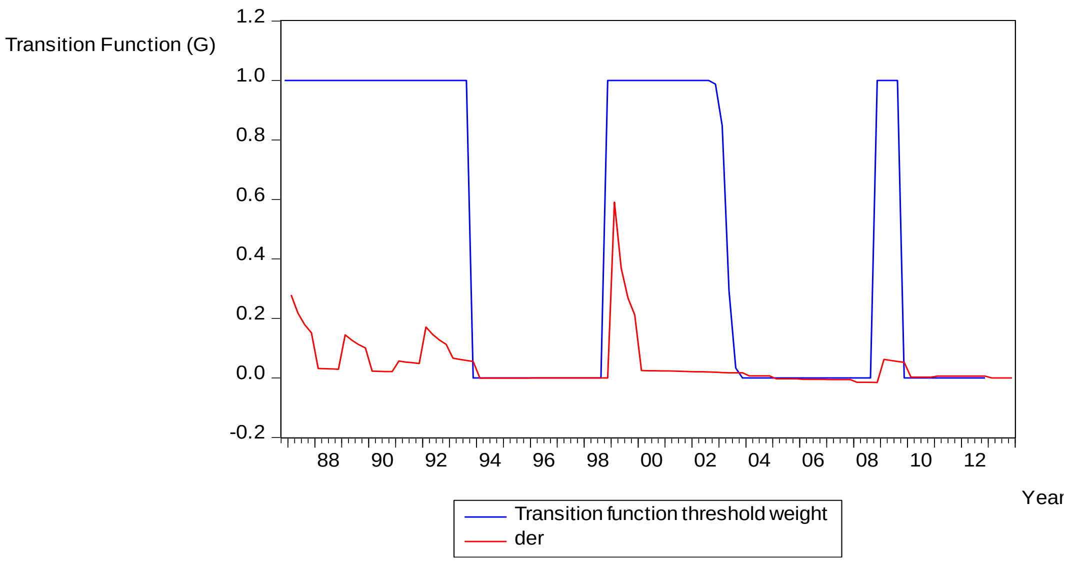


Figure 7.4: Plot of transition function (LSTR) and transition variable - exchange rate change (Δe_t)



Exponential STAR Model

To examine the nonlinearity due to the size of the change in exchange rate, we used ESTR model which is the relevant STAR model. Terasvirta, (2004) suggest that ESTR models are suitable when the local dynamic behavior of the process is similar when the transition variable is at its small and large values and different when the transition variable is at its middle values. This feature of ESTR models enables it to capture potential nonlinearities in ERPT due to "menu costs", where firms only increase prices when exchange rate changes are large than a certain threshold. Therefore, the study used the ESTR model to examine the ERPT nonlinearity due to the size of the exchange change. Table 7.7 below presents the estimation result.

Table 7.7: Estimation result of ESTR model with changes in exchange rate (Δe_t) as transition variable

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Threshold Variables (linear part)				
Δcpi_t	0.4494	0.1561	2.8780	0.0049
Δe_t	1.0334	0.2633	3.9242	0.0002
Δmpi_t	2.4670	0.7902	3.1219	0.0024
Δy_t	-1.0898	0.5052	-2.1568	0.0335
Threshold Variables (nonlinear part)				
Δcpi_t	0.5133	0.1674	3.0660	0.0028
Δe_t	-1.0931	0.2529	-4.3216	0.0000
Δmpi_t	-2.6281	0.8388	-3.1329	0.0023
Δy_t	1.2837	0.5707	2.2494	0.0268
Slopes				
Slope (γ)	124.4961	42.61864	2.921165	0.0044
Thresholds				
Threshold (c)	0.149599	0.009420	15.88108	0.0000
R^2 = 0.79	SSR = 0.031	AIC = -5.104		
LM-χ^2(1) = 0.00[0.99]	LM-F (1, 94) = 0.00[0.99]			
LM $_{ARCH}$(1) = 0.026[0.87]	LM $_{ARCH}$(2) = 0.16[0.85]			
JB = 48[0.32]				

R^2 denotes the coefficient of determination, SSR is the sum of squared residuals, AIC is the Akaike Information Criterion, LM-χ^2(1) and LM-F(1) are first order chi-square and F-statistics Breusch-Godfrey serial correlation LM test respectively. LM $_{ARCH}$(1) and LM $_{ARCH}$(2) are the first and second order F-statistics autoregressive conditional heteroscedasticity test respectively. JB is Jarque-Bera Normality test. Probability values are reported in the square brackets.

Here also the diagnostic test result shows no error autocorrelation in the disturbance as both the probability value of the chi-square and F-statistics Breusch-Godfrey Serial Correlation LM Test are not significant at 5% level. There is also no ARCH effect as both the first and second order F-statistics of autoregressive conditional heteroscedasticity test have probability values statistically not significant at 5% level. The Jarque-Bera test of normality indicates normality. The test of parameter constancy and no remaining nonlinearity also show rejection of the null hypotheses of no constant parameter and addictive nonlinearity (see the test result in Appendix B.7.7.3).

The estimation result in Table 7.7 shows that probability value for the threshold ($\boldsymbol{c}$) variable is statistically significant at 5% level with 0.149 coefficients. The speed of transition variable ($\boldsymbol{\gamma}$) also show a statistically significant probability value at 5% level, and the coefficient (124) which is moderate and an evidence of the smooth transition between the exchange rate regimes (see Figure 7.5).

The linear part of the ESTR estimation results in Table 7.7 shows that all variables are significant at 5% level of significance. Likewise, the nonlinear part of the estimation which captures the nonlinearity shows probability values which are statistically significant at 5% level for all the variables. Our variable of interest, the exchange rate ($\boldsymbol{\Delta e_t}$) which represent the ERPT is significant in both the linear and not linear part. However, the sign of the coefficient is positive in the linear part, whereas in the nonlinear part it is negative. The sum of the linear and nonlinear part coefficients of the exchange rate is -0.0597 which is approximately zero. This implies that nonlinear ERPT to the consumer price due to the size of exchange rate change in Nigeria in the short run was near zero in the sample period. The changes in exchange rate in Nigeria during the sample period are predominantly below the threshold level (see Figure 7.5). Hence the pass-through was approximately zero, which does create a significant nonlinearity in the ERPT over the sample period.

Figures 7.6, depicts the nonlinearities due to the size of exchange rate change. The graph shows the size of exchange rate changes lead to approximately zero ERPT given that the density of the exchange rate changes are below the threshold. This result is consistent with the menu costs hypothesis. When the importing firms perceive that changing price changes would cost them more, they would be ready to absorb the small exchange rate in their mark-up. But, when the change in exchange rate exceeds a given threshold, the firms would be compelled to change their prices. Therefore, the changes in exchange rate during the sample period (see Figure 7.5) which are mostly below the threshold level lead to nonlinear ERPT in Nigeria during the sample period. Hence it is pertinent to recognise that if the exchange rate changes are smaller (below the threshold) the effect on consumer prices will be minimal or even zero.

The nonlinear LSTR models offer a better fit to the data than the linear AR models considering the R-square, SSR and AIC. The LSTR model shows R^2 = 0.76, SSR =0.031 and AIC = -5.104 while the linear AR model has R^2 = 0.75, SSR = 0.037 and AIC = -5.046.

Figure 7.5: Estimated transition function (ESTR) as a function of exchange rate change

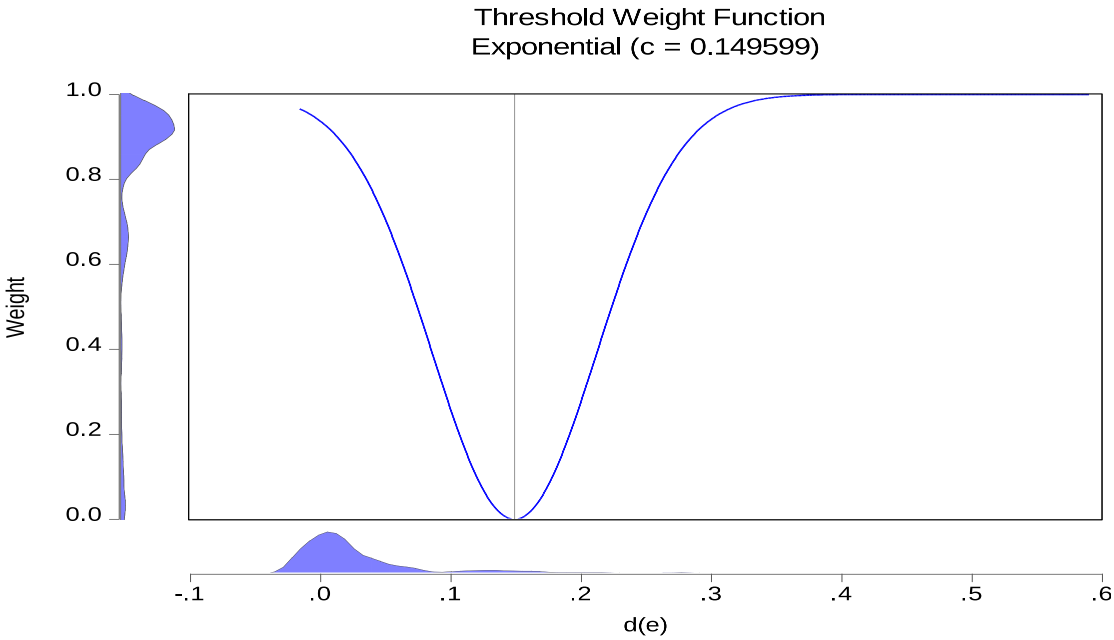
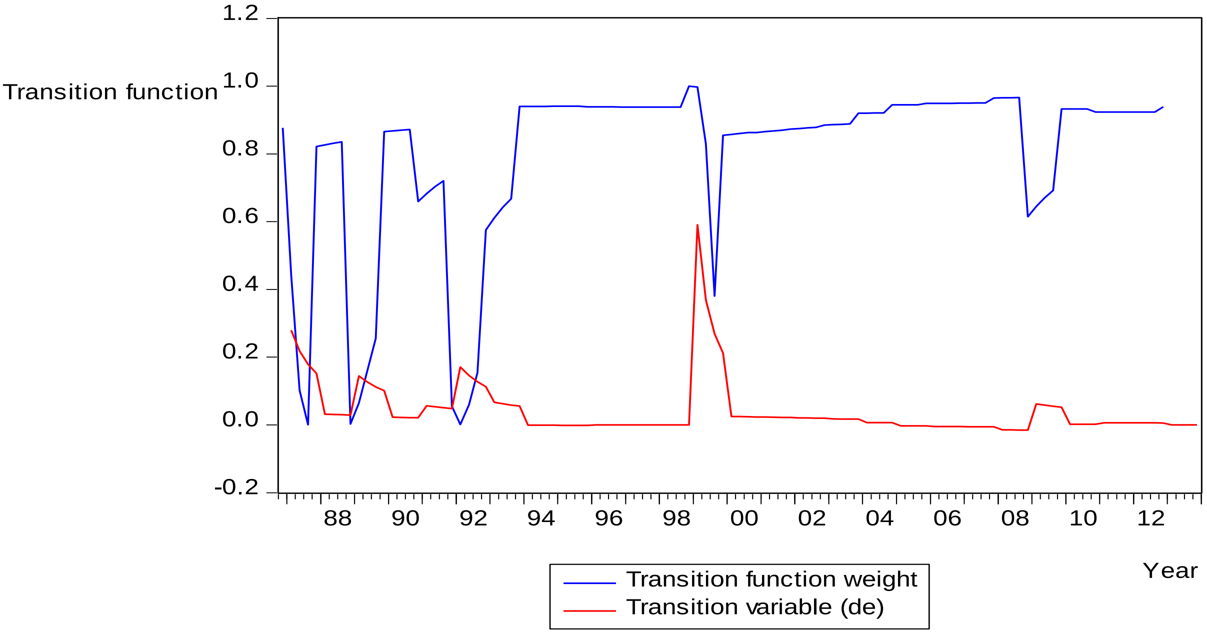


Figure 7.6: Plot of transition function (ESTR) and transition variable - exchange rate change (Δe_t)



7.5.3.3. Output gap as a Transition variable

According to Goldfajn and Werlang (2000) output gap also influences the level of ERPT. They argue that it would be easier for firms to pass-through exchange rate change during the economic boom than during the recession. Building on Goldfajn and Werlang's (2000) position, Garcia and Restrepo (2001) concluded that the low ERPT in Chile in the 1990s was due to adverse output gap which counterbalances the inflationary implication of exchange rate depreciation.

This study, therefore, used the ERPT again taking changes in output level as our transition variable to determine if changes in output level cause nonlinearity in the ERPT. The linearity tests against STAR nonlinearity carried out fail to reject the null of linearity for the sample period (See Appendix B.7.8.1). The result hence implies that the output gap changes do not lead to nonlinear ERPT in Nigeria for the sample period used.

7.6 Conclusion and Policy Recommendations

The study in this chapter analyzed the role of asymmetries and nonlinearities in exchange rate pass-through (ERPT) into consumer inflation in Nigeria during the period 1986 to 2013. We examined the potential ERPT nonlinearities and asymmetries as a consequence of inflationary environment in the economy, the size and direction of exchange rate change and output growth (changes in output level). The study presents a model on the basis of importing firm's price markup. Based on the model, we specified the empirical nonlinear ERPT model with smooth transition autoregression application.

The study confirms nonlinear ERPT due to different inflation level in the economy. The nonlinearity is more prevalent during the high inflation periods of the 1990s when inflation rate exceeds a given threshold than other periods of low inflation. This study, therefore, confirms Taylor's (2000) hypothesis that pass-through declines in low and stable inflation environment which create nonlinear ERPT. The policy implication of this part of the result is that during a low and stable inflation level in the economy, nonlinearity in ERPT is not prevalent. Therefore, if the inflation level could be maintained below the threshold, the impact of exchange rate changes on consumer prices will be reduced. The monetary authorities in Nigeria made tremendous effort to keep the inflation rate at a low level since 1999 which reduced the effect of the exchange rate change on the consumer prices. Hence it is pertinent to determine the threshold level and prevent the inflation rate from exceeding it as it reduces the impact on the consumer prices.

The study also examined the impact of direction and size of exchange rate changes in creating asymmetric and nonlinear ERPT. The result shows asymmetric ERPT to appreciations and depreciations of the exchange rate. The result also shows nonlinearity with respect to the size of the exchange rate change. There is greater ERPT with a higher rate of depreciation of the Naira, and lower ERPT with small exchange rate depreciation and in appreciation episodes. This result is in line with the quantity constraint theory (reviewed in Section 4.2.1, Chapter four). Due to the capacity of the importing firms in the importing countries, their response in transferring the change in the exchange rate to the consumer price is higher during currency depreciation. On the nonlinearity, due to the size of the exchange rate changes, the result shows that with exchange rate change higher than the threshold level the proportion of the ERPT is higher than when the exchange rate change is below the threshold level in Nigeria. This result is in line with the menu cost hypothesis where the importing firm does not transfer the exchange rate changes due to the cost of changing their menu. Therefore, the effect of the exchange rate changes on consumer price is minimal when the exchange rate changes are below the threshold level. Any policy in the country that will maintain the exchange movement below the threshold level would reduce the impact of the exchange rate changes on the domestic consumer prices.

The study also examined the output growth as a source of nonlinearities. However, the result does not show evidence of nonlinear ERPT due to the output level. Hence, depreciation or devaluation of Naira in different growth periods does not create nonlinear ERPT.

The statistical test results used to compare the performance of the linear AR and the nonlinear STAR model indicates that the nonlinear STAR model fits the data better than the linear AR model in all cases. The policy implication of this result is that the study shows ERPT even in the short-run with the nonlinear model which also confirms non-linearity and asymmetry in the ERPT. The linear model with linearity assumptions could not capture the nonlinearity and asymmetries in the ERPT. Using models that account for nonlinearities and asymmetries will help in telling us more about the ERPT in the short-run as observed from the results of this study. With this result, we conclude that there is significant ERPT even in the short-run though incomplete and full pass-through in the long-run. The implication of the on monetary policy transmission is that the effect of monetary policy shock will be slow given that the ERPT is not complete in the short-run. Therefore, the role of floating exchange rate regime of international price adjustment is not effective.

Hence the authorities need to complement the monetary policy measures of controlling the exchange rate and price stability with other non-monetary measures. Another imperative result of the study is that the exchange rate changes and the inflation level during which the Naira depreciation or devaluation takes place cause nonlinearearies and therefore, have a different effect on the consumer prices.

Appendix: B.7

B.7.1 Data Description and Sources

Data Description

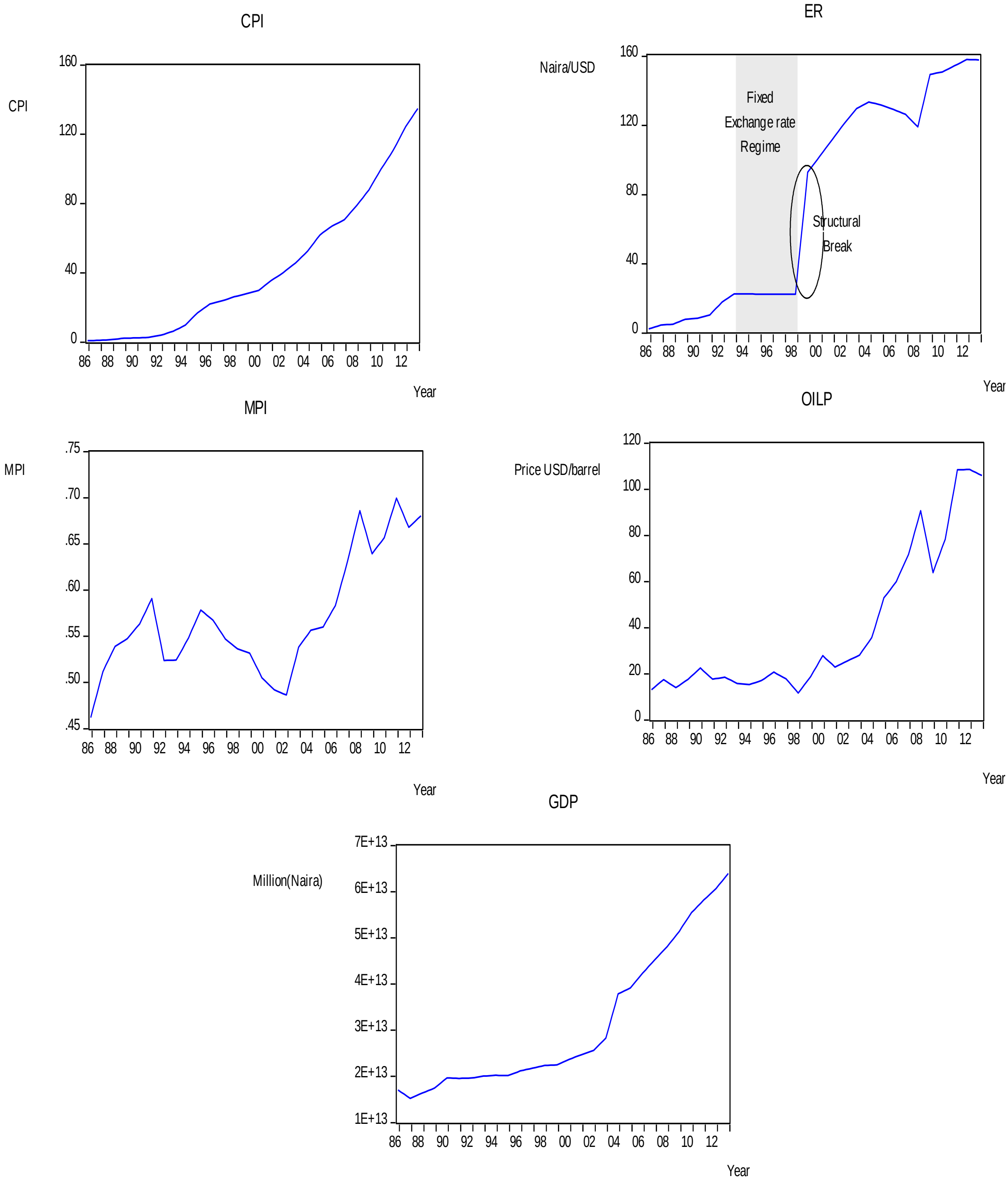
The study makes use of quarterly series for the period 1986Q4 to 2013Q4 for all variables. cpi is consumer price index with 2010 as the base year. er is nominal exchange rate which is a bilateral Naira per US Dollar exchange rate (three-month average). mpi is import price. y is a real gross domestic product (GDP).

Data Sources

Data were obtained from World Bank's World development indicators database and Penn World Table. The nominal exchange rate (e), consumer price index (cpi), Nigerian Real GDP(y), were generated from World Bank's World development indicator database. Import price (mpi) was derived from Penn World Table 8.1.

B.7.2 Figures

B1: Graphical representation of the variables in levels



B.7.4: Baseline Linear AR Model

B.7.4.1: Baseline Linear AR Model Estimation result

Variable	Coefficient	Std. Error	t-Statistic	p-values
Δcpi_t	0.8602	0.0501	17.1576	0.0000
Δe_t	0.0055	0.0237	0.2335	0.8159
Δmpi_t	-0.0039	0.1434	-0.0272	0.9784
Δy_t	-0.0992	0.1262	-0.7861	0.4336
c	0.0075	0.0039	1.9417	0.0549
R^2 = 0.75	SSR = 0.037	AIC = -5.046		
LM-$\chi^2(1)$ = 0.34[0.55]	LM-F (1, 101) = 0.33[0.57]			
LM $_{ARCH}$(1) = 0.37[0.54]	LM $_{ARCH}$(2) = 0.41[0.66]			
JB = 838[0.00]				

B.7.4. 2: Linearity test

Transition variable	H0	H4	H3	H3	Suggested Model
$\Delta \boldsymbol{cpi_t}$	0.0000	0.0000	0.55111	0.0000	LSTR
$\boldsymbol{\Delta e_t}$	0.0018	0.0453	0.2126	0.0029	LSTR
$\Delta \boldsymbol{mpi_t}$	0.0001	0.0056	0.1367	0.0018	LSTR
$\boldsymbol{\Delta y_t}$	0.9482	-	-	-	Linear

The F column shows the results of the test of linearity against the alternative of STAR nonlinearity. The F4, F3 and F2 columns are the p-values of the sequential test for choosing the appropriate transition function. The decision rule is as follows: if the test of H03 provides the strongest rejection of the null hypothesis, we choose the exponential STAR (ESTR) model. Otherwise, we select the logistic STAR (LSTR) model. The last column reports the selected model.

B.7.5 STAR model with CPI inflation as transition variable

B.7.5.2 STAR Model Estimation result

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Threshold Variables (linear part)				
Δcpi_t	0.859700	0.025931	33.15352	0.0000
Δe_t	0.024437	0.020981	1.164750	0.2470
Δmpi_t	-0.095310	0.127987	-0.744688	0.4583
Δy_t	0.077103	0.040278	1.914248	0.0585
Threshold Variables (nonlinear part)				
Δcpi_t	-1.139522	0.065960	-17.27584	0.0000
Δe_t	2.649139	0.133348	19.86632	0.0000
Δmpi_t	14.74090	0.438948	33.58236	0.0000
Δy_t	0.792506	5.469954	0.144884	0.8851
Slopes				
SLOPE	210.9733	51.49209	4.097199	0.0001
Thresholds				
THRESHOLD	0.129637	0.003496	37.08122	0.0000
R-squared	0.905139	Mean dependent var		0.046807
Adjusted R-squared	0.896338	S.D. dependent var		0.037288
S.E. of regression	0.012005	Akaike info criterion		-5.918126
Sum squared resid	0.013981	Schwarz criterion		-5.668329
Log likelihood	326.6197	Hannan-Quinn criteria.		-5.816861
Durbin-Watson stat	1.926480			

B.7.5.3: Diagnostic Analysis of STAR Estimation

Smooth Threshold Linearity Tests

Sample: 1986Q4 2013Q4			
Included observations: 107			
Test for nonlinearity using DLCPI as the threshold variable			
Taylor series alternatives: b0 + b1*s [+ b2*s^2 + b3*s^3 + b4*s^4]			
Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: b1=b2=b3=b4=0	20.76207	(16, 87)	0.0000
H03: b1=b2=b3=0	16.51295	(12, 91)	0.0000
H02: b1=b2=0	11.55762	(8, 95)	0.0000
H01: b1=0	11.72434	(4, 99)	0.0000
The H0i test uses the i-th order Taylor expansion (bj=0 for all j>i).			
Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: b3=0	13.88397	(4, 91)	0.0000
H2: b2=0 | b3=0	8.050843	(4, 95)	0.0000
H1: b1=0 | b2=b3=0	11.72434	(4, 99)	0.0000
All tests are based on the third-order Taylor expansion (b4=0).			
The Linear model is rejected at the 5 percent level using H03.			
Recommended model: first-order logistic.			
. Pr(H3) <= Pr(H2) or Pr(H1) <= Pr(H2)			
Escribano-Jorda Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H0L: b2=b4=0	13.80516	(8, 87)	0.0000
H0E: b1=b3=0	11.32768	(8, 87)	0.0000
All tests are based on the fourth-order Taylor expansion.			
The Linear model is rejected at the 5 percent level using H04.			
Recommended model: exponential with a nonzero threshold.			
. Pr(H0L) < Pr(H0E) with Pr(H0E) < .05			

Smooth Threshold Remaining Nonlinearity Tests

Additive nonlinearity tests using DLCPI as the threshold variable			
Taylor series alternatives: b0 + b1*s [+ b2*s^2 + b3*s^3 + b4*s^4]			
Additive Nonlinearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: b1=b2=b3=b4=0	5.731647	(16, 81)	0.0000
H03: b1=b2=b3=0	6.521091	(12, 85)	0.0000
H02: b1=b2=0	5.083368	(8, 89)	0.0000
H01: b1=0	7.578786	(4, 93)	0.0000
The H0i test uses the i-th order Taylor expansion (bj=0 for all j>i).			
Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: b3=0	6.763164	(4, 85)	0.0001
H2: b2=0 | b3=0	2.197576	(4, 89)	0.0756
H1: b1=0 | b2=b3=0	7.578786	(4, 93)	0.0000
All tests are based on the third-order Taylor expansion (b4=0).			
The original model is rejected at the 5 percent level using H03.			
Recommended model: first-order logistic.			
. Pr(H3) <= Pr(H2) or Pr(H1) <= Pr(H2)			

Smooth Threshold Parameter Constancy Test

Encapsulated nonlinearity test using trend as the threshold variable			
Taylor series alternatives: b0 + b1*s [+ b2*s^2 + b3*s^3 + b4*s^4]			
Parameter Constancy Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: b1=b2=b3=b4=0	4.789292	(26, 71)	0.0000
H03: b1=b2=b3=0	4.339346	(23, 74)	0.0000
H02: b1=b2=0	4.834007	(16, 81)	0.0000
H01: b1=0	5.807807	(8, 89)	0.0000
The H0i test uses the i-th order Taylor expansion (bj=0 for all j>i).			

B.7.6 LSTR model with change in exchange rate as transition variable

B7.6.2: Estimation result of LSTR model with changes in exchange rate (Δe_t) as transition variable

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Threshold Variables (linear part)				
Δcpi_t	0.913433	0.058010	15.74604	0.0000
Δe_t	-0.000535	0.026076	-0.020522	0.9837
Δmpi_t	0.179822	0.237796	0.756201	0.4514
Δy_t	-0.021354	0.182330	-0.117115	0.9070
Threshold Variables (nonlinear part)				
Δcpi_t	-0.062420	0.084635	-0.737516	0.4626
Δe_t	0.141209	0.059764	2.362777	0.0202
Δmpi_t	-0.108138	0.316150	-0.342046	0.7331
Δy_t	0.141174	0.287071	0.491774	0.6240
Slopes				
SLOPE	8663.496	70386.12	0.123085	0.9023
Thresholds				
THRESHOLD	0.017255	0.001313	13.14126	0.0000
$R^2 = 0.76$	SSR = 0.036	AIC = -4.963		
LM-$\chi^2(1)$ = 1.16[0.28]	LM-F (1, 94) = 0.14[0.30]			
LM $_{ARCH}(1)$ = 0.17[0.68]	LM $_{ARCH}(2)$ = 0.32[0.72]			
JB = 640[0.00]				

B.7.6.3: Diagnostic Analysis of STAR Estimation

Smooth Threshold Linearity Tests

Null Hypothesis	F-statistic	d.f.	p-value
H04: b1=b2=b3=b4=0	4.259450	(16, 85)	0.0000
H03: b1=b2=b3=0	5.199410	(12, 89)	0.0000
H02: b1=b2=0	4.713613	(8, 93)	0.0001
H01: b1=0	0.527029	(4, 97)	0.7161
The H0i test uses the i-th order Taylor expansion (bj=0 for all j>i).			
Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: b3=0	4.679194	(4, 89)	0.0018
H2: b2=0 | b3=0	8.732153	(4, 93)	0.0000
H1: b1=0 | b2=b3=0	0.527029	(4, 97)	0.7161
All tests are based on the third-order Taylor expansion (b4=0).			
The Linear model is rejected at the 5 percent level using H03.			
Recommended model: exponential.			
Pr(H2) < Pr(H3) and Pr(H2) < Pr(H1))			
Escribano-Jorda Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H0L: b2=b4=0	1.906031	(8, 85)	0.0694
H0E: b1=b3=0	1.787588	(8, 85)	0.0907
All tests are based on the fourth-order Taylor expansion.			
The Linear model is rejected at the 5 percent level using H04.			
Recommended model: exponential with a nonzero threshold.			
. Pr(H0L) < Pr(H0E) with Pr(H0L) >= .05			

Smooth Threshold Remaining Nonlinearity Tests

Additive nonlinearity tests using DLER(-3) as the threshold variable			
Taylor series alternatives: b0 + b1*s [+ b2*s^2 + b3*s^3 + b4*s^4]			
Additive Nonlinearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: b1=b2=b3=b4=0	3.918390	(16, 80)	0.0000
H03: b1=b2=b3=0	4.729385	(12, 84)	0.0000
H02: b1=b2=0	4.224149	(8, 88)	0.0003
H01: b1=0	2.383495	(4, 92)	0.0570
The H0i test uses the i-th order Taylor expansion (bj=0 for all j>i).			
Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: b3=0	4.424719	(4, 84)	0.0027
H2: b2=0 | b3=0	5.589220	(4, 88)	0.0005
H1: b1=0 | b2=b3=0	2.383495	(4, 92)	0.0570
All tests are based on the third-order Taylor expansion (b4=0).			
The original model is rejected at the 5 percent level using H03.			
Recommended model: exponential.			
. Pr(H2) < Pr(H3) and Pr(H2) < Pr(H1))			
Escribano-Jorda Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H0L: b2=b4=0	1.981621	(8, 80)	0.0593
H0E: b1=b3=0	1.347338	(8, 80)	0.2327
All tests are based on the fourth-order Taylor expansion.			
The original model is rejected at the 5 percent level using H04.			
Recommended model: exponential with a nonzero threshold.			
. Pr(H0L) < Pr(H0E) with Pr(H0L) >= .05			

Smooth Threshold Parameter Constancy Test

Parameter Constancy Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: b1=b2=b3=b4=0	5.132103	(31, 65)	0.0000
H03: b1=b2=b3=0	3.194893	(23, 73)	0.0001
H02: b1=b2=0	1.219078	(15, 81)	0.2751
H01: b1=0	1.221889	(7, 89)	0.2993
The H0i test uses the i-th order Taylor expansion (bj=0 for all j>i).			

B.7.7 ESTR model with change in exchange rate as transition variable

B7.7.2: Estimation result of LSTR model with changes in exchange rate (Δe_t) as transition variable

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Threshold Variables (linear part)				
Δcpi_t	0.449431	0.156160	2.878022	0.0049
Δe_t	1.033495	0.263363	3.924228	0.0002
Δmpi_t	2.467046	0.790231	3.121930	0.0024
Δy_t	-1.089858	0.505293	-2.156884	0.0335
Threshold Variables (nonlinear part)				
Δcpi_t	0.513377	0.167438	3.066077	0.0028
Δe_t	-1.093184	0.252954	-4.321663	0.0000
Δmpi_t	-2.628187	0.838879	-3.132974	0.0023
Δy_t	1.283741	0.570700	2.249416	0.0268
Slopes				
Slope (γ)	124.4961	42.61864	2.921165	0.0044
Thresholds				
Threshold (c)	0.149599	0.009420	15.88108	0.0000
$R^2 = 0.79$	SSR = 0.031	AIC = -5.104		
LM-$\chi^2(1)$ = 0.00[0.99]	LM-F (1, 94) = 0.00[0.99]			
LM $_{ARCH}$(1) = 0.026[0.87]	LM $_{ARCH}$(2) = 0.16[0.85]			
JB = 487[0.00]				

B.7.7.3: Diagnostic Analysis of STAR Estimation

Smooth Threshold Linearity Tests

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: b1=b2=b3=b4=0	4.259450	(16, 85)	0.0000
H03: b1=b2=b3=0	5.199410	(12, 89)	0.0000
H02: b1=b2=0	4.713613	(8, 93)	0.0001
H01: b1=0	0.527029	(4, 97)	0.7161
The H0i test uses the i-th order Taylor expansion (bj=0 for all j>i).			
Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: b3=0	4.679194	(4, 89)	0.0018
H2: b2=0 | b3=0	8.732153	(4, 93)	0.0000
H1: b1=0 | b2=b3=0	0.527029	(4, 97)	0.7161
All tests are based on the third-order Taylor expansion (b4=0).			
The Linear model is rejected at the 5 percent level using H03.			
Recommended model: exponential.			
. Pr(H2) < Pr(H3) and Pr(H2) < Pr(H1))			
Escribano-Jorda Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H0L: b2=b4=0	1.906031	(8, 85)	0.0694
H0E: b1=b3=0	1.787588	(8, 85)	0.0907
All tests are based on the fourth-order Taylor expansion.			
The Linear model is rejected at the 5 percent level using H04.			
Recommended model: exponential with a nonzero threshold.			
. Pr(H0L) < Pr(H0E) with Pr(H0L) >= .05			

Smooth Threshold Remaining Nonlinearity Tests

Additive Nonlinearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: b1=b2=b3=b4=0	3.672866	(16, 79)	0.0001
H03: b1=b2=b3=0	3.460766	(12, 83)	0.0004
H02: b1=b2=0	4.625312	(8, 87)	0.0001
H01: b1=0	8.374209	(4, 91)	0.0000
The H0i test uses the i-th order Taylor expansion (bj=0 for all j>i).			
Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: b3=0	1.092383	(4, 83)	0.3658
H2: b2=0 | b3=0	0.909667	(4, 87)	0.4621
H1: b1=0 | b2=b3=0	8.374209	(4, 91)	0.0000
All tests are based on the third-order Taylor expansion (b4=0).			
The original model is rejected at the 5 percent level using H03.			
Recommended model: first-order logistic.			
. Pr(H3) <= Pr(H2) or Pr(H1) <= Pr(H2)			
Escribano-Jorda Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H0L: b2=b4=0	2.233742	(8, 79)	0.0333
H0E: b1=b3=0	2.231023	(8, 79)	0.0335
All tests are based on the fourth-order Taylor expansion.			
The original model is rejected at the 5 percent level using H04.			
Recommended model: exponential with a nonzero threshold.			
. Pr(H0L) < Pr(H0E) with Pr(H0E) < .05			

Smooth Threshold Parameter Constancy Test

Parameter Constancy Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: b1=b2=b3=b4=0	2.792703	(32, 63)	0.0003
H03: b1=b2=b3=0	2.783625	(24, 71)	0.0005
H02: b1=b2=0	2.904434	(16, 79)	0.0009
H01: b1=0	0.933091	(8, 87)	0.4937
The H0i test uses the i-th order Taylor expansion (bj=0 for all j>i).			

B.7.8 LSTR model with output growth(Δy_t) as transition variable

B.7.8.1: Test for nonlinearity using output growth(Δy_t) as the threshold variable

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: b1=b2=b3=b4=0	1.549236	(16, 87)	0.1010
H03: b1=b2=b3=0	1.807930	(12, 91)	0.0583
H02: b1=b2=0	2.007515	(8, 95)	0.0536
H01: b1=0	2.570625	(4, 99)	0.0425
The H0i test uses the i-th order Taylor expansion (bj=0 for all j>i).			
Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: b3=0	1.349650	(4, 91)	0.2577
H2: b2=0 | b3=0	1.402592	(4, 95)	0.2390
H1: b1=0 | b2=b3=0	2.570625	(4, 99)	0.0425
All tests are based on the third-order Taylor expansion (b4=0).			
The Linear model is not rejected at the 5 percent level using H03.			
Escribano-Jorda Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H0L: b2=b4=0	0.714619	(8, 87)	0.6780
H0E: b1=b3=0	0.746926	(8, 87)	0.6500
All tests are based on the fourth-order Taylor expansion.			
The Linear model is not rejected at the 5 percent level using H04.			

Chapter 8 :
Summary, Conclusion and Recommendations

This chapter summarises the results of the review and empirical finding of the study, draw conclusions and make policy recommendations. Finally, this chapter states the limitations of the study and make suggestions on further areas for future research.

Summary

This thesis examined the impact exchange rate changes on consumer prices known as Exchange rate pass-through (ERPT) in Nigeria, and it investigated the presence of asymmetry and nonlinearity in the ERPT and its impact on the level and speed of the ERPT in Nigeria in the period 1986-2013 using linear and nonlinear econometric models. In this chapter, we summarised the key findings and policy implications of the thesis. The limitations and suggestions for future research are also suggested. The summary is as follows:

In chapter two we reviewed the performance of Nigerian economy with a focus on the exchange rate policies and their impact on the economy and particularly on the consumer price inflation. Some key economic indicators and their trends during 1960-2013 in Nigeria are analysed. The review shows that Nigerian economy performed well from its independence in1960 to 1970 considering the GDP growth rates, inflation rate and unemployment rates. During the period, agriculture was the key sector of the economy regardless of fluctuations in export prices. Then some excellent growth rates were observed during the oil boom period of the early 1970s. However, the boom had no much impact on the real sector as the industrial sector continued to be relatively weak. The windfall from oil seemed not to have been exploited in developing the industry sector. Until 1986, the Nigeria trade and financial policies are highly regulated. The exchange rate was also fixed where the

Naira was either pegged to the US dollar, Britain pound sterling or basket of some currencies of the main trade partners. Following the economic downturn from the late 1970s to mid-1980s after the collapse of the oil price, Nigeria made a radical policy change by adopting IMF's structural adjustment programme (SAP) which led to deregulation of the trade and financial sector and embracing floating exchange rate regime. However, following the adoption of floating exchange rate regime in 1986, Naira suffered a drastic depreciation which led to higher consumer price inflation due to the impact of ERPT. Up to mid-1990s Naira exchange rate continued to depreciate, and the consumer price inflation rate skyrocketed and reached its historical peak of 72.8% in 1995. Meanwhile, the government of Nigeria was compelled to abandon the floating regime and peg the Naira to US dollar in 1994. Later, Nigeria reverted to the floating regime in 1998, but the Naira depreciation and inflation rate that followed the reversion were lower compared to the aftermath of the first adoption of the floating exchange rate regime in 1986. The ERPT effect of the Naira depreciation after 1986 introduction of the floating exchange rate system seems to be more than the effect seen during the re-introduction in 1998. This could be due to nonlinearity and/or asymmetries in the ERPT due to the inflationary environment (Taylor's hypothesis) and the size and direction of the exchange rate changes. In 1986 the country was already in recession with high inflation rate while in 1998 the GDP growth and the inflation rate were relatively stable. From 1999 to 2013 the economy performed better with period average GDP growth and an inflation rate of 7.5% and 11.6% respectively.

In Chapter three general theoretical and empirical literature reviews on inflation and exchange rate pass-through (ERPT) were conducted and the literature review in the context of Nigeria was also carried out. We reviewed the perspective of different schools of thought like the classical, Keynesian and monetarist among others on the cause of inflation in the short-run and long-run. We also reviewed the channels and determinants of the exchange rate pass-through. In spite of the rich theoretical literature on inflation, the debates about the primary determinants of inflation continue between the economists of different schools of thought. From the review of the various theories of inflation, the theoretical causes of inflation can be grouped into four broad factors: demand-side factors, supply-side factors, inertial factors and political factors.

The demand-side factors include nominal factors like money supply or real factors in the form of the high demand for goods and low unemployment. The two sources of demand side inflation characterise the interpretation of the two principal groups of economists, the Keynesians and the monetarists. Furthermore, continuing government deficits have been regarded, especially by the monetarists and new classical economists, as a fundamental demand side cause for inflation. This non-monetary view of inflation is appropriate in the economies with inefficient tax systems, political instability, and limited access to the external borrowing of which make it easier for the government to rely on inflation tax. Such phenemenon is more similar to the situations in Nigeria during the late 1970s to mid-1980 when the oil price collapsed. With the oil being the key source of the government's revenue Nigeria witnessed the worst fiscal deficits.

On the other hand, the supply-side factors of inflation include among other things, a sudden rise in oil prices, poor crop harvest, exchange rate fluctuation and rise in import cost. These supply-side factors of inflation characterise the cost-push theory of the non-mainstream economics. However, both the Keynesian and non-mainstream economists agree on a similar propagation mechanism, which suggests changes in relative price levels that in turn lead to an incessant rise in the aggregate price level. This factor is also relevant to Nigeria, which is an oil producing country that suffers the effect of oil price fluctuation and movement in the price of agricultural produce. The exchange rate fluctuation and its effect on import cost and ultimately consumer price are also prevelent in Nigeria as our review shows.

The other source of inflation, the inertial factors, are influenced by things like wages rigidity, expectations and indexations. These features are related to the wage and price spiral that involves continuous efforts by the labour to retain their real income and the subsequent pass-through of the increases in wages to ultimate consumers which result in the increase in prices.

Lastly, politics is also contributing to the inflation process especially in countries where central banks are not independent. The political factors manifest in the inflationary process of developing countries like Nigeria where political instability, partisan politics, inequality in income distribution, continued government deficits, and the lack of an independent central bank are commonplace. Nigeria suffers all of these factors especially before the return to democracy in 1999.

The review of empirical studies revealed that different variables which emanate from the four inflation determinants mentioned above are found to be influencing the inflation. The empirical evidence also proved the relationship between the exchange rate and consumer prices. Exchange rate affects consumer prices directly or indirectly. The direct channel is essentially through the prices of traded final goods, and the prices of imported intermediate goods. The indirect channel is through the competitiveness of products in the international markets and inflation expectations. Both channels become more pronounced with an increase in the degree of openness in the economy. The analytical frameworks of the empirical studies on the effect of exchange rate on consumer prices have been mostly laid on a microeconomic basis. The two commonly used models for the ERPT estimations are the single equation model and the vector autoregressive (VAR) model.

There are few empirical studies on ERPT in Nigeria and the popular ones among them are Essien (2005) and Aliyu et al. (2009). Both of these studies show that exchange rate pass-through was incomplete and weak in Nigeria. However, both the studies assumed and used linear models without testing for nonlinearities in the ERPT. Our study provides a more robust result which considers the potential nonlinearities and asymmetries in the ERPT. Considering the lack of any comprehensive and up-to-date study on the on the speed and size of ERPT in Nigeria this study fills the gap in the literature on ERPT to consumer prices in Nigeria exploring the asymmetry and nonlinearities in the ERPT and their effect on the speed and size on the pass-through.

Chapter four reviewed the theoretical and empirical literature of asymmetric and nonlinear ERPT into consumer prices. The survey shows situations that could create asymmetric/nonlinear exchange rate pass-through. These include the exporting firm’s market share objective, capacity constraint, menu costs, production switching. Others factors include the stage of the business cycle and monetary policy reactions. Similarly, Taylor’s hypothesis is also another factor, as the low and stable inflation environment also induces nonlinearities in the ERPT. All these behaviors are prevalent among importing firms in Nigeria, as the country opened up for trades not very long ago, and most of the foreign importing firms are at different growth stages. Those foreign companies tend to have market share objectives, capacity constraints, and often switch their sources of input and also consider the cost of changing their menu. Therefore, it is imperative to examine how the behaviours of the foreign firms affect the ERPT process. The survey of empirical studies shows that some studies confirmed nonlinearities and asymmetries while some could not. However, the empirical studies that confirmed the existence of asymmetry and nonlinearity are mainly from countries like India and South Africa that share same geographical and/or structural features with Nigeria. In general, only very few studies examined non-linear and asymmetric ERPT using data from emerging and developing economies. For instance, there was no research on nonlinear and asymmetric exchange rate pass-through using Nigeria data.

Chapter five discussed the methodology employed in this thesis. The study used Vector error correction model (VECM) and Smooth transition autoregressive (STAR). In our first empirical estimation, we used the VECM which has the advantage of analysing both the long-run relationship and short-run dynamics between our core variables the exchange rate and the consumer prices but ignoring the potential asymmetry and nonlinearity. Unlike the models such as the structural VAR which uses differenced series which lead to loss of information the VECM uses the non-stationary series when cointegration is established. In our second empirical estimation, we used the STAR model which has the advantage of testing asymmetries and nonlinearities, in the ERPT process.

In chapter six we examined the exchange rate pass-through to consumer prices in Nigeria during 1986Q4 to 2013Q using VECM model. The results show high (near full) and statistically significant ERPT in the long-run in Nigeria during the sample period. However, the short-run estimate shows no significant ERPT in Nigeria during the period. A review of the adjustment coefficients shows an extremely slow adjustment of consumer price to its long-run equilibrium. This might explain the insignificant ERPT estimates in the short-run. The impulse response analysis also supports the result of the cointegration analysis showing the near zero response of the consumer price to the exchange rate shock. The variance decomposition demonstrates the contribution of external shocks where by the exchange rate shocks made some modest contribution to the consumer prices during the period 1986 - 2013.

This results could be explained by the behavior of the importing firms like market share objective and menu cost discussed (in Chapter 4, Section 4.2). The result suggests that importing firms in Nigeria might have objectives of building their market share. As such they do not pass-through the exchange rate change when it is so small that it can be absorbed in their profit margin and maintain their price unchange to control their market shares. The firms might also not effect change in price for every change in exchange rate. They have to ensure that the change in the exchange rate is significant enough to warrant a change in price due to the cost of changing menus. The firms also do not effect change in prices, to pass-through the exchange rate change as they often see the exchange changes as only temporary shocks considering the unstable nature of the exchange rates in Nigeria. Considering that Nigeria generates over 90% of its foreign exchange earning from sales of oil, the volatility of the oil price affects the Nigerian foreign exchange market. Therefore, it takes the importing firms some time to decide on changing price due to all the three reasons mentioned. Hence, the insignificant ERPT in the short run. But the result suggests that they pass-through the shifts in the exchange rate when they are settled that the change is permanent and reaches the level that is significant enough to warrant menu change and they could not absorb it in their profit margin anymore. Hence the significant and near full exchange rate pass-though in the long-run.

This result indicates that the monetary policy actions which are more relevant in the short run might not be effective. For instance, the role of the floating exchange rate system as a tool for price adjustment could not properly work when the prices do not adjust quickly to the changes in exchange rate. Therefore, the policy makers need to bring policies which encourage the other non oil sectors of the economy to develop and start contributing to foreign exchange earnings in Nigeria. This will diversify the supply to the foreign exchange market, which would stabilise the exchange rate and build the confidence of the importing firms to start perceiving a change in the exchange rate as a permanent change and react quickly.

The exchange rate stability is, therefore, essential for maintaining the domestic consumer price stability. The over-dependency of Nigeria on one commodity (oil) for it foreign exchange earning (See Section 2.2, Chapter two) have to be reviewed. Whenever there is a shock in the global oil market the foreign exchange supply drops, and consequently the exchange rate is severely affected which also impacts on the consumer price in the long-run, via the effect of exchange rate pass-through. Some other sectors of the economy need to be developed to complement the oil industry as a source of foreign exchange earning to reduce the effect of the global oil price shock transmission into the domestic consumer price.

However, the complete insignificance of the exchange rate to the consumer price in the short run is still puzzling. The behavior of the importing firm describe above also suggest some nonlinearities as the firms pass through the exchange rate changes when the change in bigger. The limitation of the VECM model used is that it is based on linearity assumption. Therefore it might be possible that such nonlinearities were not properly captured.

The follow-up to that in chapter seven the study examined the presence of asymmetry and nonlinearity in the ERPT to consumer prices in Nigeria using quarterly data from 1986Q4 to 2013Q4 to assess its possible effect on the short-run ERPT in Nigeria.

We examined the potential ERPT nonlinearities and asymmetries as a consequence of inflationary environment in the economy, the size and direction of exchange rate change and output growth (changes in output level). The study used a model on the basis of importing firm's price markup.

The result of the estimation confirms that ERPT reacts nonlinearly due to different inflation level in Nigeria during the period 1986-2013. The nonlinearity is more prevalent during the high inflation times of the 1990s when inflation rate exceeds a given threshold than other periods of low inflation. This study, therefore, confirms Taylor's (2000) hypothesis that pass-through declines in low and stable inflation environment which create nonlinear ERPT. The policy implication of this part of the result is that during a low and stable inflation level in the economy, nonlinearity in ERPT is not prevalent. Therefore, if the inflation level could be maintained below the threshold, the impact of exchange rate changes on consumer prices will be reduced. Hence it is pertinent to determine the threshold level and formulate policies to prevent the inflation rate from exceeding the level as it reduces the impact on the consumer prices.

The result also shows asymmetric ERPT due to appreciations and depreciations episodes of the exchange rate changes. Nonlinearity with respect to the size of the exchange rate change is also observed from the result. There is greater ERPT during the depreciation of the Naira, and lower ERPT in appreciation episodes. This result is in line with the quantity constraint theory (reviewed in Section 4.2.1, Chapter four). Due to the capacity of the importing firm in the importing countries, their response in transferring the change in the exchange rate to the consumer price is higher during currency depreciation. On the nonlinearity, due to the size of the exchange rate changes, the result shows that with exchange rate change greater than the threshold level the proportion of the ERPT is higher than when the exchange rate change is below the threshold level in Nigeria. This result is in line with the menu cost hypothesis where the importing firms do not transfer the exchange rate changes due to the cost of changing their menu. Therefore the effect of the exchange rate changes on consumer price is minimal when the exchange rate changes are below the threshold level. Any policy in the country that will maintain the exchange rate movement below the threshold level perhaps by diversifying the sources of foreign exchange earnings would reduce the impact of the exchange rate changes on the domestic consumer prices.

The estimation also examined the output growth as a source of nonlinearities. However, the result does not show evidence of nonlinear ERPT due to the output level. Hence, change in the exchange rate in different growth periods does not create nonlinear ERPT and different impact on the consumer prices.

We used the statistical test results to compare the performance of the linear AR and the nonlinear STAR model which indicates that the nonlinear STAR model fits the data better than the linear AR model in all cases. The result shows that using the nonlinear STAR model the ERPT is significant even in the short-run which also confirms nonlinearity and asymmetry in the ERPT. The linear model with linearity assumptions could not capture the nonlinearity and asymmetries in the ERPT. Using models that account for nonlinearities and asymmetries will help in telling us more about the ERPT in the short-run as observed from the results of this study. With this result, we conclude that there is significant ERPT even in the short-run though incomplete and full pass-through in the long-run. The implication of this result in monetary policy transmission is that the effect of monetary policy shock will be past given that the ERPT is significant in the short-run. Therefore the role of floating exchange rate regime of international price adjustment will be very efficient, and that role of floating exchange rate regime will be achieved. Another vital result of the study is that the exchange rate changes and the inflation level during which the Naira depreciation or devaluation takes place cause nonlinearities and therefore, have a different effect on the consumer prices.

The result of this study is in contrast with the findings of Aliyu *et al*., (2009) and Zubair *et al*. (2016) which suggested a small and slow exchange rate pass-through in Nigeria even in the long-run. As we maintained in our discussion of the result, such findings are really mystifying with Nigeria’s history of continued exchange rate depreciation which goes in hand with the higher inflation rate.

The Policy Implications of the Results

The most important policy implications of the results of this study are as follows:

The government of Nigeria should diversify its source of foreign exchange earnings by developing other sectors like agriculture and manufacturing to prevent shocks in the oil price affecting foreign exchange inflow and the domestic consumer prices.

The government should ensure that any deliberate devaluation of the Naira is effected during stable and low inflation to reduce the impact on consumer prices.

The government should make sure that devaluation of the Naira is carried out during stable and low Naira exchange rate depreciation or during appreciation episode to minimize pass-through to consumer prices.

The trade sector should be fully liberalized. However, the local industry should be given more incentive to grow and develop, before completely liberalizing the trade sector. So that the economy efficient and competitive locally prior to opening up to international competition.

The government should reduce distortions in the forex markets and ensure that no excess demand was cleared.

The government should embark on export friendly policies to raise the supply of forex and ease excess demand.

The government should use fiscal policies through budgeting and reduce excess money supply which creates raises the excess demand for the forex.

Limitations of the study and Suggestions for future study

This study is the most extensive investigation of the asymmetric and nonlinear exchange rate pass-through in Nigeria. The study explores the asymmetry and nonlinearity in the ERPT and its impact on the speed and level of the ERPT in Nigeria. However, there are some limitations of the study. The first limitation of the empirical models in chapters six and seven is the short data duration. Therefore, we have to be cautious with the results, and further study should be carried out when longer period data become available. Also when monthly or weekly data become available in the future the estimation with higher frequency data could also provide more information especially about volatility as this study used a quarterly data.

Secondly, when industry data become available the exchange rate pass-through estimation can be carried with disaggregated industry level data to see the exchange rate pass through in different industries which the literature suggested that, they tend to differ in developed countries where the data is available.

In the study we could not use bootstrapping because of the time constraint as it will require us to learn and write program or find a suitable statistical software. Even with a good software, the procedure is computationally intensive that require much longer time than we have remaining for the PhD. The by bootstrapping of the STR models' coefficient standard errors is a another potential area for future research.

The focus of this study was on the short run dynamic, though the long run ERPT was also reported in the linear VECM model. The long run ERPT was not considered in the nolinear STAR model. Using non-linear models to examine long run ERPT is also another area for future research.

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