CANKAYA UNIVERSITY

GRADUATE SCHOOL OF SOCIAL SCIENCE

ECONOMICS

MASTERS THESIS

EXCHANGE RATE PASS-THROUGH TO DOMESTIC CONSUMER PRICES IN NIGERIA: A STRUCTURAL VAR APPROACH

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DECEMBER, 2013

Title of the Thesis: **Exchange Rate Pass-Through To Domestic Consumer Prices In Nigeria: A Structural VAR Approach**

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ABSTRACT

EXCHANGE RATE PASS-THROUGH TO DOMESTIC CONSUMER PRICES IN NIGERIA: A STRUCTURAL VAR APPROACH

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DECEMBER, 2013, 69 Pages

This study examines the degree and extent of exchange rate pass through into domestic consumer price inflation in the Nigerian economy between 1986Q1 and 2013Q1 using structural vector auto regression (SVAR) methodology. The results from impulse response analysis show that the exchange rate pass through to consumer prices is incomplete, relatively low and below the average range. Moreover, the speed of adjustment to structural shocks, such as the exchange rate, output, monetary policy rate and money supply shocks is high and effects of such shocks are highly volatile and therefore can potentially distort the status quo. The overall results offer supportive evidence in favor of the exchange rate channel, and monetary policy rate as a plausible track for monetary policy transmission mechanism and exchange rate pass through in the Nigerian economy. The results from forecast variance decomposition analysis show that the consumer price inflation own shocks, positive money supply shocks and output shocks retain dominance over other factors in explaining consumer price inflation in the Nigerian economy. Therefore, Nigeria ought for more effective monetary policy through conscious efforts by the monetary authorities than ever before, more particularly, the adoption of fully fledge inflation targeting. This will help to brin

expectations of inflation down and thereby, the expectations channel will become more credible and stronger. This will in turn make the anticipated effects of monetary policy to require less aggressive monetary policy rate changes.

Keywords: Exchange Rate Pass Through, inflation, Taylor Rule, Structural VAR, Nigeria

ÖZ

Bu çalışma TÜFE (Tüketici Fiyat Endeksi) üzerinden döviz kurunun dereceli ve kapsamlı olarak TÜFE (Tüketici Fiyat Endeksi)'ye nüfusunu , yapısal vektör oto regrasyon (SVAR) yöntemini kullanılarak Nijerya ekonomisindeki 1986Q1 – 2013Q1 arasındaki ve fiyat enflasyonunu inceler. Tepki analizinden çıkan sonuçlar döviz kurunun tüketici fiyatlarına etkisinin eksik olduğunu ve ortalamanın altında olduğunu göstermektedir. Bunun yanında döviz kurundaki, hâsıladaki, para politikalarındaki bunalımlar ve para kaynağı bunalımları gibi yapısal bunalımlara yapılan müdahalelerin hızı statükonun çarpıtılması sonucunu doğurabilir. Ayrıntılı sonuçlar Nijerya ekonomisind epara politikası oranlarına akılcı bir yön vermede döviz kurunun bağlantısına ve nüfusuna ilişkin deliller ortaya çıkarmaktadır. Tahminlere dayalı sonuçlarda ayrışma analizitüketici fiyatlarına ilişkin bunalımlar olduğunu göstermektedir ve pozitif para kaynağı vehâsıla bunalımlarının tüketici fiyat enflasyonunu doğrudan etkileyen en önemli faktörler olduğu görülmektedir. Bu nedenle Nijerya daha etkili para politikalarına, özellikle de ekonomiyle ilgili makamların özel olarak ekonominin yüksek enflasyondan arındırılmasına yönelik geliştireceği politikalara ihtiyacı vardır. Bu enflasyon beklentilerini düşürecektir ve beklenti kanalları daha güçlü ve güenilir hale gelecektir. Bu durum zamanla öngörülen para politikalarında daha sakin oran değişikliklerine ihtiyaç duyulmasını sağlayacaktır

Anahtar Kelimeler: Döviz Kuru Nüfuzu, enflasyon, Taylor Kuralı, Yapısal VAR, Nijerya

DEDICATION

This thesis is dedicated to my centrifugal hubs i.e. my parents that holistically, contribute to my life and studies, from kinder garden to university education. May peace and blessings of God be upon my deceased father and may God grant him high place in paradise. His contribution remains tremendous and fundamental. My beloved mother, may God increase her in knowledge, wisdom, peace of mind and good health.

ACKNOWLEDGEMENT

To God the omnipotent, omnipresent and the omniscient is my prime gratitude that spheres my life with good health and average reasoning faculty to undergo this thesis research to a successful fruition. Similarly, it remain worthy to always acknowledge the effort of my central hub i.e. my parents for their holistic contribution to my life in general may God grant them peace and blessing both here on earth and hereafter, and may paradise be their final abode. Furthermore, it is vital to mention my dear sister for her constant moral support regarding my studies. Of relevance my lecturers deserve a wonderful acknowledgement for their worthwhile contribution to my knowledge, especially my thesis supervisor (Asst Prof Aysegul Eruygur). Generally, to all relations and all allies in need and indeed whose prayers really augment my success. Also my impressive and monumental gratitude to the Kano State Government under the able leadership Dr Rabiu Musa Kwankwaso that offer me an oversee scholarship. Needless to mention all shortcomings and honest errors are entirely mine and they cannot be shared with anyone.

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CHAPTER 1

INTRODUCTION

Empirical literature on the exchange rate pass-through is wide ranging. Apparently robust stylized fact from this literature revealed that exchange rate pass-through (ERPT) is incomplete, although the degree pass through tend not to be the same across countries. ERPT is expected to be incomplete if the import, export and consumer prices variation is less than one. Whether the ERPT is incomplete or persistent, it is foreseeable that an appreciation of currency diminishes import prices, and the reverse arises in case of a depreciation (Hooper and Mann, 1989; Gagonon and Knetter, 1995; Menon, 1995; Anderton, 2003; Frankel *et al.* 2005; Krugman, 1987). Variations in import prices, then, in turn affect domestic consumer prices. A more contemporary body of literature (McCarthy, 2000; Mihailov, 2005; Choudhri and Hakura, 2006; Campa and Golberg, 2006; Cazorzi and *et al.*, 2007; Akofio-Sowah, 2009; and Razafimahefa, 2012) with their cross-country investigation scrutinizes the impact of exchange rate on alternative prices such as consumer prices . On the whole these studies have analysed the extent of exchange rate pass-through to consumer prices, which is crucial for several reasons.For example knowledge of pass through ease the prediction of the real exchange rate volatility, it sheds light on the transmission mechanism of international macroeconomic shocks, and it also assists in the coordination of international macroeconomic policy to enhance competitiveness. More so, knowledge of the association between the nominal exchange rates and inflation in developing economies may give a good picture of the extent to which inflation contributes to economic distortions. Additionally, the extent of exchange rate pass-through is central in the determination of appropriate monetary policies, which enable the monetary authorities to device the right monetary policy response for exchange rate movements.

Both theoretical and empirical literatures on ERPT have concentrated mostly on advanced economies, mostly the USA, Japan, Canada, and Germany, to mention a few. However, developing economies such as Nigeria attracts few empirical research. But, there has been an increased interest to analyse ERPT in developing economies in the recent years (e.g. Ogun,

2000; Choudhri and Hakura, 2001; Bhundia, 2002; Mwase, 2006; Akofio- Sowah, 2009; Aliyu *et al.* 2009; Frimpong and Adams, 2010; Sanusi, 2010; Adedayo, 2012; and Razafimahefa, 2012). Particularly, for the Nigerian economy, Adedayo has (2012) examined the channel for exchange rate pass through. Findings from this study revealed that interest rate channel is the significant path of exchange rate pass through in Nigeria. The study suggested that monetary authorities should at all-time guide the fluctuations of the exchange rate and its effects on the macroeconomic prices in Nigeria. Another study conducted on the Nigerian economy is Aliyu *et al.* (2009). This study has conducted an extensive empirical investigation from the first quarter of 1986 to the fourth quarter of 2007 on exchange rate pass through for the Nigerian economy. The study employed vector error correction model (VECM) and their findings suggested that exchange rate pass through in Nigeria is low, even though it is to some extent high in import than in the consumer prices. According to these researchers exchange rate pass through in Nigeria has declined along the price chain, which partly overturns the conventional wisdom in the literature that ERPT is always considerably high in the developing and emerging economies than in the developed economies. Most of the empirical findings on ERPT related to the Nigerian economy have focused mainly on examining the degree of exchange rate pass through, that is; whether it is low or high, complete or incomplete. However, justifications behind low pass through is yet uncovered according to the conventional determinant of exchange rate pass through as whether it is a micro or macro phenomenon. One side of the motivation of this study is to establish a stand point that would highlight the degree of exchange rate pass through (ERPT) as a function of micro or macro determinant.

Empirical literature divides the determinants into two, micro and macro determinants (see for example Campa and Golberg, 2002)[1]. By micro factors we simply mean the microeconomic state of the market structure and industry composition of a country's import bundle. In perfectly competitive markets, firms absorb exchange rate shocks by not passing exchange rate changes into consumer prices in order to maintain a proportion of the market share . Therefore, firms only adjust their mark up. This phenomenal behavior is known as pricing to market (PTM). In contrast, by macro factors we simply mean that ERPT is influenced by macroeconomic conditions endogenous to the economy, such as low inflation environment (see Taylor hypothesis, 2000), monetary policy credibility, size and trade openness of the

[1] This distinction was introduced by Campa and Goldberg (2002).

economy, differences in exchange rate regimes, exchange rate volatility, and the time horizon of the analysis, (i.e whether the economy is in the short or long run. Evidently pass through is almost complete in the long run.)

The aim and value added of this study is to re-estimate exchange rate pass through elasticity with a more sophisticated methodology. A structural VAR (SVAR)[2] model will be used to compute exchange rate pass through elasticity for the Nigerian economy. After doing so, our next goal is to analyse exchange rate pass through at a macro-economic level. Particularly, we aim to studythe reactions of macroeconomic variables to an exchange rate shock. We examine whether the degree of exchange rate pass through is related to the inflation environment. Taylor (2000) was the first to demonstrate how nominal rigidities in a low inflation environment could lead to a low ERPT. Supporting evidence was given by studies including Gagnon and Ihrig (2004), Chaoudri and Hakura (2001), and Campa and Goldberg (2005) for the advanced economies, and by Chaoudri and Hakura (2006) for the emerging economies. Similarly, the Taylor (2000) hypothesis that low inflation environment leads to a lower ERPT has also been tested for some Asian and Eastern European countries (see Cazorzi 2007; Ito and Sato 2007; and Beirne and Bijsterbosch 2009)[3].

In addition, the standing studies on the Nigerian economy cover time periods that is outmoded. Moreover, the methodological background, i.e. SVAR is classier than that used in most previous studies for the Nigerian economy on ERPT. For example Adedayo (2012) and Aliyu *et al.*(2009) have applied a single equation estimation technique and vector error correction model (VECM), respectively. Advantageously, for a structural model to be estimated certain restrictions are needed about which variables are allowed to affect each other. Thus, the SVAR methodology possibly allows one to identify explicit "structural" shocks disturbing the system, which pave way for specifying embedded features of an economy. In this case, a structural exchange rate shock and monetary policy transmission channel is identified through impulse response analysis, and structural decomposition of innovations. Besides, the SVAR methodology allows the use of impulse response functions to compute exchange rate pass through elasticity dynamism. Forecast error variance

[2] To the author's knowledge, a structural VAR estimation method has not been applied to the issue, to study the Nigerian economy.

[3] More commonly, this paper finds broad validation for a positive relationship between the degree of the exchange rate pass through (ERPT) and inflation, in line with Taylor's hypothesis, both in advance, markets and developing economies.

decomposition is equally obtained from the SVAR to examine the significance of the identified shocks in explaining domestic consumer price variation.

This study is very relevant to the Nigerian economy. The study provides evidence that the adoption of credible monetary policy and inflation targeting is associated with a lower ERPT and improvement of the overall economic performance. Therefore, Nigeria as a small open economy is alerted of the appropriate linkage among the monetary policy transmission mechanisms to exchange rate pass through. The extent and timing of when to strike monetary policy response against exchange rate movement in the Nigerian economy is highly imperative.

The empirical results from impulse response analysis show that exchange rate pass through to consumer price inflation in Nigeria is incomplete, relatively low, and below the average range. Moreover, the speed of adjustment to structural shocks, such as the exchange rate, output, monetary policy rate and money supply shocks is high and effects of such shocks are highly volatile and therefore can potentially distort the status quo. This study also vindicates a strong evidence that is consistent with Taylor's (2000) proposition that high or average pass through is associated with high inflation and vice versa.

This thesis is structured as follows. Chapter 2 provides an overview of the theoretical and empirical studies on exchange rate pass through (ERPT). Chapter 3 briefly discusses the exchange rate developments, the path of inflation and the monetary policy conducted in the Nigerian economy during the past decades. Chapter 4 describes the data and the methodology used in the study and chapter 5 contains the main empirical results. Finally, chapter 6 concludes.

CHAPTER 2

LITERATURE SURVEY

2.1 Theoretical Literature

Essentially, over the past three and a half decades interest on exchange rate pass through questions grew up following the shift from fixed exchange rate regime traced during the Bretton Wood era, where we have adjusted peg system. After its collapse, managed floating becames popular in many countries of the world. Issues of ERPT to imports prices have dated back to over thirty years or so. ERPT signifies the level to which exchange rate changes are passed on to the local currency prices of traded goods. Goldberg and Knetter (1997; p1248)[4] define exchange rate pass through as " percentage change in the local currency import prices resulting from a one per cent change in the exchange rate between the exporting and the importing countries." Similarly, the exchange rate pass-through can be defined as the change in local currency domestic prices resulting from 1 percent change in the exchange rate. According to Campa and Goldberg (2002), pass-through studies consider the degree to which exchange rate movements are passed into traded goods prices, versus absorbed in producer profit margins.

Most of the studies on this issue focus on changes in import prices following exchange rate movements. Another similar view as seen by Mumtaz *et al.* (2006:4), is that exchange rate pass through (ERPT) is the percentage change in local currency import prices following a one percentage change in the exchange rate between importing and exporting countries. According to Barhoumi (2005:3), ERPT can statistically be represented as the elasticity of import prices to a change in exchange rates. Alteration in import prices can consequently be extended into producer and consumer prices which will end up affecting price level in the economy. When import prices change by 100% to exchange rate movements or fluctuations,

[4] Goldberg and Knetter (1997) provide a comprehensive review of this literature.

ERPT is said to be full or complete. Similarly, a less than 100% change in prices denotes that ERPT is incomplete or partial

The main theoretical basis of exchange rate pass through was based on the law of one price (LOP). İt states that identical products should sell for the same common currency price in different countries. According to the law of one price (LOP) there is costless arbitrage, where identical products would sell for the same common currency price in different countries.

Now let's show this relationship by using the equation below;

$$P_i = EP^* \quad (1)$$

Where P is the home currency price of the good in country x, where P^* is the foreign currency price of the good in country y, where E is the exchange rate of the x's currency per unit of y's currency where, i is the good under consideration.

For testing the validity of law of one Price (LOP) for good i, over a given period of time *(t),* we can make use of regression equation where all variables are expressed in logs (see Akofio-Sowah, 2009).

$$P_t = \alpha + \delta P^* + \Upsilon E_t + \varepsilon_t \quad (2)$$

Now if law of one price (LOP)[5] should hold, then equation 2 would forecast $\alpha = 0, \delta = 1, \Upsilon = 1$, implying that changes in the exchange rate would be completely pass through to the price of domestic good *i.* That is if law of one price (LOP) holds exchange rate movements translate into proportional movements to domestic prices, hence is equal to one. Similarly, if the law of one price or purchasing power parity holds for all products between two markets then the absolute LOP hold between these two countries. However, the underlying assumption of maintaining the powerful version of law of one price (LOP) or purchasing power parity (PPP) are very stringent and unreliable. That there is instantaneous costless arbitrage and also some goods enters the basket of goods with the same weight in every country. Empirical literature confirms that the assumptions can hardly hold. (see Akofio- Sowah, 2009; Hooper and Mann (1989); Campa and Goldberg (2002); Goldberg And Knetter, 1997) employed the use of an equation similar to the one use by Akofio-Sowah (2009). Their estimation and findings also

[5] Incomplete pass-through to import prices and consumer prices reflects departures from the law of one price (LOP) in traded goods (see Akofio-Sowah, 2009).

indicate that ERPT is incomplete. Incompleteness of pass to import and consumer price index reflects departure from the law of one price (LOP) in the traded goods (see Bailliue and Bouakez, 2004). Theoretical and empirical literature evidently shows that the violations of the law of one price (LOP) are due to the fact that goods are not homogenous, there are cost in trade and arbitrage not always occur, Price rigidities and imperfect competition. In fact this was the principal reason of Krugmans' pricing to market concept of explaining incomplete pass through to import prices and consumer prices.

The effect of an exchange rate on domestic prices measures along the chain of production which include export and import prices and a measure of consumer inflation. İt is important to note that the direct impact of exchange rate fluctuations occurs through path of internationally traded prices of goods (Goldberg and Knetter, 1997) literature survey analysed pass through to import prices as incomplete. Similarly, a lot of theoretical explanations posed this question (see Menon, 1995)

Dornbusch(1987) and Krugman (1987) argued that exchange rate pass through exhibit less than one for one transmission mechanism and can be explained by imperfect competition or pricing to market (PTM)[6]. That the foreign producers maintain to adjust the level of mark-up that will enable them sustain a stable market share in the market within the domestic economy. In developed and emerging markets this strategic behaviour can drive the rate of pass through to zero to Krugman. Again in his seminal contribution, Dornbusch (1987) identifies four factors that have the likelihood of affecting the degree of pass through to destination currency import prices (see Bache, 2007). (i) the degree of market integration or segmentation (ii)the degree of product differentiation(iii)the functional form of the demand function(iv) the market structure and the degree of strategic interaction among suppliers.

In relation to the relevance of the extent of degree of market integration, assuming that markets are perfectly integrated, the law of one price holds. The law in its real version "says when prices are measured in common currency, identical products should sell for the same price everywhere" considering the relative version of the law of one price allows for a wedge between the common currency of identical products. In contrast, markets are segmented via

[6] PTM is the ability of monopolistically competitive firms to (intentionally) practice price discrimination, setting different prices for different destination markets (see Bailliu and Fujii, 2004).

formal and informal trade barriers; firms may set different prices to different markets hence making law of one price not hold.

Now we see the implication of product differentiation for the degree of pass through, Dornbusch used Dixit and Stiglitz (1977) model of monopolistic competition. The model reveal that for a given marginal costs destination currency imports prices responds proportionally to movements in nominal exchange rate, that is exchange rate pass through is complete. This follows from the assumption that elasticity of demand is constant. In order to get incomplete pass through in the monopolistic competition, we have assumed that the elasticity of the demand is increasing in firms' price. Here demand must be inelastic; therefore it will be optimal for monopolistic firm to adjust the mark up as a result of exchange rate fluctuation. This behavior lower the extend of pass through to significant level making the magnitude of exchange rate pass through to import prices to be low. It it important to note that this corresponds to Krugmans' concept of pricing to market (PTM) or what is also known as exchange rate adjustment.

Furthermore, ERPT elasticity depends on the functional shape of the demand curve. Dornbusch use the example of Cournot industry of foreign and domestic based firms that supply homogenous goods in the domestic markets with a linear demand curve, he found out that ERPT is incomplete. The pass through elasticity is increasing in the relative number of foreign firms in the domestic markets (see Bache 2007). However the explanation of the model considered by Dornbusch is static. Krugman (1987) asserted that ERPT is incomplete. and explanation for the incompleteness require model of imperfect competition, he consider a concept called "pricing to market" (PTM) and several studies are consistent with these explanations or considerations. For example Campa and Goldberg (2002) conduct a study of industrialised countries, and find that the ERPT lies between zero and one, the pass through is highest for imported goods prices, lower for the producer prices and lowest for the consumer prices.

2.2 Channels and Determinants of Exchange Rate Pass Through

it was noted that there are three channels which exchange rate pass through are shifted or transmitted to consumer prices (i) prices of imported consumption goods, (ii) domestically produced goods priced in foreign currency and (iii) prices of imported intermediate goods.

While the effect of exchange rate movements is direct in the first two channels[7], in the last channel exchange rate movements affect domestic prices less directly by changing the costs of production (see Sahminan, 2002). Similarly, According to Hyde and Shah (2004:3), they asserted that here are two broad channels that exchange rate movements can affect domestic prices, these are direct and indirect channels. This validates the assertion of Lafleche (1996:23), exchange rate movements can affect domestic prices directly through changes in the price of imported finished goods and imported inputs i.e. raw materials and capital goods. When the currency of the domestic country appreciates, it will leads to lower import prices of finished goods and inputs. Likewise, when the currency of the domestic currency depreciates it will result in higher import prices which are more likely to be passed on to consumer prices. Currency depreciation also causes a rise in imported inputs which may result in increase in the marginal cost of producers. Thus, this result to higher prices in domestically produced goods. But the indirect channel however, is said to occur when the exchange rate of the domestic country depreciates, the prices of the domestic products decrease making them relatively cheaper to foreign buyers. This will induce an increase in the demand size of exports and an increase in aggregate demand, Resulting to an increase of domestic prices.

Diagrammatically, we can illustrate the channels of exchange rate pass through, as direct and indirect channels as schematically, depicted by Lafleche (1996). This provides a simple way import prices affects consumer price through the direct and indirect channels.

[7] The pass-through process consists of two stages. In the first stage, exchange rate movements are transmitted to import prices. In the second stage, changes in import prices are transmitted to consumer prices.

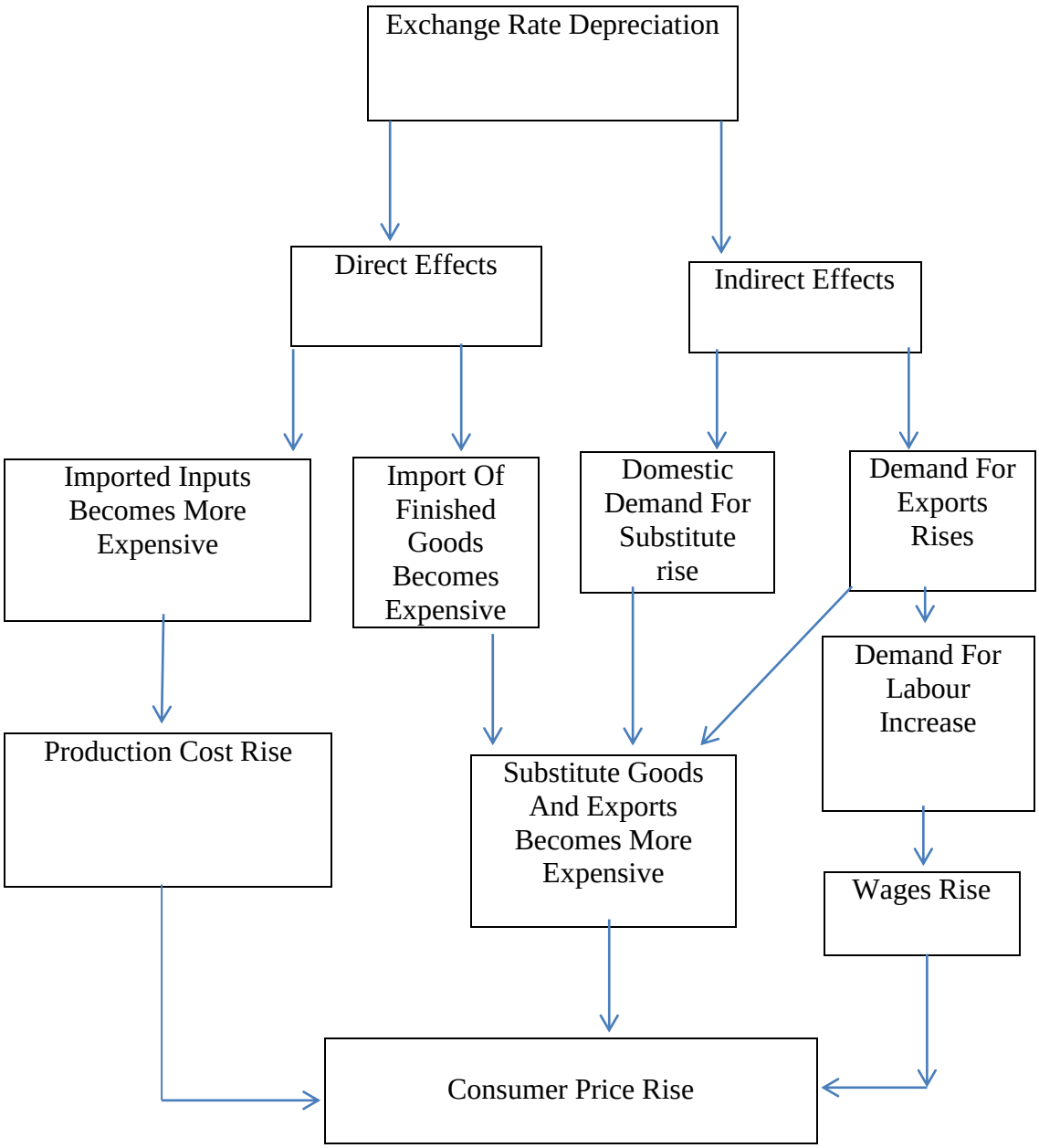

Figure: 1 Direct and Indirect Channels of Exchange Rate Pass-through to Consumer

Source: Adapted From Lafleche (1996)

The exchange rates pass through process of two stages, in the first stage exchange rate movements are transmitted to import prices, and in the second stage changes are transmitted to consumer prices as seen in the above diagram.

The dynamics of exchange rate pass-through elasticity differ considerably across countries. Therefore, it is pertinent to analyse whether the elasticity is influenced by the set of macroeconomic policies implemented domestically. It is vital for policy makers to understand the determinants of exchange rate pass-through to be able to predict changes in domestic prices and proper immediate action.

Inflation volatility: Average inflation is measured by the percentage change of CPI inflation. Inflation volatility is measured by the standard deviation of the percentage change in CPI inflation. Taylor (2000) asserted that responsiveness of prices to exchange rate rely positively on inflation. The theoretical foundation 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 via price-adjustments. Various writings augmented the assertion (e.g. Devereux and Yetman, 2008; Choudhri and Hakura, 2006; Mwase, 2006; Campa and Goldberg, 2005) that appears to be overall supportive of the Taylor hypothesis. This hypothesis is reflected adversely to a greater extent in developing economies than in developed economies. This is due to the fact that developing economies have higher rates of inflation when compared to the developed economies.

Trade openness: Trade openness has been measured by the ratio of exports and imports to GDP of a country. The more open a country in its trade the more should be the ERPT. According to Ca'zorzi *et al*. (2007), the more a country is open the more movements in exchange rates are transmitted through import prices into CPI changes. In other words the higher the size of imports and exports the greater the degree of ERPT through the direct and indirect channels of EPRT.

***Size of the economy*:** If the size of the economy is large, the larger the market share of domestic import substituting goods, larger the ratio of domestic firms to foreign firms, thus resulting to a more elastic demand faced by the foreign firms and the local currency pricing should be more prevalent in that country (Krugman, 1986; Dornbusch, 1986). Thus, the larger the size of a economy, the lower the extend of pass through. A higher income level

may result to and exhibit a higher degree of competition in the domestic market. In such a case, firms possess limited "pricing power" preventing them from rapidly and intensively passing exchange rate changes through to domestic prices.

Exchange rate volatility: (Krugman, 1989), and (Taylor, 2000) asserted that a given fluctuation in exchange rate is likely to be passed on to import prices in an environment where such fluctuations are common and transitory. Fear to lost market share will induce firm to stay away from frequent price changes if they suspect the change is transitory. Thus, the expected variability should have a negative effect on pass through elasticity. Similarly, According to Akofio-Sowah, 2009: 303), the effect of exchange rate volatility on pass-through is dependent on whether the effects are expected to be transitory or permanent. If transitory firms would rather adjust their profit margins rather than change prices, thus pass-though is minimized. However if the effects are viewed as permanent then prices would be changed resulting in exchange rate movements affecting prices to a greater degree (see Mnjama, 2011).

2.3 Empirical Literature On Advanced Economies

Generally, exchange rate pass through literature devote attention on the traded goods prices, import and export. Of recent a number of studies were conducted to estimate exchange rate pass through, the main findings in the literature is that the exchange rate pass through is incomplete. The study used regression analysis with the aggregate consumer prices as the dependent variable. (Choudri and Hakura, 2006) estimated the ERPT to consumer price inflation for 71 countries for the period of 1979-2000, their findings indicates that the average pass through extent for the set this of countries ERPT is classified as low. For high inflation countries estimate shows 0.4 in the first quarter, 0.14 after the four quarters and 0.16 after the twenty quarters. Similarly, studies conducted for the case of developed countries include (Anderton, 2003; Campa and Goldberg 2004; Campa *et al.* 2005; Gagnon and Ihrig 2004; Hahn (2003), and McCarthy, 2000). Cross country comparisons include (Choudri and Hakura, 2006; Frankel *et al.* 2005; and Mihaljek and Klau, 2000). Issues of whether exchange rate pass through decline since 1980s and 1990s remain a debate, especially of recent writings by (Campa and Goldberg, 2005) ascertain evidence that a variation in the commodity composition of manufactured imports contributed to a decrease in the pass through to aggregate import prices in many countries in the 1990s. Marazzi e tal (2005) examine a substantial drop in pass through to US import prices (see Bache, 2007). Menon (1995) analytically, conduct an empirical study on industrialised economies, using models of OLS

estimation techniques. He shows that exchange rate pass-through to be incomplete and varies significantly in these countries depending on the size and level of openness in these individual countries.

Similarly, Frankel *et al.* (2005) further contribute to the argument on the causes of differences in exchange rate pass-through. Using vector autoregressive (VAR) models they argue that countries with a larger proportion of multinational firms, smaller countries and developing countries tend to have higher exchange rate pass-through to domestic prices. Small countries experience higher pass-through compared to advance countries because advance countries where reaction to domestic consumer price increases from exchange rate depreciation. Again McCarthy (2000) empirically, conduct another study exchange rate pass-through on the aggregate level using import, producer and consumer prices in a VAR model for a number of industrialized countries. Like Menon (1995), he shows that pass-through tends to be positively correlated with the degree of openness of the economy.

In recent time[8], most if not all empirical evidence on exchange rate pass through use single equation, vector auto regression (VAR), structural vector auto regression (SVAR), and vector error correction model (VECM). For both the advanced, emerging, and developing economies as a method of estimating exchange rate pass through. (Example McCarthy, 2000; Hahn, 2003; Choudri, e tal, 2005; Faruqee, 2006; and Sanusi, 2010) to mention but a few. The strength of using structural VAR approach is that it takes explicit account of endogeineity of the exchange rate and allows the estimation of pass through to a set of prices. For instance import prices, producer prices, and consumer prices. For instance import prices, producer prices, and consumer prices. In the same vein, strength for using structural VAR is that, it becomes easy to estimate and evaluate ERPT easily. The estimate of the extend of exchange pass through using VAR has the inclusion of a nominal exchange rate, other price indices such as import prices, producer prices and consumer prices. Sometimes oil prices for export oriented economies are used as a measure of output gap, wages and even interest rates (see Bache 2007). Empirical literature on pass through reveals the multiplicity of econometrics methodologies and estimation techniques presently used in applied macro econometrics. In

[8] Some recent examples are the single-equation models in Campa & Goldberg (2005) and Marazzi *et al*. (2005), and the VAR and structural VARs in (McCarthy, 2000; Hahn, 2003; Mwase, 2006; Ito and Sato, 2007; Cazorzi *et al.*2007; and Sanusi, 2010).

some countries, such as Australia, Canada, and the United Kingdom, the enhanced credibility of monetary policy through the adoption of an inflation targeting frame work for monetary policy. In the United States monetary policy credibility was enhanced through maintaining commitment to low inflation following a disinflation and low exchange rate pass through. The proposition of Taylor (2000) has since become under constant verification and test. Campa and Goldberg (2002) applied OLS in a log linear model of import price pass through to find out whether pass is a micro or micro issue. Their findings suggest that ERPT pass through is less than one in the short run, but closer to one in the long run. The average pass across OECD is 60% over a quarter and 75% over the fourth quarter. US have the lowest pass through followed by Germany. Takhtamanova (2008) supports Taylor hypothesis for a set of fourteen OECD countries (see Razafimahefa, 2012).Many industrialised countries seem to have experienced a decline in exchange rate pass through to consumer prices in the 1990s, despite large exchange rate depreciation in many of them[9]. Even though several factors have contributed to this trend, in assessing extend of exchange rate pass through and whether it has indeed declined, has important implication for the design of monetary policy.

In explaining the phenomenon (Taylor, 2000) argued that the observed decline in the pass through can be explained due to a lower inflation environment and more stable environment has leads to a decline in the pricing power of firms.(Choudri and Hakura, 2001; Gagnon and Ihrig, 2001; Bailiu and Fujii, 2004) tested Taylor's assertion, the empirical findings support Taylors' proposition. The relationship between the monetary environment and inflationary environment is of importance. A lower inflation leads to a lower degree of exchange rate pass through[10] (Choudri and Hakura, 2001) show that estimated pass through tends to vary systematically with mean inflation rate. For countries with very high inflation, we find as in (Choudri and Hakura, 2001) that aggregate pass through is very high, and in many cases different from unity. This means there is a non-linear relationship between estimated pass

[9] Starting in the early 1990s, many industrialized countries reduced their inflation rates and entered a period of relative price stability. Although several factors are thought to have contributed to this trend, it is generally agreed that a shift towards more credible monetary policy regimes played an important role (see Bailliu and Fujii, 2004).

[10] The lower pass-through since the mid-1990s might have been partly caused also by other structural changes such as the declines in prices of imported goods due to higher productivity in producer countries or to shift of imports from more expensive countries to lower-cost countries, or rising distribution costs in the domestic price structure which increase domestic costs of imports in relation to import (producer) prices (see Razafimahefa, 2012).

through coefficient and average inflation rates. i.e. as inflation rises, pass through also rises. Devereux *et al.* (2004) augmented that countries with relatively low volatility of money growth will have relatively low rates of exchange rates pass through, While countries with relatively high volatility of money growth will have relatively high pass through rates.

On the micro side, producers may optimize expected profits by fully reflecting the changes in exchange rate into prices, say the consumer prices. This occur when the composition of the domestic economy possess features of imperfect competition. Obsfeld and Rogoff (1995) called this producer currency pricing (PCP). But in the case of competitive markets, producers to some extend producers bear the exchange rate changes or shock by reducing mark ups to keep market share. This kind of pricing behaviour was defined by Krugman (1987) as "pricing to market" here the prices are rigid and sticky due to imperfect competition in the market mechanism. A phenomenon called local currency pricing (LCP) persists. In the first case, that is producer currency pricing (PCP) the exporters or importers do not face much competition then mark ups or prices may be less responsive to fluctuations or exchange rate movement, in relation to the value of exporters or importers currency against the buyers. Therefore, in this situation exchange rate changes are fully passed into the buyers' currency and in turn producer shift cost effect to consumer price. Conversely, if the domestic markets are highly competitive, firms have no option than to safeguard their market share by absorbing part of the exchange rate changes, to accepts lower mark ups. For instance export to certain US industries such as autos alcoholic beverages depicted high pricing to market (PTM) or local currency pricing (LCP) and hence lower pass through, since exporters or importers want to sustain market share. More generally, empirical studies consistently found that manufactured goods exhibits lower pass through than agricultural goods (see for example Campa and Goldberg, 2005; and Marazzi *et al.* 2005).

One more significant factor that determines ERPT is the degree openness of the economy. For example lower degree of openness would cause the response to inflation and real exchange rate to be weaker (see Takhtamanova, 2012). The foreign firms change the price in response to real exchange rate fluctuations. Thus if firms begin to respond less to real exchange rate changes, the aggregate response of price will be also dampened. This is as a result lower degree of openness found in developing economies. Evidence revealed that the advanced countries are less prone to exchange rate pass through due high degree of openness, like in United States, China, Germany, France, Canada, Netherlands and UK.

The exchange rate pass through tends to be higher in countries with fixed exchange rate regimes than in countries with flexible exchange rate regime. For most advanced and emerging economies that adopted flexible exchange rate they indicatively recorded lower pass through. In contrast, most less developed countries like Angola, Benin, Zimbabwe, Namibia, Eritrea, Senegal and Cameroun to mention but a few. These countries have fixed exchange rates regimes and hence high ERPT (see Razafimahefa, 2012). Additionally, exchange rate pass through was generally acknowledged to be greater in lower income countries and relatively small in advanced economies. More so, ERPT is low in more open economies where there is high share of traded goods.

2.4 Empirical Literature On Emerging and Developing Economies

Enormous literatures on advanced economies were published, and small when compared to the advanced economies in relation to exchange rate pass through in emerging and developing economies. The emerging economies also play an increasing role in global trading, taken in general emerging economies now accounted for around 40% of world exports. Better than in 1990s when they record less than 30%. Clear estimation of the exchange rate pass through degree and pricing to market is highly important to have a good picture of ERPT (Bussiere and Peltonen, 2008).

Extensive literature survey on exchange rate pass through in central and Eastern European countries were published (see Beirne and Martin, 2009). They analysed using vector auto regression (VAR) model to explore the degree of exchange rate pass through in the eastern and central European countries. The results were as follows the degree of ERPT appears to be most prevalent in the Bulgaria, Estonia, and Latvia, where almost a one to one relationship can be observed. For example, a 1% fall in the nominal effective exchange rate (NEER) (i.e. depreciation) for Latvia increases domestic consumer prices by 0.97%. From the ERPT estimates the average across all countries in the east and central Europe is 0.605. in the fixed exchange rate countries (i.e. Lithuania, Bulgaria, Estonia, and Latvia) yields exchange rate pass-through to local prices yields 0.758. Transversely the more flexible exchange rate regime economies like Hungary, Poland, Czech Republic, Romania, Slovakia, the normal ERPT is 0.483. Lesser pass-through estimates appear to be apparent where inflation has become quieter over time (e.g. Czech Republic). The nature of the exchange rate regime in place may have had a robust role to play in contributing to low inflation. Similarly, a fixed regime should suggest a strong relationship between the exchange rate and nominal variables (e.g.

Prices) and therefore, a large ERPT. On the other hand, a more flexible regime should be linked with a lower extent of ERPT as the linkage between the exchange rate and prices deteriorates. Exchange rate pass through in East European countries experience different results as regards the size and or magnitude of the pass through (See Corricelli e tal, 2006). Studies by (Dabusinkas, 2003) estimate pass through to be zero in the example of Estonia. (Bitan, 2004) observes that average pass-through is 54% for Estonia using single equation technique. Mihajek and Klau (2001) estimate ERPT of 6% for the Czech Republic, 45% for Poland and 54% for Hungary. One set back of this approach however is the desertion of endogeineity questions. Darvas (2001) uses a time varying based equation methodology which permits for regime shifts, and estimated ERPT of 15% Czech Republic, 20% for Poland, 40% for Hungary and Slovenia. Similarly Corricelli (2006) employ co integrated VAR approach, the results show full pass through for Slovenia and Hungary 80% for Poland and 46% for Czech Republic. The ERPT estimates of the Central and East European countries suggest a high degree of pass through sensitivity. In deed we can say that evidence of low pass through does not hold for these economies as in the case of highly advanced countries.

More so, evidence from (Ito and Sato, 2007) used structural vector auto regression (SVAR) technique in investigating exchange rate pass through. Exchange rate pass through is found to be high in Latin American countries and Turkey, Than East Asian countries with exclusion of Indonesia. Particularly, Indonesia, Mexico and Turkey pass through has less significant degree. But Argentina displays a strong reaction of CPI to exchange rate shock (Ito and Sato, 2007). Similarly, (Ca'zorzi *et al.* 2007) employ the use of vector auto regression model to examine degree of pass through of exchange rate to CPI in 12 emerging economies in Asia, Latin America and Central Europe. The result suggested that emerging markets with only one digit inflation, mostly in the Asian countries, they tend to have low pass through to import and consumer prices. This is similar to the degree commonly observed in advanced economies. Therefore somewhat overturns the previous belief ERPT is always low advanced economies, a bit high for the emerging economies, and highest for the developing economies. (Ca'zorzi *et al.,* 2007)[11] findings indicates that low inflation notably in the Asia countries makes pass through to consumer prices small, which support the Taylor hypothesis. In Singapore, the estimation of the coefficient are found to be slightly negative, they are not significantly

[11] Cazorzi *et al.* 2007 found a link between macroeconomic environment and the exchange rate pass-through especially the inflation profile of an economy in the emerging markets.

different from zero. Therefore the phenomenon of slow and incomplete pass-through described by a number of empirical literature, can be seen as a success of monetary policy in achieving low inflation and relatively more stable economy in many advanced and some few emerging economies.

Empirical studies on exchange rate pass through (ERPT) for the African countries are very scanty. But there has been an Increased interest to analyse ERPT in African countries in recent years (e.g. Ogun, 2000; Bhundia, 2002; Mwase, 2006; Akofio- Sowah, 2009; Aliyu *et al.* 2009; Frimpong Adams, 2010; Sanusi, 2010; Adedayo 2012; and Razafimahefa, 2012). Ogun (2000) conduct an empirical study on ERPT and export prices for the Nigerian economy. How export prices react to exchange rate changes. The study used quarterly data ranging from 1986 to 1995 using ordinary least squares (OLS) method. The results obtained suggested that 93% of the exchange rate changes are reflected in the price of manufactured exports. The author considers this to the fact that 75% of the data was generated due to dearth of data availability. The studies suggested the prevalence of market segmentation in the manufactured export sector of the country. The Author opines that the manufactured export firms price discriminate between the domestic and export markets. Thus as a result the exchange rate changes may not usually be reflected fully in the domestic price of manufactured export goods of the country (See Mnjama, 2011). Bhundia (2002) carried out an empirical investigation on ERPT in South Africa which Focused on CPI inflation using monthly data from 2000-2001 under a structural vector auto Regression model. This period was chosen as it was when monetary policy had the most Impact on inflation. The findings obtained indicated that average pass-through is low. However for nominal shocks it appears to be much higher. On average, eight quarters after a 1 % shock to the (nominal effective exchange rate (NEER), will result in a 0.12 % increase to the CPI, giving rise to a pass-through Elasticity of 12%.

It is also noted that exchange rate shocks result in a steady increase over time in the level of CPI. Mwase (2006) studied the effects of exchange rate changes on consumer prices in Tanzania using structural VAR models with quarterly data spanning from 1990: Q1 to 2005: Q1. The analysis was done using both the entire period and by dividing the sample into the periods before and after 1995: Q3. This was done to analyse how pass-through evolved in the 1990's. The first sample captured the period characterised by passive monetary policy with high and volatile inflation while the second captured the period characterised by depreciation

and Declining and stable inflation. The results for the full period indicate a significantly low level of pass-through with a 10% exchange rate appreciation resulting in a 0.05 decrease in Inflation. The sub-sample results indicated a significant decrease in the short run ERPT to Inflation in the second sample. The first period impulse response results indicated that a l0% Depreciation during the period 1990: Q1 to 1995:Q3 results in a 0.17% increase in inflation With pass-through effects rising to 0.89% in 12 periods. In contrast the period after 1995:Q3 showed that 10% depreciation is associated with a 0.03% decrease in inflation with pass-Through effects rising to 0.23% in 12 periods. (see Mnjama, 2011).

Akofio-Sowah (2009) conducted a study on 27 developing countries, 15 in Sub-Saharan African and 12 in Latin American to determine whether there was a link between ERPT and the monetary regime: pegged, currency board and dollarization of a country. The period covered was between 1980 and 2005. He found ERPT to be incomplete and significantly influenced by the inflationary environment. The regimes that succeeded in reducing inflation tended to have lower degrees of ERPT. This was seen in the common market east African countries (COMESA) in Africa that had high levels of inflation resulting in higher degrees of ERPT as compared with other countries which the author attributed to the monetary regime adopted. Latin America also showed a positive relationship between ERPT and the inflation environment. The effect of size and trade openness on ERPT were not significant for both sub-Saharan Africa and Latin America while the effect of exchange rate volatility is shown to be positive and significant in Sub-Saharan Africa and significantly negative in Latin America. The author explain that, this is because exchange rate movements are perceived to be permanent in Sub-Saharan Africa and transitory in Latin America (see Mnjama, 2011). Moreover, (Sanusi, 2010) studied exchange rate pass through, using structural vector auto regression (SVAR) model to estimate pass through effect of exchange rate pass through changes to consumer prices. The Findings evidently showed that pass through to consumer prices is in complete, although substantially high which differed from another study for Ghana by Frimpong and Adams (2010), according to the author large pass through is plausible given Ghana's history of massive exchange rate depreciation that coexisted with high inflation.

CHAPTER 3

PRELIMINARY ANALYSIS

3.1 Exchange Rate Regime and Inflation Dynamics In Nigeria

Exchange rate volatility is accompanied by economic costs to an economy[12] as such most countries have engaged in exchange rate policy reforms. In particular, many Sub-Saharan African countries have moved towards the independence of their Central Banks to implement different forms of exchange rate systems. This situation has permitted some of these countries to achieve maintainable levels of growth and development although some have become worse-off with it. Gluts of studies in recent years have intensive attention on this occurrence (see Bakare, 2011). In Nigeria, exchange rate policy has undergone through many changes since 1986. In analysing the dynamism we categorized periods of exchange rate policies periods into three paces, the pre- structural adjustment program (SAP) era, structural adjustment program (SAP) era in 1986 and post structural adjustment program (SAP) era. In the pre-SAP era (1970-1986), Nigeria adopted fixed exchange rate, between 1970 and 1975 due to the operation of an independent exchange rate system, then the Pound Sterling ceased to serve as a direct external anchor for the Nigerian currency. This results to appreciation of the exchange rate. In another case is the depreciation in the value of the Naira between 1976 and 1977 as a result of the introduction of US dollar as one of the reference currencies. The period between 1986 and 2002, the floating exchange rate policy was introduced and the value of the Naira steadily depreciated. Similarly, in 1986 and 2001 due to some factors among which are over valuation of the Nigerian Naira, excess demand of foreign exchange over supply, excess liquidity in the economy, capital flight from the economy, to mention but a few. with the approval of the Structural Adjustment Programme (SAP) in 1986, there was a sequential fall in fiscal deficits as government detached subsidies and compact her participation in the economy. But by way of the effects of the Structural Adjustment Programme (SAP) policies gathered motion, there was a fall in the growth rate of Gross

[12] For example, persistent price variability and balance of payments problems.

Domestic Product (GDP) in 1990 from 8.3% to 1.2% in 1994, with inflation mounting from 7.5% in 1990 to 57.0% in 1994. The devaluation of the Naira by the Central Bank of Nigeria (CBN) through the Second Tier Foreign Exchange Market (SFEM) led to a decrease in agricultural outputs as machines and raw materials generally imported were out of scope. It is important to note that the Structural Adjustment Programme (SAP) in relation to exchange policy generated inflationary pressure in the Nigeria due to depreciation of naira. The failure of the flexible exchange rate mechanism (the AFEM introduced in 1995 and the IFEM in 1999) to ensure exchange rate stability, managed floating exchange rate was re-introduced on July 22, 2002 known as the Dutch Auction System (DAS). But in 2002, the Naira appreciated due to the introduction of Dutch auction system (DAS) based on market-oriented approach to price determination of which the economic implication resulted to relative stability in the exchange rate movement in the Nigerian economy, and therefore, making inflation milder (see Omojimite and Akpodje, 2010; and Bakare 2011). The DAS was conceived as a two-way auction system in which both the CBN and authorized dealers would participate in the foreign exchange market to buy and sell foreign exchange. Subsequently, the wholesales Dutch Auction System (WDAS) was introduced in February 20, 2006. The establishment of the WDAS was also to expand the foreign exchange market in order to have a favorable exchange rate. The wholesales Dutch Auction System (W-DAS) is a managed floating exchange rate mechanism. Batini (2004) reaffirms that Nigeria's exchange rate arrangement is a managed float, according to the IMF member countries' exchange rate regime classification (See Fischer, 2001). More specifically, in July 2002 with the reintroduction of bi-weekly Dutch Auction System (DAS) by means of an operative system for its foreign exchange market to switch the Interbank Foreign Exchange Market (IFEM). The Dutch Auction System (DAS) is a technique of exchange rate determination through auction where bidders pay according to their bid rates and where the presiding rate is reached at with the last bid rate that clears the market. under the DAS the exchange rate is system is largely determined by the bids made by commercial banks on behalf of their customers. So the change back to a DAS shows that Nigeria seems to desire for more, elasticity in the exchange rate is an indication that Nigeria seems to be deciding for highly effective monetary regime resolution to stabilize the prices.

Figure 1b shows the relationship between the nominal exchange rate (USD: Naira) and inflation in Nigeria. An increase in the exchange rate means an appreciation, while a decrease indicates depreciation of the exchange rate which is shown on the vertical axis from figure 1b.

Despite the numerous effort by the government to stabilise the exchange rate, the value of naira depreciated throughout 1980's. For instance it depreciated from 1.75 to 7.4 between 1986 and 1989 with corresponding inflation rate of 5.7 to 50.4 respectively. On the whole the Nigerian naira has depreciated. More especially between 1986 and 1994 when the exchange rate depreciation was around 21.9 percent, which leads to record high inflation of 57 percent in the economy. The policy of guided or managed deregulation pegged the Naira at N21.9 against the US dollar in 1994. This deregulation increased it to N92.3=S1.00 in 1999. Subsequently, it depreciated further to N120.57 in 2002 and N132.88 in 2004. Inflation in Nigeria remains high until 2006 when it declined to 8 percent as a result of slight appreciation of the exchange rate to 128.6. With the impact of the Global Financial Crisis that sets in 2009, the naira depreciated to N148.9 and at the end of 2012 the of naira stands at N156=S1.00. It is important to note that the evolution of the inflation rate has closely followed the exchange rate developments. For instance, the inflation rate averaged about 8 percent between 2006 and 2012, corresponding to the period with relatively stable exchange rate. The managed floating exchange rate regime or arrangement i.e. the Retail Dutch Auction System (RDAS) and Wholesale Dutch Auction System (WDAS) adopted in 2002 and 2006, respectively, caused a slight appreciation of the exchange rate that makes inflation relatively lower compared to the past decades.

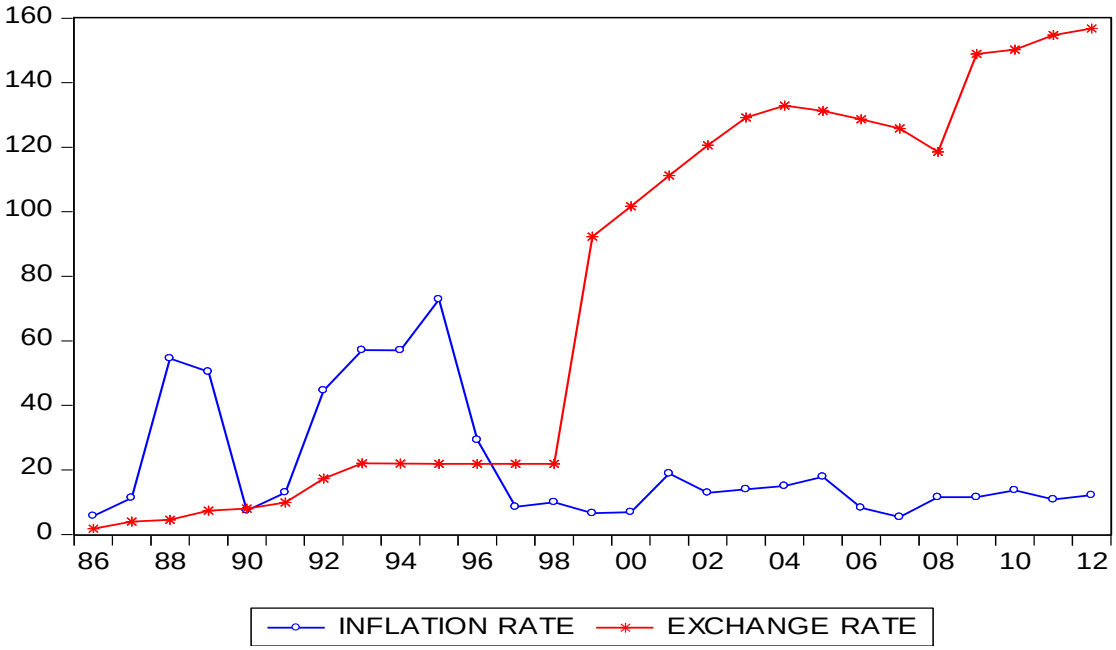

Figure 1b: Nominal Exchange Rate (Nigerian Naira per US Dollar) and Inflation Developments 1986-2012

Sources: Computed from World Bank data.

3.2 Monetary Policy In Nigeria

Monetary policy is an economic management technique to restore the economy on the rail of Sustainable economic growth and development. It has been the pursuit of nations and formal assessment of how money affects economic aggregates dates back to the time of Adams Smith and later championed by the monetary economists, like Milton Friedman. Since the expositions of the role of monetary policy in influencing macroeconomic objectives like economic growth, price stability, equilibrium in balance of payments and host of other objectives, monetary authorities are responsible for using monetary policy to grow their economies. In Nigeria, monetary policy has been used since the Central bank of Nigeria was saddled the responsibility of formulating and implementing monetary policy.

Monetary policy operates largely through its influence on aggregate demand in the economy. It has little direct effect on the trend path of supply capacity. Rather, in the long run, monetary policy determines the nominal or money values of goods and services that is, the general price level. An equivalent way of making the same point is to say that in the long run, monetary policy determines the value of money movements in the general price level. This

indicates how much the purchasing power of money has changed over time. In this sense, inflation is a monetary phenomenon. However, monetary policy changes do have an effect on real activity in the short to medium term. Although monetary policy is the dominant determinant of the price level in the long run, there are many other potential influences on price-level movements at shorter horizons. There is a link several links in the chain of causation running from monetary policy changes to their ultimate effects on the economy.

The Monetary Policy Committee (MPC)[13] sets and determines the short-term interest rate at which the Central Bank of Nigeria deals with the money markets. Decisions about that official interest rate affect economic activity and inflation through several channels, which are known collectively as the 'transmission mechanism' of monetary policy. The triumph monetary policy strategy requires an understanding of the relationship between Operating instruments of monetary policy and the ultimate goals such as the output and price stability. Monetary policy affects the macroeconomic variables through monetary transmission channels. There are several transmission channels (e.g. the interest, asset price, exchange rate channels) that have been identified in the literature.

The monetary policy transmission mechanism can be divide it into three main channels: the interest rate channel, the exchange rate channel and the credit channel.

The interest rate channel refers to the effect of the central bank's policy rate on household decisions to save or consume, and firms' decisions to invest. As prices and inflation expectations are sticky, a reduction in the policy rate will also reduce the real interest rate in the economy. This makes it more beneficial for households to consume and borrow since it is less beneficial to save. Similarly, it becomes more beneficial for companies to borrow and invest. The increase in demand in the economy gradually results in prices and wages to increase more quickly.

In addition, a reduction in the policy rate normally weakens the domestic currency. Since prices are sticky, the exchange rate also weakens in real terms. Weaker real exchange rate makes domestically-produced goods cheaper compared to foreign goods. This leads to an increase in the demand for exports and in the demand for products that compete with imported goods, which gradually results in inflation rising as well. This exchange rate channel also has a more direct effect on inflation. Banks do not play a prominent role in either the interest rate

[13] See Central Bank of Nigeria (CBN) monetary policy communique for various policy decisions on the monetary policy rate.

channel or in the exchange rate channel. However, the banks and credit supply play a central role in the credit channel. A lower interest rate generally leads to an increase in the price of various kinds of assets. For example, it leads to an increase in the net present value of the future cash flows of a financial asset, such as a share. This means that the price of the financial asset increases. When the interest rate is low, the demand for and prices of real assets such as houses also increase. These assets are used as collateral for loans and the collateral increases in value, the banks become more willing to lend money. In addition, the future wages of households and the future profits of companies rise when demand increases as a result of the lower level of interest rates. On the whole, the credit channel is a mechanism through which the effect of changes to the policy rate is enhanced through lending from the banks.

The banks also play a role in the credit channel of the traditional transmission mechanism. But it is a different role from the one they play in the risk-taking channel. In the credit channel the increase in lending is due to an improvement in the debtors' collateral and repayment capacity which makes it less risky for banks to lend money. In the risk taking channel lending increases because the banks are more willing to take on higher risks. The risk-taking channel is therefore more about the behavior of banks than about how a change in interest rates affects the situation of the borrowers (See Apel and Claussen, 2012).

3.3 Conduct Of Monetary Policy In Nigeria

In Nigeria the period of monetary policy can be broadly classified into two, the regime of direct controls and institutional development (1973-1992), and the regime of direct and indirect controls, financial reform and deregulation. The adoption of Structural Adjustment Programme (SAP) in September 1986 marked the period of financial reform and deregulation. The direct control measures aimed at influencing the cost and availability of credit to the various sectors of the economy, the regulation of deposit and lending rates, and sectorial credit allocation guidelines. Indirect technique of monetary policy seeks to achieve the same objectives but through the use of market related instruments, such as Open Market Operations and Discount Window Operations, and the effects of these operations are transmitted to the rest of the economy through the financial markets (see Dada A Eme, 2009).

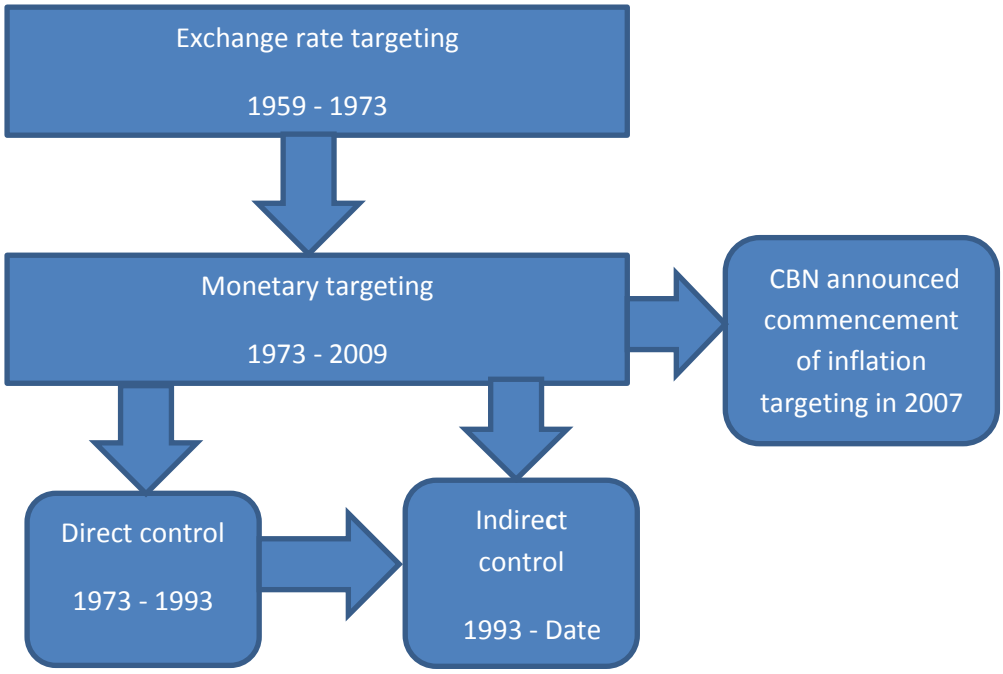

Figure 2: Schema Of The Conduct Of Monetary Policy In Nigeria

Source: *Adopted From Chibundu 2009, And Modified By The Author.*

The period 1959-1973 is known as the direct control era. The major objective of monetary policy during this period was to promote rapid and sustainable economic growth. To this end, the CBN declare and impose quantitative interest rate and credit ceilings on the money deposit of banks and sustained the sectoral credit allocation policy to 'preferred' sectors (agriculture, manufacturing, and residential housing) as against the less 'preferred sectors' like imports and general commerce. This classification as explained by (Nnanna, 2001:5 cited in Omotor, 2009) enabled the monetary authorities to direct financial resources at concessionary rates to sectors considered as priority areas. These rates were typically below the CBN–determined minimum rediscount rate (MRR). The CBN also compelled banks to deposit with it special deposit any shortfall in the allocation of credit to the designated preferred sectors. However, this policy of direct control in the allocation of credit to the priority sectors did not meet the prescribed targets and failed to impact positively on investment, output and domestic prices (see Omotor, 2009).

Similarly, the Central Bank of Nigeria (CBN) in 1959, initially, the conduct of monetary policy in Nigeria under the colonial government was largely determined by the existing

economic conditions in Britain between the periods 1959-1973. The instrument of monetary policy at that time was the exchange rate, which was fixed between the Nigerian pound and the British pound. This was very convenient, as fixing the exchange rate provided a more effective mechanism for the maintenance of balance of payments viability and for control over inflation in the Nigerian economy. This fixed parity lasted until 1967 when the British pound was devalued (See Nnanna, 2001). After 1973 the CBN stress commitment to monetary targeting which has been the major anchor of monetary policy framework in Nigeria with either or both the narrow and broad money serving as intermediate targets. The implementation of monetary policy under monetary targeting demands the announcement of monetary aggregate targets at the beginning of every year by the CBN. Appropriate operating targets are then used to influence the expected course of monetary policy. Since the beginning of the Open Market Operations (OMO) in 1993, the use of base money as the operating target has been stressed. This implies that base money is used as the operating target while the difference between the maximize level of reserves and the actual becomes the target of OMO within the framework of liquidity management. The discounting window operation serves as the adjustment valve for meeting short-run reserve needs of the banking system (see Dada, 2009).

The phase of indirect control began in 1993, the monetary policy framework of indirect controls involved the use of market instruments, particularly the Open Market Operations (OMO) introduced at end of June 1993 and is conducted wholly on Nigerian Treasury Bills (TBs), including Repurchase Agreements (REPOS). The OMO which is complemented by the CBN with the use of reserve requirements are the Cash Reserve Ratio (CRR) and the Liquidity Ratio (LR). The CRR has been progressively increased from 6 percent in 1995 to 12.5 percent in April, 2001. In 2005 there was an upward adjustment of the CRR by a total of 150 basis points and subsequent reduction. The Minimum Rediscount Rate (MRR) is also used by the CBN to influence the level and direction of other interest rates. The changes in the rate indicate whether the monetary authorities wish to adopt a policy of monetary tightening or otherwise. The rate was 16.5 in December 2002, 15 percent in June 2004, 13 percent in December 2005 and 10 percent in December 2006 (see Omotor, 2009).

Furthermore, Omotor (2009) observed that in 2006, the CBN also introduced a new interest-rate determination scheme which establishes an interest-rate spread of three percentage points that is above and below a short-term Monetary Policy Rate (MPR). The MPR fixed at 10 percent in 2006 was reduced and retained at 8.0 percent in August 2007. Consequently, the

annual headline inflation rate which averaged 17.9 percent in 2005 stood at 8.4 percent in 2006. Inflation stayed within single-digit of 6.4 percent in the first half of 2007. The exchange rate on the other hand has also faired relatively well. Apart from a drop in the market premium in the first week of June 2006 from N24 to N9.00, the naira exchange rate appreciated from US$1/N151 in March 2006 to US$1/ N126.88 at end-March 2007 and further appreciated to US$1/ N126.05 at end-June, 2007 (Central Bank of Nigeria Communiqué of the Monetary Policy Committee: various issues).

The major challenge to price stability in 2009 through the first half of 2010, was moderating the double digit, year-on-year headline inflation rate from the 3-year high of 15.1 per cent at end-December 2008 to single digit. The CBN continued to use the Monetary Policy Rate (MPR) to signal the direction for other money market rates in the domestic economy (see CBN, Monetary policy review).Similarly, in March 2013 the central bank of Nigeria maintain its position to retain the monetary policy rate at 12 per cent. This policy rate kept the inflation rate on target range.

CHAPTER 4

METHODOLOGY

4.1 Structural VAR (SVAR) Framework

The SVAR methodology makes use of economic theory to trace the contemporaneous association between the variables of interest (Sim, 1986; Bernanke, 1986; Stock and Watson, 2001). The model requires an "identification assumption" to allow contemporaneous correlations to be causally identified. For example exchange rate and the inflation rate are expected to influence each order in most if not all theoritical models. In order to determine the role of exchange rate fluctuations in causing movements on domestic consumer prices it is most appropriate to estimate a system that will treat them as endogenous. Similarly, monetary policy affect exchange rate and inflation simultaneously. For instance in the floating exchange rate regime, the exchange rate is an endogenous variable that responds to economic policies (Ito and Sato, 2007). Fluctuations in the exchange rate have large effects on macroeconomic variables, SVAR therefore, is a useful approach that permits such interactions among the exchange rate and other macroeconomic variables.

The SVAR analysis of the exchange rate pass-through has advantages over a single equation analysis. First, SVAR approach allows us to identify structural shocks through a structural decomposition of innovations. Moreover, the effects of structural shocks to other macroeconomic variables on domestic inflation are also investigated under a SVAR framework. Previous studies typically analyze the exchange rate pass-through into a single price index by using a single-equation-based approach. In contrast, SVAR approach allows us to investigate dynamically the exchange rate pass-through elasticity into domestic consumer prices.

The SVAR model is represented as follows[14]

[14] See Enders, (2004)

$$BX_t = \Gamma_0 + \Gamma_1 X_{t-1} + \varepsilon_t \qquad (3)$$

where *B* and Γ_1 are (nxn) and Γ_0 is an (nx1) matrices.To normalize the vector appearing on the LHS of this equation, we need to multiply the equation by the inverse of the matrix B. The multiplication by B inverse allows us to obtain VAR in standard form (unstructured VAR)[15] as follows:

$$B^{-1}BX_t = B^{-1}\Gamma_0 + B^{-1}\Gamma_1 X_{t-1} + B^{-1}\varepsilon_t \qquad (4)$$

$$X_t = A_0 + A_1 X_{t-1} + e \qquad (5a)$$

Hence equation (4) and (5a) are equal

$$X_t = B^{-1}\Gamma_0 + B^{-1}\Gamma_1 X_{t-1} + B^{-1}\varepsilon_t = A_0 + A_1 X_{t-1} + e_t \qquad (5b)$$

where $A_0 = B^{-1}\Gamma_0$, $A_1 = B^{-1}\Gamma_1 X_{t-1}$, $e_t = B^{-1}\varepsilon$ .Therefore, the vector e_t of the reduced form errors is related to the vector ε_t of innovations by the following system of structural[16] equations:

$$e_t = B^{-1}\varepsilon_t \qquad (6a)$$

As such e_t is assumed to have zero mean, constant variances, and are serially uncorrelated, but because of the matrix B^{-1} there has to be contemporaneous correlation between innovations. A SVAR model can be used to identify shocks and trace them out by employing impulse response analysis and forecast error variance decomposition (FEVD) by imposing restrictions on the matrices A and/or B. SVAR model is a structural model, it departs from a reduced form standard VAR model and only restrictions for A and B can be added. It should be noted that the reduced form residuals can be retrieved from a SVAR model by $e_t = B^{-1}\varepsilon$ and its variance-covariance matrix is thus; $\mathbf{B^{-1}DB^{-1}} = \Sigma$.

[15] For a further detail review and discussion on the methodology, advantages and disadvantages of alternative unstructured VAR and structural VAR (see Stock and Watson, 2001).

[16] For a review of the SVAR methodology (see Bache, 2007) on econometrics of exchange rate pass through

$$\Sigma = \begin{bmatrix} \sigma_1^2 & \sigma_{12} & . & \sigma_{1n} \\ \sigma_{21} & \sigma_2^2 & . & \sigma_{2n} \\ . & . & . & . \\ \sigma_{n1} & \sigma_{n2} & . & \sigma_n^2 \end{bmatrix} \qquad (6b)$$

Since Σ is symmetric, it is important to note that without some restrictions, the parameters in the SVAR are not identified. We assume that the model contains *n variables (excluding the constant term).* For identification purposes, at least n^2 *independent restrictions on parameters of the structural form are needed to exactly identify the system.* Structural shocks are supposed to be mutually uncorrelated; therefore the variance-covariance matrix of the structural shocks is required to be diagonal. Without loss of generality, assuming all structural shocks are mutually independent, the standard deviations of the structural shocks are normalized to one. That is, the variance-covariance matrix of the structural shocks is set to the identity matrix, which yields *n(n +1)/2 restrictions.* Consequently, it is clear that we need $n^2-n(n+1)/2=n(n-1)/2$ *restrictions are needed*[17]. These restrictions can now be imposed either on the contemporaneous or on the short run properties of the system.

4.2 An Empirical Model of ERPT for The Nigerian Economy

This study imposes restrictions to retrieve the exchange rate innovations, while a contemparaneous association holds among the variables to the short run fluctuations in the exchange rate, inflation and monetary policy. We consider a multivariate system of the economy which included the consumer price index *(CPI), output or aggregate demand (Y), the monetary policy rate (MPR), the nominal effective exchange rate (NEER), and the broad money (M2). M2* is included to capture the monetary aggregate targeting in the economy. Similarly, *M2* can influence both the private and public sector activity in the short run, as such the *M2* also captures the effect of the decisions of these agents when inflation rate increases or decreases. *The MPR is the monetary policy reaction function used by the monetary authorities* to influence the overall economic activity and it also captures the lite inflation targeting in the Nigerian economy. It is worthy to note that both a monetary policy rate and a broad money supply variable are included in the model to capture the general conduct of the monetary policy and its effects on the price level in the Nigerian economy. In our five-variable structural VAR model we incorporate theory-consistent assumptions or restrictions that

[17] Necessary condition for exact identification.

identify the causal influence of exchange rate and monetary policy on domestic price innovations using Sim-Bernanke, (1986) structural decompositions[18].

The baseline empirical model is estimated as a standard form VAR with five endogenous variables to model the Nigerian economy. This study follows Mwase (2006) and Sanusi (2010) which assumed that the economic agents' expectation tend to rely on past developments, implying that expectations are principally adaptive. For example, a track record of prudent and credible monetary policy in controlling inflation developments can highly influenced the adaptive expectations of the agents. If the government policy stance is prudent, credible and has a strong monetary discipline the agents will have confidence for most of the periods expecting inflationary pressure to be amielorated. Hence, it is assumed that the expectations are equivalent to a linear projecction based on lags of the endogenous variables in the VAR.

Recalling equation (5a) that is given above, the VAR can be interpreted as the standard form of a structural VAR. The standard form representation of the model may be written as:

$$X_t = A_0 + A_1 X_{t-1} + e$$

Given that X_t = [ΔY $\Delta M2$ ΔMPR $\Delta NEER$ ΔCPI] is a 5×1 row vector of the endogenous variables observed at time t, where ΔY is log nominal output, ΔM2 denotes the log of a monetary aggregate such as M2, and ΔMPR gives the monetary policy rate, ΔNEER represents the log of nominal effective exchange rate, ΔCPI is the log Consumer price index.. Also recalling that from equation 5, this is the same as $\mathbf{A(L)}\, X_t = A_0 + e_t$ ignoring deterministic terms, the unrestricted k-th order VAR for X_t is given by

$$\mathbf{A(L)}\, x_t = e_t \qquad (7)$$

where $\mathbf{A(L)} = I - \sum_{i=1}^{k} AiL^i$ is an 5x5 matrix polynomial in the lag operator L ($L^j X_t \equiv X_{t-j}$), *A1, A2,.....,Ak* are 5×5 matrices of autoregressive coefficients, and

$$e_t = \left[e^{ny} e^{bm} e^{mr} e^{er} e^{pi}\right] \qquad (8a)$$

This is a 5×1 row vector of error terms. The errors are assumed to be serially independent Similarly, the structural shock (ε_t) i.e. the innovations are also assumed to be independently

[18] See Nwase (2006) and Sanusi (2010) for the analysis of exchange rate pass through for Tanzania and Ghanaian economy respectively.

and normally distributed with mean zero and variance-covariance matrix i.e. $\varepsilon_t \sim i.i.d(0, \sigma_{\varepsilon i}^2)$ .The ε_t innovation could be called "shocks" and they are economically identifiable (i.e., can be output shocks, money supply shocks, monetary policy rate shocks, exchange rate shocks, and consumer price inflation shocks). Therefore, the structural shocks vector is represented by:

$$\varepsilon_t = \left[\varepsilon^{ny} \varepsilon^{bm} \varepsilon^{mr} \varepsilon^{er} \varepsilon^{pi}\right] \qquad (8b)$$

where $\varepsilon^{ny}, \varepsilon^{bm}, \varepsilon^{mr}, \varepsilon^{er}, \varepsilon^{pi}$ represent the output, broad money, monetary policy rate, nominal exchange rate and consumer price index shocks respectively.

From (4) and (5a) we have obtained (6), which is an important characteristic we use in our model that can be expressed as:

$$e_t = B^{-1}\varepsilon$$

But **A(L)** = B^{-1} which is the 5x5 matrix defined below. Thus:

$$\begin{bmatrix} e^{ny} \\ e^{bm} \\ e^{mr} \\ e^{er} \\ e^{pi} \end{bmatrix} = \begin{bmatrix} 1 & \eta_{12} & \eta_{13} & \eta_{14} & \eta_{15} \\ \eta_{21} & 1 & \eta_{23} & \eta_{24} & \eta_{25} \\ \eta_{31} & \eta_{32} & 1 & \eta_{34} & \eta_{35} \\ \eta_{41} & \eta_{42} & \eta_{43} & 1 & \eta_{45} \\ \eta_{51} & \eta_{52} & \eta_{53} & \eta_{54} & 1 \end{bmatrix} \begin{bmatrix} \varepsilon^{ny} \\ \varepsilon^{bm} \\ \varepsilon^{mr} \\ \varepsilon^{er} \\ \varepsilon^{pi} \end{bmatrix} \qquad (9)$$

The first variable (i.e. the output) is a representative of the real sector, second, third, fourth variables and the last variable represents the monetary sector. The aim of monetary and real sector variables at the same time is to take into account the fact that policymakers reactions to shocks are different in relation to exchange rate plan or regimen in place designed to give a positive result and to achieve monetary policy objectives. İn other words the variable choice allows to take into consideration the exchange regime in view and inflation or monetary targets. This is important in analysing the latest exchange regime and the monetary policy stance of inflation targeting in 2007 with acute take off in 2009.Vitally the pressing aim is also to see how this monetary framework explains exchange rate pass through (ERPT) and the degree in Nigeria economy. Therefore we employ the path of structural vector auto regression to impose contemporaneous short run restrictions for non-recursive system and then impose then impose restrictions in the B^{-1} which is the passage matrix in view of the exchange rate pass through and the latest monetary policy position of the Nigerian economy.

4.3 Identification Constraint

In this work we adopt the SVAR methodology developed by Bernanke (1986). Two types of restrictions are mentioned in the literature; short-run restrictions and long-run restrictions. To identify the structural shocks, we choose to identify the system with short-run constraints[19]. In other words, we will constrain certain variables not to have long-term effects.

In our model of *n = 5* endogenous variables, there should be n^2=25 independent restrictions on parameters of the structural form. We set the variance-covariance matrix of the structural shocks ε_t to the identity matrix, thus *n(n-1)/2 =10 restrictions are needed for full identification*. Throughout this study, as noted above we will make use of short-run restrictions only. These are restrictions that are directly imposed on B^{-1} which determines the contemporaneous reactions of the variables to structural innovations.

The identification of shocks in a system of 5 variables requires 10 constraints: the right-hand side, is a mixture of the structural shocks, (exogenous forces of the system), and of the matrix B^{-1} which describes the coefficients associated to these shocks.

$$B^{-1}= \begin{bmatrix} 1 & \eta_{12} & \eta_{13} & \eta_{14} & \eta_{15} \\ \eta_{21} & 1 & \eta_{23} & \eta_{24} & \eta_{25} \\ \eta_{31} & \eta_{32} & 1 & \eta_{34} & \eta_{35} \\ \eta_{41} & \eta_{42} & \eta_{43} & 1 & \eta_{45} \\ \eta_{51} & \eta_{52} & \eta_{53} & \eta_{54} & 1 \end{bmatrix} \qquad (10)$$

The following constraints are drawn from the theoretical assumption commonly accepted since the work of Blanchard and Quah (1989), which is about the difference between supply and demand shocks. Indeed, economic theory supposes that supply shocks (the output equation as a supply shock) can affect economic activity both in the short term and long term. Whereas the demand shocks affect economic activity only in the short term, for example the nominal demand shock (i.e. monetary shocks). This enables us to identify *four restrictions* ($\eta_{12}\,;\eta_{13};\ \eta_{14}\,;\eta_{15}=0$ *).* Similarly, we also impose another *four restrictions on the two demand shocks; that is, in the second and fourth equations* $\eta_{23}\,;\eta_{24}\,;\ \eta_{25};\ \eta_{45}=0$*, which is the monetary and exchange rate shock respectively.* Finally, the last *two restrictions are on*

[19] The zero restrictions imposed in (11) are similar to (McCarthy, 2000; Hahn, 2003; Mwase, 2006; Ito and Sato, 2007; and Sanusi, 2010).

the third equation related to the monetary policy reaction function ($i.e., \eta_{34}$; $\eta_{35} = 0$) as shocks that have both short term and long term effects on consumer price inflation with exchange rate shock as the catalyst.

Thus, the matrix representing the effects of structural shocks on the variables of our model is the following one:

$$\begin{bmatrix} e^{ny} \\ e^{bm} \\ e^{mr} \\ e^{er} \\ e^{pi} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ \eta_{21} & 1 & 0 & 0 & 0 \\ \eta_{31} & \eta_{32} & 1 & 0 & 0 \\ \eta_{41} & \eta_{42} & \eta_{43} & 1 & 0 \\ \eta_{51} & \eta_{52} & \eta_{53} & \eta_{54} & 1 \end{bmatrix} \begin{bmatrix} \varepsilon^{ny} \\ \varepsilon^{bm} \\ \varepsilon^{mr} \\ \varepsilon^{er} \\ \varepsilon^{pi} \end{bmatrix} \qquad (11)$$

Note that each line can be viewed as an equation. This may be seen by multiplying through each term on the right-hand side[20]. Each reduced-form shock is a weighted average of the selected structural shocks. The elements $\eta_{12} \dots \dots \dots \eta_{45}$ represent the weights attached to the structural shocks[21]. For example, the equations are:

$$e^{ny} = \varepsilon^{ny} \qquad (12)$$

$$e^{bm} = \eta_{21}\varepsilon^{ny} + \varepsilon^{bm} \qquad (13)$$

$$e^{mr} = \eta_{31}\varepsilon^{ny} + \eta_{32}\varepsilon^{bm} + \varepsilon^{mr} \qquad (14)$$

$$e^{er} = \eta_{41}\varepsilon^{ny} + \eta_{42}\varepsilon^{bm} + \eta_{43}\varepsilon^{mr} + \varepsilon^{er} \qquad (15)$$

$$e^{pi} = \eta_{51}\varepsilon^{ny} + \eta_{52}\varepsilon^{bm} + \eta_{53}\varepsilon^{mr} + \eta_{54}\varepsilon^{er} + \varepsilon^{pi} \qquad (16)$$

The first variable in the ordering is contemporaneously affected only by the shock to the first equation; the second variable is affected by the shocks to the first and second equation and so on. The last variable in the ordering is contemporaneously affected by all the shocks in the

[20] Imposition of identification restrictions resulted to the following shocks in equation (12) to (16).

[21] The structural shocks (ε_t) in each period *t* are determined by expectations conditional on available information at the end of period *t-1, (Et-1(.)),* and an error term (e_t). Therefore the one period ahead forecasting error in inflation or pass through to consumer prices due to variability in the structural shocks say $\varepsilon^{ny}\varepsilon^{bm}\varepsilon^{mr}\varepsilon^{er}$. recalling that $e_t = B^{-1}\varepsilon$, as such inflation forecast error is: $e^{pi} = \eta_{51}\varepsilon^{ny} + \eta_{52}\varepsilon^{bm} + \eta_{53}\varepsilon^{mr} + \eta_{54}\varepsilon^{er} + \varepsilon^{pi}$ This is the last equation, this inflation forecast errors can be caused by exchange rate shocks and other shocks implicit in the system as analysed.

system. It is clear that, unless the reduced form innovations are uncorrelated, the impulse response functions will not be invariant to the ordering of the variables in the VAR[22].

One way of depicting this identification would be to interpret the first and last equations as an aggregate supply and aggregate demand model with an upward sloping AS curve and downward-sloping AD curve. The last equation moves the price level and real output, so it indicates a shift of the AS curve. The first equation moves real output only, it represent a shift in the AD curve. The second equation could be interpreted as a money demand equation derived from the quantity equation: MV = PY, where V stands for velocity and Y for real income. Hence, the second equation can be interpreted as a velocity shock or money demand shock, if we take real output to represent real income. The third equation could represents a monetary policy reaction function or monetary policy aggregate target such as inflation targeting and its impact on the exchange rate shock. Consequently, the fourth equation i.e. the nominal exchange shock, will have cumulative momentum on the last equation, the consumer price inflation equation, given the preceding shocks on the fourth equation. The central bank systematically responds to equations (12), (13), (14), and (15) as well as lags of all variables. Any change in equation (16) (i.e. consumer price inflation) not accounted for by this response, would be an exogenous monetary policy or money supply shock and exchange rate shock which offer signal on the pass through effect and systemic shock in the economy. This work imposed restrictions to retrieve exchange rate structural innovations from the other innovations, while allowing for contemporaneous response adjustment of parameters to the exchange rate innovations using structural decomposition. In the next chapter,we therefore estimate the above equations.

[22] The variables in the model are categorized into two groups: the non-policy vectors, which include the log of output, the log of consumer price index, and the policy vectors, which include the log of the exchange rate and the log of money supply, and monetary policy rate. The goal is to examine how exchange rate shock as a policy variable affects consumer prices in the structural VAR model.

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CHAPTER 5

ESTIMATION RESULTS

5.1 Data

In this chapter we commence by briefly presenting our data. The macroeconomic data set used in this study is taken from the IMF's International Financial Statistics (IFS) database, and Central Bank of Nigeria (CBN) statistical bulletin and Report. We have used quarterly observations extending from 1986Q1 to 2013Q1. The sample period we choose is more appropriate because of the structural changes and also we exclude the period of rigidly fixed exchange rate regime. Hence, begining of the period corresponds to the inception Structural Adjusment Program (SAP, 1986). The end period of the sample includes the period when inflation targeting was formally adopted, i.e., between 2007 and 2009.

Our data set includes Output (Y) which stands for GDP taken in real terms, and the CPI is expressed on the base (2005=100), the CPI measures the avearage change overtime in the prices paid by consumers for a market basket of consumer goods and services, the monetary policy rate (MPR) reflects the official interest rate set as a benchmark interest rate by the Monetary Policy Committee (MPC) of Central Bank of Nigeria (CBN). Nominal effective exchange rate (NEER) is measured in nominal terms which reflect the value of Naira in terms of US dollar ($/₦). A decrease in the NEER variable is termed nominal depreciation of the currency and vice versa. The M2 represent the broad money, which is a narrow monetary aggregate M1 plus quasi money. In the next step we have performed unit root test to examine the time series properties of the data[23].

[23] All variables are were put into their natural logarithm before the analysis.

5.2 RESULTS

5.2.1 Unit Root Tests

We start by investigating the time series properties of the data as an initial step to the VAR analysis. The data were tested for their orders of integration before conducting the cointegration analysis. The ADF, PP and KPSS results are reported in Table 1. With the exception of the NEER, all of the three tests indicate that all the series are integrated of order, I(1). Thus, the series are non-stationary in levels but stationary in first differences. For the NEER, while the PP test results suggest that the variable is stationary in levels, the ADF and KPSS test results suggest otherwise.[24].

Table: 1 Unıt Root Test Result

	LEVEL			***FIRST DIFFERRENCE***		
VARIABLES	***ADF***	***PP***	***KPSS***	***ADF***	***PP***	***KPSS***
Y	-1.27775	-1.278558	0.284096	-3.84738**	-11.2441**	0.488878*
M2	-1.99167	-1.407775	0.169830	-10.5177**	-10.5238**	0.252011**
MPR	-2.655739	-2.825081	0.166242	-9.52002**	-9.49160**	0.113412**
NEER	-4.10925*	-4.07402*	0.312971	-8.03742**	-7.96890**	0.556909**
CPI	-1.89562	-0.882211	0.272451	-2.78815**	-6.32887**	0.455016*

Note: The Lag length of the ADF regression was selected according to the Schwartz Bayesian Information Criterion (SBC). For the levels, we included trend and intercept, as the visual inspection of the line graphs of the series indicate; The ADF and PP critical values at levels is -3.453601(*) indicates rejection of unit root at 5%. For their first differences, line graphs indicate that only intercepts can be included; The ADF and PP critical values at first differences is -2.889753(**) and -2.581890(***)indicates rejection of unit root at 5% and 10%

[24] The Lag length of the ADF regression was selected according to the schwartz Bayesian Information Criterion(SBC). In practice, the SBC will select a more parsimonious model than will either AIC or t-test (Enders, 2004; 193). Once a tentative lag length has been determined diagnostic checking should be conducted. Plotting the residuals is a most important diagnostic tool. There should be always being absence of evidence of structural change and serial autocorrelation. Therefore, the correlogram of the residual should be examined and should appear to be a white noise process (Enders, 2004; 192). In line with this reasoning, we examine the correlogram of the levels and first differences of all the series. It indicates that the residuals are white noise process.

respectively, While the KPSS critical values at levels is 0.146000(**), and for their first differences is 0.463000(**) indicates rejection of unit root at 5%.The critical values are derived by MacKinnon (1996).

Figure 3a and b: Natural Logarithm Of Consumer Price Index and Monetary Policy Rate in levels

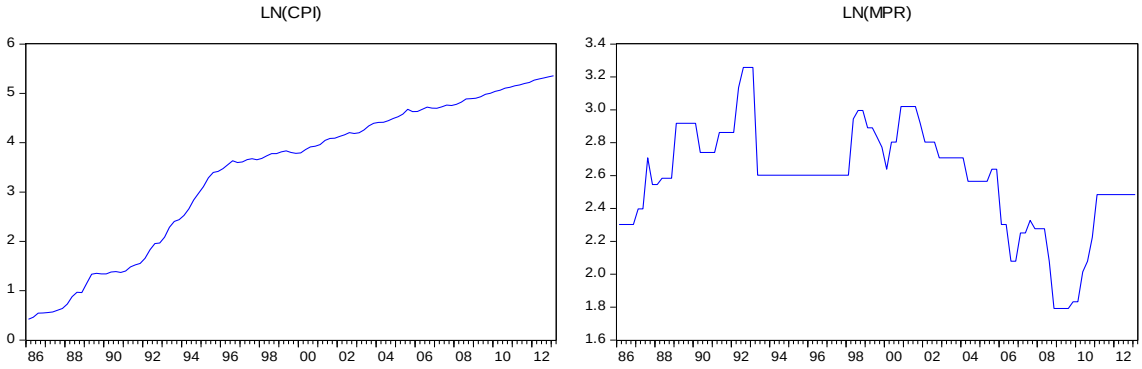

Figure 3c and d: Natural Logarithm of Nominal Exchange Rates and Output in levels

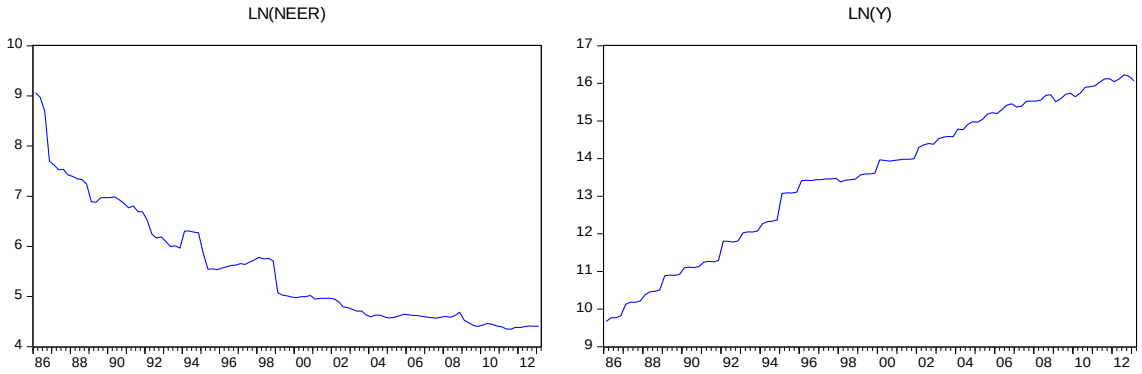

Figure 3e: Natural Logarithm of Broad Money Supply (M2) in levels

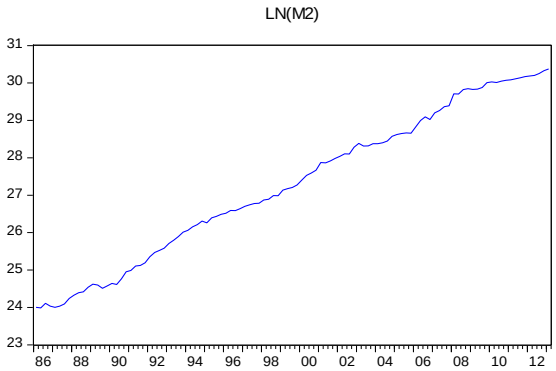

Figure 3f and g: Natural Logarithm Of Consumer Price Index and Monetary Policy Rate in first diffrence

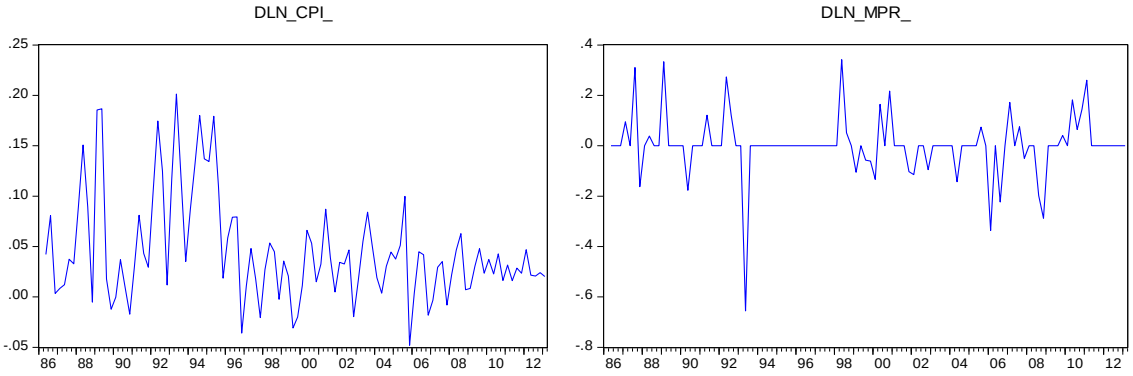

Figure 3h and i: Natural Logarithm of Nominal Exchange Rates and Output in first difference

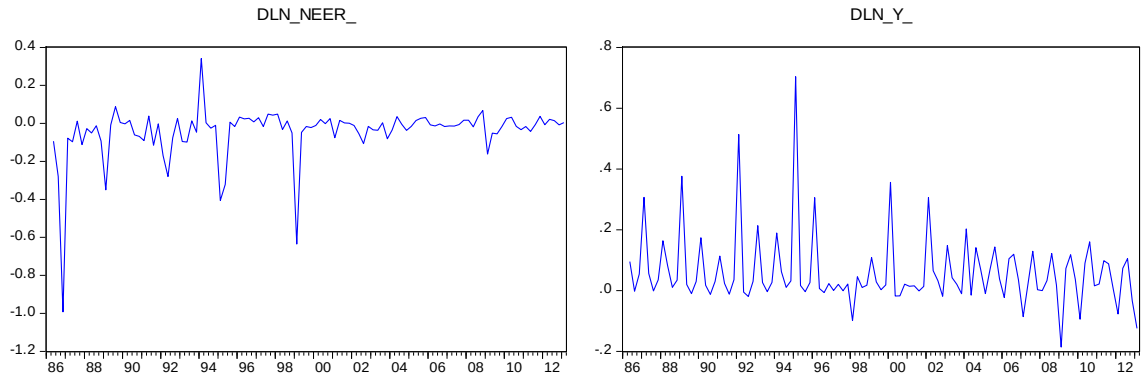

Figure 3j: Natural Logarithm of Broad Money Supply (M2) in first difference

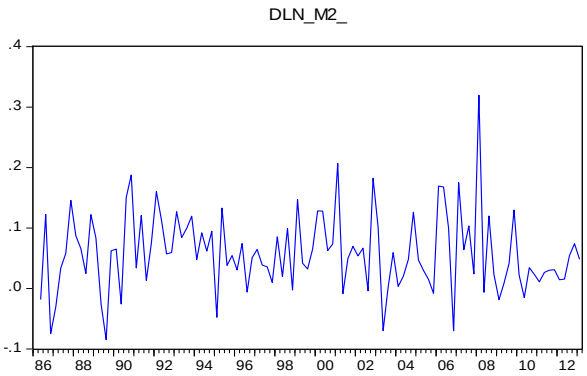

Figure 4a-j depicts the plots of the time series data graphs, for both levels and first difference of the series. While a visual inspection of figures 4a-e indicates that the series is non stationary in levels, figures 4f-j indicate that the time series data becomes stationary after taking the first difference. Therefore, the visual inspection of the data also confirms our previous finding that the time series data is intergrated of order I(1).

5.2.2 Cointegration Tests

Given that each variable under study is intergrated of order (1), it is possible that they are cointegrated, that is, they have a linear combination that is stationary. Now to test the possible existence of cointegration between the variables, we employ the test implemented by Johansen (1991) and Johansen and Juselius (1990). The results of the Johansen cointegration test are influenced by the order of the VAR model. The order of the VAR model was chosen with the help of three information criteria, which include the LR (Likelihood Ratio Criterion), AIC (Akaike Information Criterion), and FPE (Final Prediction Error). Sinceall these criteria have unanimously agreed on a VAR order of 5, a lag length of 5 was selected as the VAR order. At the appendix section we report the results of the VAR order tests.

Table 2: Johansen Cointegration Test: λ_{trace} test and λ_{max} test statistics

NULL HYPOTHESIS	ALTERNATIVE HYPOTHESIS		5% CRITICAL VALUES	PROB
λ_{trace} test		λ_{trace} test		
r =0	r =0	63.381	69.818	0.14
r ≤1	**r >1**	41.143	47.856	0.18
r ≤2	**r >2**	24.451	29.797	0.18
r ≤3	r >3	13.717	15.494	0.09
r ≤4	**r >4**	4.0047	3.8414	0.04
λ_{max} test		λ_{max} test		
r =0	r =0	22.238	33.876	0.58
r =1	r =1	16.691	27.584	0.60
r =2	r =2	10.734	21.131	0.67
r =3	r =3	9.7126	14.264	0.23
r =4	r =4	4.0047	3.8414	0.04

Note: CV denotes the 5 percent critical value, and Prob denotes probability value in the above table. According to the results appearing in Table 2, we cannot reject the null hypothesis of no of cointegrating vector. Both λ_{trace} test and λ_{max} test t statistics are below 5 percent critical value. This indicates no cointergration at the 0.05 level. it is indicative that the critical values in both tests are greater than the trace statistic and max-eigen statistic. Similarly, the last row in table for both the λ_{trace} test and λ_{max} test statistics indicates the rejection of the null hypothesis due to low p value of less than 5% which confirms absence cointergration.

Cointegration relationship between CPI, NEER MRP M2 Y has been investigated using Johansen's maximum likelihood technique. Table 2 reports the results of both the trace and maximum eigenvalue statistics. Both tests accept the null hypothesis in favor of no cointegrating relationship at 5% level of significance. Consequently, we conclude that there is no cointegrating relationship among the variables, which implies the variables do not establish long run relationship.

The cointegration tests show no evidence of cointegrating vectors in the macro system. Thus, for the rest of the analysis the VAR model is carried out in first differences and no error-correction terms are included. According to VAR literature, when there are cointegrating relationships among the variables, that is, when data are I(1) and cointegrated, one can

estimate a VAR/SVAR model in levels. However, if the variables involved are not found to be cointegrated, the VAR/SVAR is specified in first differences. Therefore, we are able specify our VAR model in first difference.

5.2.3 SVAR Estimation Results

The model consists of five variables. Prior to the estimation of structural VAR the time series data was transformed to a stationary series via differencing their natural logarithms. As stated above in the absence of cointegration among the variables, SVAR was estimated in first differences. That is; *ΔY, ΔM2, ΔMPR, ΔNEER, and ΔCPI* denote the first differences of the log of output, the log of monetary aggregate *M2*, the log of the monetary policy rate *MPR*, the log of the nominal effective exchange rate *NEER*, and the log of consumer price level, *CPI*, respectively. The lag length was selected using the Likelihood Ratio (LR) criterion, the Akaike Information Criterion (AIC), and the Final Prediction Error (FPE) criteiron. Since all of these criteria suggested 4 as the order of the unrestricted VAR model in first difference, a lag length of 4 was used in the study (see Table A2 in the appendix).

The VAR also fulfills the stability condition, indicating that all roots of the characteristic polynomial lie within the unit circle, and hence pointing to stationarity. Diagnostic tests are conducted to further assess the nature of the residual errors. The Lagrange multiplier (LM) or the Breusch-Godfrey test could not reject the hypothesis of no serial autocorrelation at lags between 1 and 12 with a *high p-value greater 5 percent (see Table 4). Similarly, Table 5 depicts the computed, Jarque-Bera normality test.* This test rejects the null hypothesis of normality due to excess kurtosis in the residuals. A visual inspection indicates that the residuals display a number of outliers (see figure A3 in the Appendix). It is of relevance to note that when the normality assumption is rejected, Monte Carlo tests for serial autocorrelation should still be very accurate, though not exact (see Lutkepohl, 1991 and Mackinnon, 2005)

The likelihood ratio test (LR-test) is computed for the SVAR model. That is whether the covariance matrix of the residual for SVAR model is diagonal. They were found to be non-zero. The relevance of this test is, if the covariance of the matrix residuals are zero there is no point using contemporaneous restrictions to identify the SVAR system (see Sanusi, 2010). The LR statistic is found to be greater than the critical value, so we reject the null hypothesis that the restrictions are not valid. Therefore, we can accept the imposed identification restrictions within matrix B^{-1}(see Appendix A1). Similarly, this suggests that shocks in the

entire equations have contemporaneous correlation in the system[25] and thus, thecontemporaneous correlation among the variables would have been neglected by the unrestricted VAR model.[26]

Table 3: VAR Residual Serial Correlation LM Tests

Lags	1	2	3	4	5	6	7	8	9	10	11	12
Lm stat	26.99	20.29	20.64	37.23	39.01	20.06	26.09	23.36	27.46	23.18	10.48	28.8
Prob	0.36	0.73	0.71	0.50	0.03	0.74	0.40	0.55	0.33	0.56	0.99	0.26

Table 4: VAR Residual Normality Tests of the individual equations

Variables	**ΔY**	**ΔM2**	**ΔMPR**	**ΔNEER**	**ΔCPI**
Normality JB Prob	489.4 0.00	50.69 0.00	107.8 0.00	303.7 0.00	7.80 0.00
Skewness	2.41	0.65	-0.37	-1.7	-0.20
Prob	0.00	0.00	0.12	0.00	0.38
Kurtosis	12.46	6.15	7.93	10.64	4.27
Prob	0,00	0.00	0.00	0.00	0.00

The estimated system of the shocks from the SVAR can be seen from equations (17) to (21) given below. The coefficients of the structural shocks (impulse response coefficients) $\varepsilon^{ny}, \varepsilon^{bm}, \varepsilon^{mr}, \varepsilon^{er}$ and ε^{pi} represent the given standard deviations of the variables in the system,. The respective *p–values* are given in parenthesis below the coefficient estimates. It can be seen that all the coefficients carry the correct signs. Of relevance to note, the contemporaneous relationship among our variables holds implicitly in the system.

$$e^{ny} = 0.103736\varepsilon^{ny} \quad (17)$$

(0.0000)

$$e^{bm} = 0.011937e^{ny} + 0.060793\varepsilon^{bm} \quad (18)$$

[25] Hence this gives justification for structural VAR to take into consideration the contemporaneous correlation among the variables.

[26] The estimation of unrestricted VAR model is reported in Table A3 at the appendix section.

(0.8354) **(0.0000)**

$$e^{mr} = 0.075649\, e^{ny} - 0.201384 e^{bm} + 0.120661 \varepsilon^{mr} \quad (19)$$

(0.5073) (0.3008) **(0.0000)**

$$e^{er} = -0.407758\, e^{ny} - 0.076511 e^{bm} - 0.021640 e^{mr} + 0.088714 \varepsilon^{er} \quad (20)$$

(0.0000) (0.5948) (0.7641) **(0.0000)**

$$e^{pi} = 0.06986 e^{ny} + 0.108660 e^{bm} + 0.054652 e^{mr} - 0.081860 e^{er} + 0.03228 \varepsilon^{pi} \quad (21)$$

(0.0391) **(0.0382)** **(0.0373)** (0.218) **(0.0000)**

Now the next step is the examination of exchange rate pass through to consumer price inflation using innovation accounting, that is combination of impulse response and variance decomposition assessment. In the following section we present the SVAR model estimation results. We analyse the impulse responses of consumer price inflation variable to exchange rate, monetary policy rate, money supply, and output shocks (in the amount of 1 percentage point for all variables), and the proportion of the variance of prediction error or variance decomposition of consumer price inflation variable accounted for by these shocks. Apart from measuring the size of the accumulated influence of the unit shocks on the observed variables, the analysis of impulse responses also enables an estimate of the duration of shock absorption and of the significance of a particular shock's influence on consumer price inflation.

5.2.4 Impulse Response (IR) and Variance decomposition (VD) Analysis

In the SVAR model, it is assumed that there are 5 shocks in the economy, which include the output shocks, exchange rate (NEER) shocks, money supply shocks, monetary policy rate shocks, and consumer price index (CPI) shocks. The impulse response function shows the response of each variable to structural one standard deviation of each shock e.g exchange rate shock. Therefore, impulse response analysis is used to investigate the dynamic interactions between the endogenous variables in the system and these effects can be cumulated through time *t = 1, 2, . . .T*. Thus, using the IR analysis one could obtain the cumulated impact of a unit change in a particular variable e.g exhange rate shock on the domestic consumer price variable at time *t*.

The variance decomposition (VD) analysis shows the values of the percentage share of the forecast variance of a variable that can be explained by its own shock and by other variables shocks. This enables us, therefore, to measure the relative importance of the various shocks on domestic consumer prices. . In the short run, most of the variation is due to its own shock,

butas the effects of the lagged variables start setting in, the effects of other shocks increases in percentage over time.

The exchange rate pass through to domestic prices is calculated from the impulse response function results. The pass through can be define as the accumulated effect of a structural one standard deviation to the nominal effective exchange rate in period *t* on domestic consumer prices in period *t.* Note that the accumulated response measures the effects of exchange rate changes on the domestic consumer prices.The dynamic pass through elasticity (φ) at time *t is given by:*

$$\boldsymbol{ERPT^{\varphi}} = \frac{\%\Delta \boldsymbol{pi_t}}{\%\Delta \boldsymbol{er_0}}$$

The numerator is the percentage change in the level of the consumer prices inflation between period zero, when the initial exchange rate shock strikes, and at time *t. The denominator is the* percentage change in the nominal effective exchange rate at time 0.

Impulse Response (IR) Analysis

Table 5 depicts the accumulated response of price to a structural one standard deviation shock to each of the variables in the system. The fifth column shows the response of the price level to a one standard deviation shock to the exchange rate. From these results , it can be clearly seen that exchange rate pass through to consumer price inflation is incomplete, fairly gradual, and taking about 14 quarters to yield outright or full impact. However, the effects of the respective shocks on the CPI differ. The immediate effect of a structural one standard deviation shock to the exchange rate (which corresponds to a 0.09 increase, or 9 percent appreciation) indicates a decrease in prices of about 0.007 (or 0.7 percent). With this appreciation of the exchange rate, the initial pass through elasticity is high, but less than one for one passage to consumer prices implying that there is a high immediate impact elasticity of 0.77 percent of an exchange rate shock on consumer prices. Over 4 quarters, the price level decreases to around 0.01 percent and to 0.02 per cent in 8 quarters following the initial exchange rate shock, this corresponds to 0.11 and 0.22 impact elasticity. By the end of 12 quarters the price level decrease steadly to 0.02 percent that correspond to steady impact elasticity 0.22 like in the previous quarter.

At the point of outright or full impact of the shock, that is at the end of (14 quarters), the exchange pass through is incomplete and gallops below the average range in an accelerating

manner swiftly. Signifying 0.09 percent appreciation of the exchange rate culminated to decrease in consumer prices to 0.03 percent with fervent dynamic exchange rate pass through elasticity of 0.33 percent (see Figure 4d). These results suggest that exchange rate pass through in Nigeria is incomplete, relatively low and below the average range. Moreover, the speed of adjustment to structural shocks, such as the exchange rate, output, monetary policy rate and money supply shocks, is high and effects of such shocks are highly volatile and therefore can potentially distort the status quo.

Drawing from the graphical plot of the exchange rate and the inflation rate in chapter three, it is clear that in this period the Nigerian economy experienced record high inflation of 57 percent as a result of the massive depreciation of the exchange rate between 1986 and 1995. This corresponds to a high ERPT elasticity of 0.77 percent in the period. Likewise in the period between 2006 and 2013 the Nigerian economy has experienced a relatively low inflation and this corresponds to a relatively low ERPT elasticity of 0.33 percent. Therefore, there seems to be positive relationship between ERPT and inflation for the Nigerian economy: As inflation declines (rises) overtime the ERPT becomes lower (higher). This vindicates a strong evidence that is consistent with Taylor's (2000) proposition that high or average pass through is associated with high inflation and vice versa.

Table 5: Estimated Accumulated Impulse Response of Consumer Price Level to Structural One Standard Deviation Shocks

Forecast Horizon	*Output*	*Broad Money*	*Monetary Policy Rate*	*Exchange Rate*	*Consumer Prices*
T=1	0.011281	0.006296	0.006808	-0.007262	0.032285
T=4	0.022333	0.036756	0.018056	-0.013173	0.049138
T=8	0.041431	0.064271	0.019595	-0.020441	0.067574
T=12	0.051812	0.079388	0.019547	-0.024960	0.076048
T=14	0.059318	0.082228	0.020592	-0.026600	0.080580
STRUCTURAL SD	0.103736	0.060793	0.120661	0.088714	0.032285

From Table 5, we can account for the money supply and monetary policy rate effects on the CPI, which requires the analysis of the structural one standard deviation of the corresponding shock on the CPI. While, a 6.1 percent shock to the money supply results the price level to

increase by 0.63 percent, a 12 percent shock to monetary policy rate causes a 0.7 percent increase in the price level. Although the immediate impulse response of price level to money supply and monetary policy rate shocks is close to each other,the respective elasticities differ at 0.10 and 0.05 respectively. This interestingly, has an implicit impact on the Nigerian economy. Similarly, the result is utterly plausible given that the present monetary policy committee of CBN kept the monetary policy rate at 12 percent over 8 quarters from 2011 till date. The ripple effects heighten substantially in the fourteen quarter after monetary innovations sets which amount to 8.2 and 2.1 percent increase in price level, for a money supply and monetary policy rate shock, respectively. These correspond to the elasticities of 1.35 and 0.17, respectively.

This relationship between money and prices has been established well in both theory and practice. For example, the Quantity Theory of Money (MV=PY), by assuming constant velocity of money and long-run output, suggests that monetary innovations feed directly and positively into domestic inflation. It is obvious from the results that the money stock elasticity is higher than the monetary policy rate. This indicates that the money supply is significant as a causal channel of inflation in the Nigerian economy than the monetary policy rate. It points out that the monetary authorities in Nigeria have to be vigilant in pursuit of multidirectional monetary policies to achieve macro-economic objectives in the Nigerian economy.

The effect of money supply and monetary policy rate shocks on the price level looks similar and as well high in the beginning (see Table 5). Rough comparison of exchange rate and monetary variable shocks suggest that the price level is susceptible to variability of the macroeconomic components. The reaction of the pricel level to the broad money and output shocks is relatively high. However, it is vital to note that each shock has its directional impact in causing the exchange rate to co move, which in turn affect consumer prices. The monetary policy rate and money supply or broad money shocks can also be seen as the monetary policy shock. The monetary policy can influence consumer prices indirectly through exchange rates or directly through monetary targeting and inflation targeting.

The middle line represents the impulse responses[27] while the upper and lower dashed lines represent the two standard error bands (see Figure 4a-d) generated from a Monte Carlo integration simulation with 100 replications.. The vertical axis shows the percentage point

[27] The rest of the impulse response plot of the entire system is shown in Figure A4 in the Appendix.

change in the domestic price index or the percentage of pass-through and the horizontal axis shows the time (in quarters). Yet we are not going to discuss the effects of all shocks assumed; we will present here only the responses of domestic prices with respect to NEER and MPR and the response of MPR to an exchange rate shock.

Figure 4a: Accumulated Impulse Response of Consumer Prices to a Structural Standard Deviation Shock to the Exchange Rate (With Two Standard Error Band)

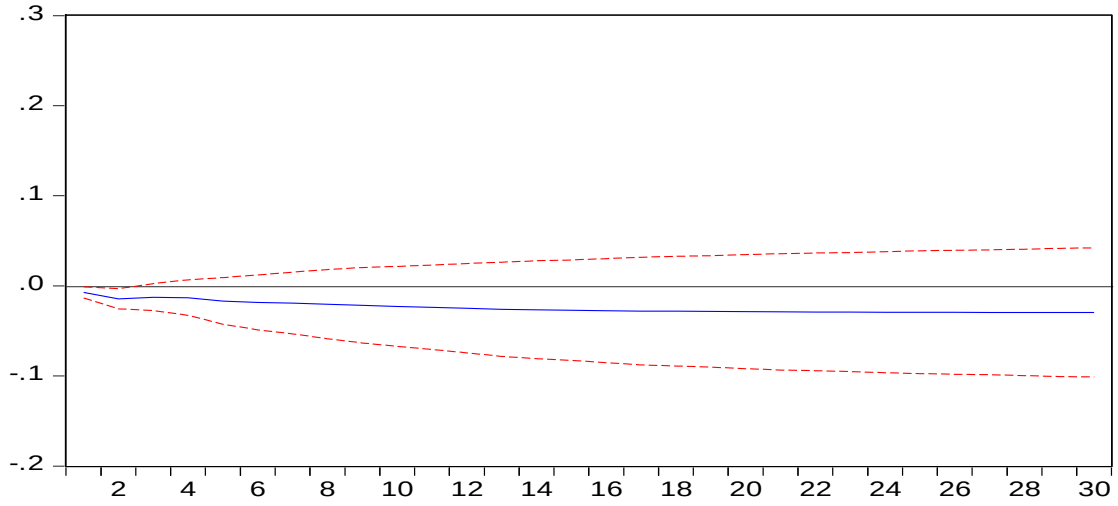

Figure 4b: Accumulated Impulse Response of consumer prices to a Structural Standard Deviation Shock to the Monetary Policy Rate (With Two Standard Error Band)

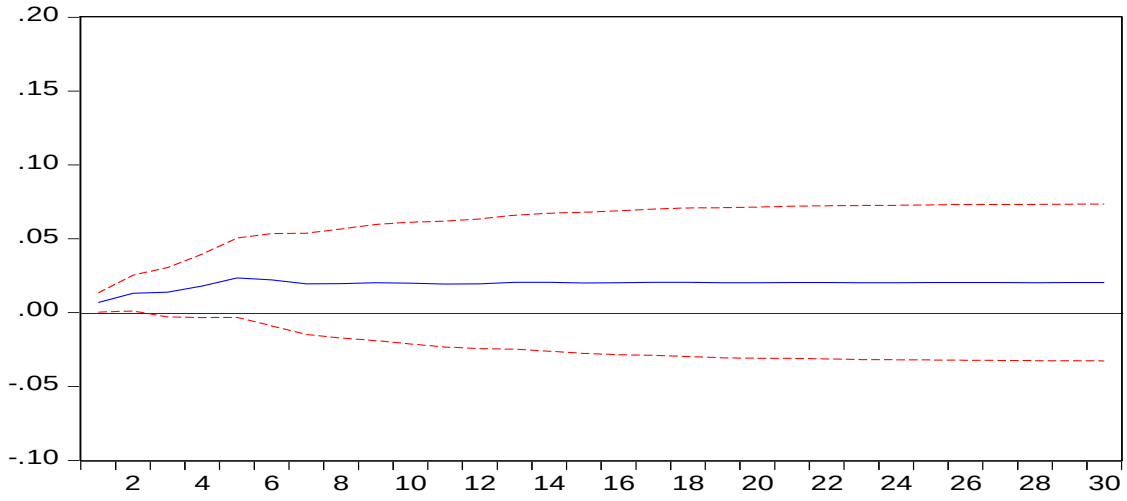

Figure 4c: Accumulated Impulse Response of Monetary Policy Rate to a Structural Standard Deviation Shock to the Exchange Rate (With Two Standard Error Band)

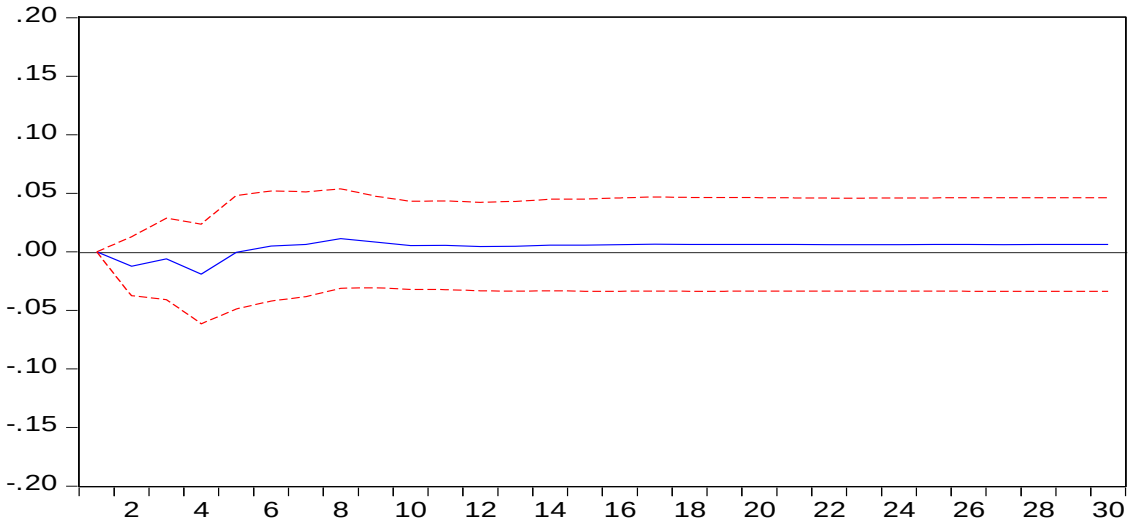

Figure 4d Dynamic Exchange Rate Pass through Elasticity

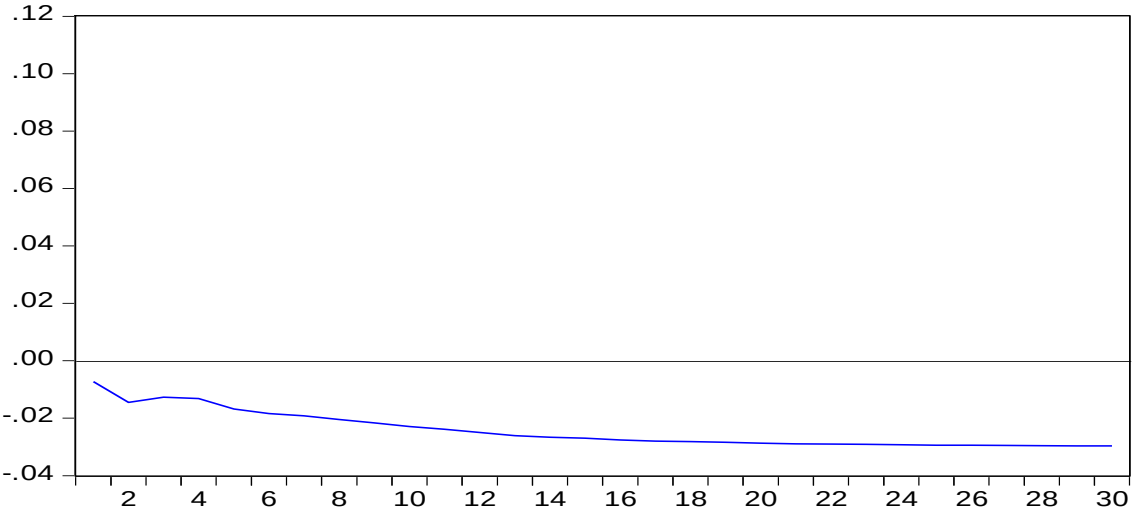

Figure 4a and 4b report the accumulated responses of CPI to a structural one standard deviation shock to the exchange rate and the monetary policy rate, respectively.

As Figure 4a shows that the initial impact of an exchange rate shock on consumer prices is negative and it remains so by the end of the 14 quarters. It is clear from Figure 4b that the

monetary policy rate shock like the exchange rate shock has a significant and continuous effect on domestic consumer prices. A sudden and transitory rise in the short-term monetary policy rate is accompanied by an increase in prices, with the impact taking off between 2 and 12 quarters after the shock . Then again, a sudden and transitory rise in the nominal exchange rate (which implies an appreciation) is accompanied by a decrease in domestic consumer prices, with the impact taking off between 4 and 14 quarters (see Figure 4a).

Figure 4c shows the effect exchange rate shock on monetary policy rate. The structural one standard deviation shock to exchange rate effects the monetary policy rate positively and this effect is persistent. The monetary policy rate decreases initially between 2 and 6 quarters, and later increase slighly in the subsequent quaters. The effect of the exchange rate innovation on domestic prices is larger with impact elasticity of 0.33, and the speed is also higher than that of monetary policy shock with impact elasticity of 0.17 (see Figure 4a and b). This high impact elasticity of exchange rate to the consumer prices is shown in figure 4d in the above gragh.

Figure 4d shows the dynamic exchange rate pass through to domestic consumer prices. To summarise, in the first quater exchange rate pass through is high, while in the (2, 4, and 8 quarters) exchange rate pass through gallops and deccelerate swiftly and reached full impact in the (14 quarters). It can be observed that the effect of an exchange rate shock on consumer prices is highly volatile both in the short and long term.

Comparatively, other empirical findings conducted especially in the Sub-Saharan Africa (SSA)[28] have found both fairly large, and low exchange pass-through elasticities, for exampleof 0.79 for Ghana (Sanusi, 2010), 0.028 for Tanzania (Mwase, 2006), and 0.34, 0.38, 0.39, 0.32 and 0.46 for Burkina Faso, Kenya, Cameroon, Zimbabwe and Zambia (Chaoudhri and Hakura, 2001), respectively. The evidence presented in this study characterised these countries as low inflation economies. In the same vein, some of the developed countries with low inflation include US with a pass through elasticity of 0.16, Germany with 0.13, France with 0.18, China with 0.41, Australia wih 0.05, Newzealand with 0.42 and Norway with 0.13. The exchange rate pass through elasticity for countries characterised with high and moderate inflation include Argentina with 1.09, Brazil with 0.92, Isreal with 0.83, Peru with 0.64, Equator with 0.68, Uruguay with 0.62, Sieera leone with 0.52 and Turkey with 0.52.

[28] (See Razafimahefa, 2012) who found high exchange rate pass through elasticity for some Sub-Saharan African countries. For example 0.887 for Ethiopia, 0.865 for Mali, 0.797 for Guınea Bissau, 0.607 for Angola, 0.554 for Cameroun, and 0.536 for Gabon.

Cazorzi *et al.* (2007)[29] tested the Taylor hypothesis for a set of emerging markets. The first set of the countries in which annual inflation rate was on avearage less than 10% over the sample period were found to experience a low degree of exchange rate pass through elasticity. For example 0.01 for Taiwan, -0.06 for Singapore, 0.13 for Korea, and 0.37 for Hong Kong. While countries in which inflation is between 10% and 20%, was subject to considerably higher degree of exchange rate pass through. For example, in Mexico with 1.39, in Hungry with 0.91, in China with 0.77 and Poland for 0,56.

Variance Decomposition (VD) Analysis

Both Table 6 and Figure 5 shows the effects of the five shocks on consumer prices. Variance decomposition draws more general insights into the impact of other shocks in the model on consumer price inflation. Although impulse response functions provide information on the size and speed of the pass-through, they give little information on the importance of the respective shocks for the variance of the consumer price inflation. Variance decompositions of the consumer price inflation, which enable us for a *k*-period a head forecast, to calculate the proportion of the fluctuations in a series that is due to its "own" shocks versus shocks of other variables. In table 5, the third column represents the proportion of the forecast error variance attributable to output shocks, the fourth column is the proportion attributable to money supply shocks, the fifth to monetary policy rate shocks, the sixth to nominal exchange rate shock and, last column presents the proportion attributable to its own shock. All the results are shown for a forecast horizon of 1, 2, 4, 8,16, and 24 quarters.(see Table 6 and Figure5).

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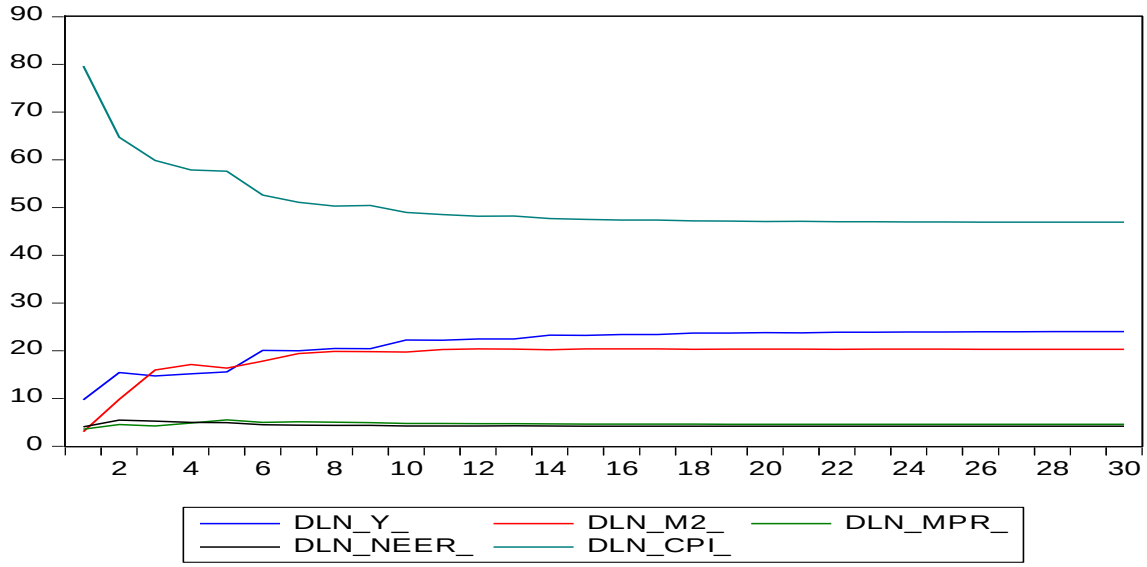
[29] Similarly, other comparable results for central and East European countries by (Beirne and Bijsterbosch, 2009). There study found pass through elasticity of 0.698 for Bulgaria, 0.505 for Czech Republic, 0.925 for Estonia, 0.370 for Slovakia 0.436 for Romania, 0.969 for Latvia, 0.634 and 0.469 Hungary and Poland respectively. Therefore, the result for exchange rate pass through elasticity found for the Nigerian economy is broadly in line with some of studies, for countries that have not achieve low overtime.

Table 6: Variance Decomposition Response of Inflation 1986Q1 – 2013Q1

Forecast Horizon	*S.E*	*Output*	*Broad Money*	*Monetary Policy rate*	*Exchange Rate*	*Consumer Prices*
T=1	0.036170	9.728035	3.029660	3.542787	4.031100	79.66842
T=2	0.043652	15.40920	9.804392	4.539921	5.489247	64.75724
T=4	0.046531	15.16691	17.09885	4.853138	4.989612	57.89149
T=8	0.053696	20.47062	19.84670	5.007071	4.371980	50.30363
T=16	0.056299	23.40071	20.39371	4.626016	4.203287	47.37627
T=24	0.056616	23.93225	20.32772	4.584551	4.170196	46.98529

S.E denotes standard error; forecast horizon refers to a quarter. A 24 quarter forecast horizon is considered.

Figure 5: Variance Decomposition Response of Inflation 1986Q1 – 2013Q1



Now we begin by investigating the importance of ERPT for consumer price fluctuations. The variance decomposition of inflation indicates that short run dynamics in consumer price inflation are explained mostly by its own fluctuations, followed by output shocks and money supply shock. The weight of its own shock ranges from over 79.6% to 46.9%, and this percentage declines as the forecast horizon increases. The percentage of variance explained by exchange rates shock is quite low, ranging from 4% to 4.1%. Output shocks account for about 9.7 percent of the variation in consumer price inflation within the first quarter. Innovations in monetary policy rate and money supply account for 3 and 3.5 percent of the variation in CPI within the same period, whereas the exchange rate changes explain 4 percent of this variation. In the medium term (e.g., the eight quarter), output and money supply shocks account for about 20.4 and 19.8 percent of the inflation variance and they become the second and third most significant explanatory factor in explaining the price index after its ownshocks. Within a 24 quarter interval, output shocks explain about 23.9 percent of the consumer price inflation dynamics in Nigeria. While money supply, monetary policy rate, and exchange rate, explains about 20.3%, 4.5%, and 4.1% percent respectively.

The output shocks explain much of the short-run variations in consumer price inflation, which characterizes Nigeria as a rapidly growing economy. The explanation for the relatively high consumer price inflation is that aggregate demand rises over time at a faster pace than the full employment level of real output. The initial effect is the wealth effect whichsays that a rise in the price level will make people who have money and other financial assets to feel poorer, and thus causes them to buy less. Nigerian residents want to buy cheaper-priced foreign goods,

causing a fall in exports and a rise in imports (Foreign Sector Effect). This will lead to a reduction in net trade and then overall contractions in aggregate demand, which may in turn, affect external balance of Nigeria in the medium and long term. Similarly, another consequence is the interest rate effect. That is, if the price level rises via output shocks, this causes a rise in inflation and demands for money, and in turn a consequential rise in interest rates with a deflationary effect on the economy. This assumes that the central bank (in our case the central bank of Nigeria) is setting monetary policy rates in order to meet a specified inflation target. This explains the adoption of lite inflation targeting in the Nigerian economy.

CHAPTER 6

CONCLUSION

This study examines the degree and extent of exchange rate pass through into consumer price inflation in the Nigerian economy between 1986Q1 and 2013Q1 using SVAR. methodology. This methodology potentially allows one to identify specific "structural" shocks affecting the system, which pave way for specifying the embedded features of an economy. The estimations are carried out using a fully-fledged system of five variables that include output, money supply, monetary policy rate, nominal exchange rate and consumer price index. The results from impulse response analysis show that the exchange rate pass through to consumer price inflation in Nigeria is incomplete, relatively low and below the average range. Moreover, the speed of adjustment to structural shocks, such as the exchange rate, output, monetary policy rate and money supply shocks is high and the effects of such shocks are highly volatile and therefore can potentially distort the status quo. The variance decomposition analysis has shown that consumer price inflation own shocks, positive money supply shocks and output shocks retain dominance over other factors in explaining consumer price inflation in the Nigerian economy. The positive money supply and output shocks indicate positive consumer price inflation over time, signaling an inflationary environment.This also vindicates a strong evidence that is consistent with Taylor's (2000) proposition that high or average pass through is associated with high inflation and vice versa.

Moreover, monetary policy credibility is crucial in order to reap the benefits of lower pass through. This is linked with the choice of low inflation regime. We focus on the innovations (shocks) of money supply on the rest of the variables. Our results reveal that monetary policy contraction causes a little downward response in the price level as well as an increase in the short and long run monetary policy rates. This further causes aggregate output to increase and exchange rate to depreciate. The results suggest that monetary policy has a limited persistent influence on CPI. Although, we cannot out rightly underscore monetary policy credence, yet the results do not cast doubt on whether monetary policy tightening is effective and useful in controlling the evolution of consumer price inflation in the Nigerian economy. A long lasting

and significant inflation reduction might require strong tightening of monetary policy, causing stability in price level at least in the short run

In restoring fervent international competitiveness and to achieve financial intergration in the global economy, Nigeria ought for more effective monetary policy through conscious efforts by the monetary authorities than ever before. More particularly, the adoption of fully fledge inflation targeting is required. This will bring inflation expectations down and thereby, the expectations channel will become credible and stronger, which will in turn make the effects of monetary policy more anticipated and will thereby require less aggressive monetary policy rate changes. Such credibility will help monetary policy to become more reliable in achieving both internal and external balance.

REFERENCES

1. Aliyu, S.U.R., Yakub, M.U., Sanni, G.K. and Duke, O.O. (2009). "Exchange Rate Pass-Through in Nigeria: Evidence from a Vector Error Correction Model", JEL Classification: F31, F41.
2. Anderton, R. (2003). "Extra-Euro Area Manufacturing Import Prices and Exchange Rate Pass- Through", ECB Working Paper.
3. Akofio-Sowah, N. (2009). "Is there a link between Exchange Rate pass-through and the monetary regime: Evidence from Sub-Saharan Africa and Latin America" International Atlantic Economic Society15: 296-309
4. Apel, Michael and Claussen, Andreas. (2012). "Monetary Policy, Interest Rates and Risk Taking", Services Risk Bank Review.
5. Bailliu, J and Bouakez, Hafedth (2004)."Exchange Rate Pass Through In Industrialised Countries" Bank Of Canada Review, Spring.
6. Bailliu, J., & Fujii, E. (2004)."Exchange rate pass-through and the inflation environment in industrialized Countries": An empirical investigation. Bank of Canada, Working Paper 2004–21.
7. Bache, I. Wolden. (2007). "Econometrics of Exchange Rate Pass Through", Doctoral Dissertation In Economics, Norges Bank.
8. Bernanke, Ben S. (1986). "Alternative explanations of the money-income correlation:" Carnegie-Rochester Conference Series on Public Policy, 25: 49–99.
9. Batini, N (2004)."Achieving And Maintaining Price Stability In Nigeria" IMF Working Papers, WP/04/97.
10. Bakare, A.S. (2011). "The Consequence Of Foreign Exchange rate Reforms On The Private Domestic Investment In Nigeria", International Journal of Economics and Management Science, vol. no:1 p25-31
11. Barhoumi, K. (2006). "Differences in long run exchange rate pass-through into import prices in developing countries: An empirical investigation". Economic Modelling. 23: 926-951

12. Beirne, J Martin and Martin, B. (2009). “Exchange Rate Pass Through In Central And Eastern European Member States “European Central Bank, Working Papers, No, 1120, December
13. Bhundia, A. (2000). "An Empirical Investigation of Exchange Rate Pass-through in South Africa”, IMF Working Paper 165
14. Burstein, A., Eichenbaum, M. and Rebelo, S. (2005). “Large Devaluations and the Real Exchange Rate” Journal of Political Economy, 113, 742-784.
15. Bussiere, M and Pelton, (2008). ”Exchange Rate Pass Through In The Global Economy-The Emerging Market Economies “European Central Bank, Working Papers, No. 951
16. Blanchard, Oliver J. and Danny Quah (1989).‘The Dynamic Effects of Aggregate Demand and Supply Disturbances’, American Economic Review, 79(4): 655-673.
17. Campa, Jose and Linda Goldberg, (2005). “Distribution Margins, Imported Inputs, and the Insensitivity of the CPI to Exchange Rates” manuscript.
18. Campa, Jose and J.M. González-Mínguez, (2005). "Differences in Exchange Rate Pass-Through in the Euro Area", European Economic Review, forthcoming.
19. Campa, Jose and Linda Godlberg. (2002). “Exchange Rate Pass-through into import prices: a Macro or Micro Phenomenon”, NBER Working paper 8934, May.
20. Ca'zorzi, M, Hahn, E and Sanchez, M, (2007). “Exchange rate pass-through in emerging markets”European Central Bank Working Paper Series No. 739. [Online]. Available: http://ssm.com/abstract id=970654. [Accessed 7 April 2010].
21. Chibundu C Ezema, (2009). “Monetary policy framework in Nigeria: Formulation and Implementation Challenges”, Monthly Seminar African Institute of Applied Economics (AIAE).
22. Choudhri, E. and Hakura, D. (2006). “Exchange Rate Pass-Through to Domestic Prices: Does the Inflationary Environment Matter”? Journal of International Money and Finance, 25, 614-639.
23. Choudhri, Ehsan U., and Dalia S. Hakura, (2001). “Exchange Rate Pass-Through to CPI: Does the Inflationary Environment Matter?” IMF Working Paper 01/194 (Washington: International Monetary Fund).
24. Choudhri, E. U., Faruqee, H., & Hakura, D. S. (2005). “Explaining the exchange rate pass-through in different prices” Journal of International Economics, 65, 349–374.

25. Dada, A. Eme. (2009). “Inflation Targeting Monetary Policy And Output In Nigeria”, Journal Of Monetary And Economic Intergration. Vol. 11, No:1
26. Darvas, Z. (2001). “Exchange Rate Pass Through and Real Exchange Rate In Eu Candidate Countries” Discussion Paper 10/10, Economic Research Centre Of The Deutsche Bundes Bank.
27. Dabusinkas, A, (2003). “Exchange Rate Pass Through To Estonia Prices” Bank Of Estonia, Working Papers, No, 10.
28. Devereux, Michael, Charles Engel, and Peter Storgaard. (2004). “Endogenous exchange rate pass-through when nominal prices are set in advance” Journal of International Economics, Vol. 63, no. 2, July, pp. 263-291.
29. Devereux, M and Yetman, J, (2008). “Price Adjustment and Exchange Rate Pass-through: Theory and Evidence”, Hong Kong Institute for Monetary Research. [Online].
30. Dornbusch, R. (1987). “Exchange Rates and Prices,” American Economic Review 77 (March 1987), 93-106.
31. Enders, Walter. (2004). “Applied econometric time series”, Second edition, New Y John Wiley & Sons.
32. Faruqee. Hamid, (2004). “Measuring the Trade Effects of the EMU,”International Monetary Fund Working Paper WP/04/154.
33. Frankel, J., Parsley, D. and Wei, S. (2005). “Slow Pass-Through Around the World: A New Import for Developing Countries”, NBER Working Paper No. 11199.
34. Frimpong, Siaw and Anokye M. Adam (2010). “Exchange Rate Pass-Through in Ghana”International Business Research, 3(2), pp. 186 – 192.
35. Goldberg, Pinelopi and Michael Knetter, (1997). "Goods Prices and Exchange Rates: What Have We Learned?” Journal of Economic Literature, vol. 35, 1243-92.
36. Gagnon, Joseph and Jane Ihrig. (2001). “Monetary Policy and Exchange Rate Pass-Through.”Board of Governors of the Federal Reserve System, International Finance Discussion Papers #704 (July).
37. Goldberg, P., and M. Knetter, (1997). "Goods Prices and Exchange Rates: What Have We Learned?" Journal of Economic Literature, Vol. 35, No. 3, pp. 1243–72.
38. Hahn, E. (2003). “Pass-Through of External Shocks to Euro Area Inflation”, European Central Bank Working Paper No. 243.

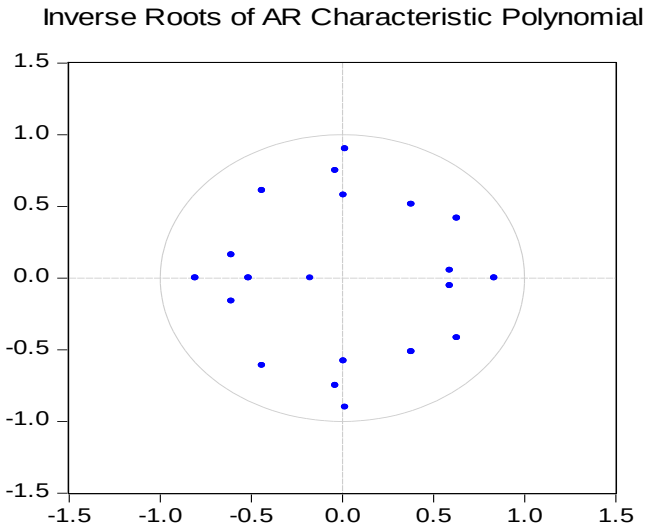
39. Hooper, P. and C. Mann (1989). “Exchange Rate Pass-through in the 1980s: the Case of US Imports of Manufactures”, Brookings Papers of Economic Activity, vol. 1. (1989), pp. 297-337.
40. Hyder, Z and Shah, S. (2004). “Exchange rate pass-through to domestic prices in Pakistan. State Bank of Pakistan Working Paper No.5.
41. Ito, T and Sato, Kiyatak. (2007). “Exchange Rate Pass Through And Domestic Inflation: Acomparison Between East Asia And Latin American Countries” Research Institute Of Economy, Trade And Industry, Papers Series 07-E-040
42. Krugman, Paul, (1986). “Pricing to Market When the Exchange Rate Changes,” in Real-Financial Linkages Among Open Economics. ed. by Sven W. Arndt andJ. David Richardson, pp. 49–70 (Cambridge, Massachusetts: MIT Press).
43. Laflèche, Thérèse (1996). ”The Impact of Exchange Rate Movements on Consumer Prices”. Bankof Canada Review Winter 1996-1997, 21-32.
44. Lutkepohl, H. (1991). Introduction to Multiple Time Series Analysis. Berlin, Springer-Verlag.
45. Marazzi, Mario, Nathan Sheets, and Robert Vigfusson et al. (2005). “Exchange Rate Pass Through to US Import Prices: Some New Evidence”, Federal Reserve Board of Govenors, International Finance Discussion Paper no: 833, April.
46. MacKinnon, James. G. (2005). “Bootstrap Methods in Econometrics” Department of EconomicsQueen’sUniversity Kingston, Ontario, Canada, http://www.econ.queensu.ca/faculty/mackinnon/ K7L 3N6,
47. McCarthy, Jonathan. (2000). “Pass-Through of Exchange Rates and Import Prices to Domestic Inflation in Some Industrialized Economies”. Federal Reserve Bank of New York Staff Report no. 111 (September).
48. Menon, J. (1995). “Exchange rate pass-through”, Journal of Economic Surveys, 9 (2): 197-231.
49. Mihailov, Alexander. (2005). Exchange rate pass-through on prices in US, German and Japanese macrodata. University of Essex.
50. Mihaljek, D. and Klau, M. (2000). “A Note On The Pass-Through From Exchange Rate and Foreign price changes to Inflation In Selected Emerging Market Economies”, BIS Papers,8, 69-81.[30]. Olivei, Giovanni P.
51. Mnjama S Gladys (2011).”Exchange Rate Past Through To Domestic Prices In Kenya, Department Of Economics Thesis Submitted To Rhodes University Grahamstown.

52. Mumtaz, H, Oomen, and Wang, J. (2006). "Exchange rate pass -through into UK Import Prices" Working Paper No: 312. Bank of England. [Online].
53. Nnanna, O.J. (2001). "Monetary Policy Framework in Africa: The Nigerian Experience" Paper Presented at the 2001 South African Reserve Bank Conference
54. Obstfeld, Maurice, and Kenneth Rogoff. (1995). "Exchange Rate Dynamics Redux," Journal of Political Economy 103, 624-60.
55. Ogun, O, (2000). "Exchange rate changes and Export Prices in a small semi-open economy". Open economies review. 11: 127-134
56. Omojimite B U And Akpokoje, (2010) Impact Of Exchange Rate On Trade Performance In Nigeria, Journal Of Social Science 23(1):53-62
57. Omotor G Douglass, (2009). "The Nigerian Economy and Monetary Policy: Some Simple Empirics", MPR Paper No:22672
58. Onyeimu Charlse. (2012). "Monetary Policy and Economic Growth Of Nigeria", Journal Of Economics and Sustainable Development. ISSN 2222-1700 Vol No
59. Peersman, G. and Fank Smets. (2001). "The monetary transmission mechanism in the Euro area: More evidence from VAR analysis", ECB Working Paper No. 91.
60. Razafimahefa, I.F. (|2012)."Exchange rate pass-through in sub-Saharan African economies and its determinants", IMF Working Papers, WP/12/141, International Monetary Fund.
61. Sanusi, A, R. (2010). "Exchange Rate Pass Through To Consumer Prices In Ghana: Evidence From Structural Vector Auto Regression"Mpra Paper, No, 29491 March 2011.
62. Sims, C. (1986). "Are Forecasting Models Usable For Policy Analysis?" Quarterly review, Federal Reserve Bank of Minneapolis.
63. Stock, J. H., and M. W. Watson (2001) "Vector Autoregressions", Journal of economic perspective, volume No;15, 101-115.
64. Takhtamanova, Y. (2008). "Understanding Changes in Exchange Rate Pass-Through Federal Reserve Bank of San Francisco"Working Paper 2008-13 Federal Reserve Bank of San Francisco, San Francisco.
65. Taylor, John B. (2000). "Low Inflation, Pass-Through, and the Pricing Power of Firms" European Economic Review, June volume 44 issue 7 pp. 1389-1408.

66. Uchendu, O.A. (2000). "Inflation targeting: A Monetary Policy Management Framework For The Attainment of Price Stability In Nigeria" Central Bank of Nigeria Economic and Financial Review, 38(2, June): 1–16.
67. Uchendu, O. A. (2000). "Inflation Targeting: A Monetary Policy Management Framework for the Attainment of Price Stability in Nigeria" CBN Economic and Financial Review (EFR), Vol. 38, No. 2, June, pp. 1 16.
68. Uchendu, O. A. (2007). "Inflation Targeting: Rationale and Conceptual Issues" a paper presented at the Inflation Targeting Workshop holding at CBN, Abeokuta Branch From 23rd to 27th July.
69. http://www.businessdayonline.com/NG/index.php/banking-a-finance/2439-proposed-inflation-targeting-or-mistargeting-in-nigeria
70. http://www.tradingeconomics.com/nigeria/inflation-cpi
71. See Eric Zirvot (2000) Notes on Structural Modelling), Eric zivot.

APPENDIX A

FIGURE A1; VAR STABILITY CONDITION



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

TABLE A1; ESTIMATING VAR IN LEVELS; VAR LAG ORDER SELECTION CRITERIA

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-144.2613	NA	1.32e-05	2.955669	3.085131	3.008079
1	564.7990	1333.876	1.73e-11	-10.59008	-9.813310*	-10.27562
2	605.3923	72.34446	1.28e-11	-10.89886	-9.474781	-10.32235*
3	626.9218	36.23782	1.38e-11	-10.83013	-8.758752	-9.991579
4	654.8188	44.19332	1.33e-11	-10.88750	-8.168812	-9.786897
5	689.3810	51.33005*	1.13e-11*	-11.07685*	-7.710856	-9.714200
6	706.4868	23.71093	1.38e-11	-10.92053	-6.907227	-9.295830
7	723.5620	21.97795	1.71e-11	-10.76360	-6.102992	-8.876854
8	743.2931	23.44289	2.07e-11	-10.65927	-5.351351	-8.510471

TABLE A2; ESTIMATING VAR IN FIRST DIFFERENCE; VAR LAG ORDER SELECTION

Lag	LogL	LR	FPE	AIC	SC	HQ
0	525.3909	NA	2.08e-11	-10.40782	10.27756*	-10.35510
1	565.0875	74.62976	1.55e-11	-10.70175	-9.920200	10.38544*
2	584.5554	34.65281	1.74e-11	-10.59111	-9.158265	-10.01121
3	619.3525	58.45904	1.44e-11	-10.78705	-8.702913	-9.943562
4	653.6058	54.12030*	1.22e-11*	10.97212*	-8.236688	-9.865039
5	672.7849	28.38512	1.41e-11	-10.85570	-7.468978	-9.485032
6	685.9230	18.13056	1.87e-11	-10.61846	-6.580447	-8.984204

TABLE A3; FULL SAMPLE ESTIMATE OF THE UNRESTRICTED VAR MODEL

Vector Autoregression Estimates
Date: 10/12/13 Time: 11:28
Sample (adjusted): 1987Q2 2013Q1

Included observations: 104 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DLN_Y_	DLN_M2_	DLN_MPR_	DLN_NEER_	DLN_CPI_
DLN_Y_(-1)	-0.263816	0.100716	0.030692	-0.149958	0.054918
	(0.11506)	(0.06744)	(0.13478)	(0.10928)	(0.04012)
	[-2.29288]	[1.49334]	[0.22772]	[-1.37222]	[1.36890]
DLN_Y_(-2)	-0.345415	0.046437	0.204217	0.039029	0.005772
	(0.12246)	(0.07178)	(0.14346)	(0.11631)	(0.04270)
	[-2.82058]	[0.64691]	[1.42356]	[0.33555]	[0.13517]
DLN_Y_(-3)	-0.215178	0.127760	0.112133	0.014759	-0.064000
	(0.12070)	(0.07075)	(0.14139)	(0.11464)	(0.04209)
	[-1.78272]	[1.80577]	[0.79306]	[0.12874]	[-1.52069]
DLN_Y_(-4)	0.269479	0.035517	0.195375	0.029281	0.006581
	(0.11964)	(0.07013)	(0.14015)	(0.11363)	(0.04171)
	[2.25247]	[0.50647]	[1.39409]	[0.25769]	[0.15776]
DLN_M2_(-1)	0.181185	-0.029915	-0.058757	-0.123698	0.157334
	(0.17842)	(0.10458)	(0.20901)	(0.16946)	(0.06221)
	[1.01549]	[-0.28603]	[-0.28113]	[-0.72994]	[2.52901]
DLN_M2_(-2)	-0.030567	0.035595	-0.168977	0.055972	0.126405
	(0.17588)	(0.10310)	(0.20603)	(0.16705)	(0.06133)
	[-0.17379]	[0.34526]	[-0.82014]	[0.33506]	[2.06118]
DLN_M2_(-3)	-0.101721	0.059479	-0.269454	0.084548	0.054229
	(0.17903)	(0.10494)	(0.20972)	(0.17004)	(0.06242)
	[-0.56819]	[0.56680]	[-1.28485]	[0.49723]	[0.86874]
DLN_M2_(-4)	-0.149252	0.172271	0.091500	-0.180448	0.034981
	(0.16857)	(0.09881)	(0.19747)	(0.16010)	(0.05878)
	[-0.88541]	[1.74347]	[0.46337]	[-1.12706]	[0.59515]
DLN_MPR_(-1)	-0.043854	-0.056388	0.060921	-0.016668	0.027328
	(0.08787)	(0.05150)	(0.10293)	(0.08345)	(0.03064)
	[-0.49909]	[-1.09482]	[0.59187]	[-0.19973]	[0.89199]
DLN_MPR_(-2)	0.017934	-0.049949	0.066263	0.073787	0.005049
	(0.08640)	(0.05065)	(0.10122)	(0.08207)	(0.03013)
	[0.20756]	[-0.98620]	[0.65466]	[0.89911]	[0.16760]
DLN_MPR_(-3)	0.037697	0.103497	-0.028284	-0.331366	0.048287
	(0.08708)	(0.05104)	(0.10200)	(0.08270)	(0.03036)
	[0.43291]	[2.02771]	[-0.27728]	[-4.00662]	[1.59037]
DLN_MPR_(-4)	-0.088943	-0.099108	-0.238681	0.066396	-0.025058

	(0.09433)	(0.05529)	(0.11050)	(0.08959)	(0.03289)
	[-0.94294]	[-1.79251]	[-2.16011]	[0.74112]	[-0.76189]
DLN_NEER_(-1)	-0.076857	-0.103034	-0.112206	0.225836	-0.046073
	(0.12258)	(0.07185)	(0.14359)	(0.11643)	(0.04274)
	[-0.62699]	[-1.43396]	[-0.78141]	[1.93974]	[-1.07795]
DLN_NEER_(-2)	-0.048444	0.050045	0.086424	-0.007815	0.070671
	(0.08033)	(0.04709)	(0.09410)	(0.07630)	(0.02801)
	[-0.60305]	[1.06282]	[0.91840]	[-0.10243]	[2.52306]
DLN_NEER_(-3)	-0.013334	0.057921	-0.173079	-0.021929	-0.013895
	(0.08366)	(0.04904)	(0.09801)	(0.07946)	(0.02917)
	[-0.15938]	[1.18107]	[-1.76599]	[-0.27597]	[-0.47633]
DLN_NEER_(-4)	-0.017819	-0.079431	0.242815	-0.087548	-0.000819
	(0.08266)	(0.04845)	(0.09683)	(0.07851)	(0.02882)
	[-0.21557]	[-1.63944]	[2.50775]	[-1.11517]	[-0.02842]
DLN_CPI_(-1)	0.293541	-0.399616	0.323226	0.189471	0.428775
	(0.33600)	(0.19695)	(0.39360)	(0.31913)	(0.11716)
	[0.87364]	[-2.02903]	[0.82121]	[0.59372]	[3.65988]
DLN_CPI_(-2)	0.200537	0.068372	-0.507403	-0.262529	-0.175348
	(0.35971)	(0.21085)	(0.42137)	(0.34164)	(0.12542)
	[0.55750]	[0.32427]	[-1.20418]	[-0.76843]	[-1.39806]
DLN_CPI_(-3)	0.505403	-0.069865	0.143171	-0.136291	0.267093
	(0.33164)	(0.19440)	(0.38850)	(0.31499)	(0.11564)
	[1.52393]	[-0.35939]	[0.36853]	[-0.43268]	[2.30975]
DLN_CPI_(-4)	0.066100	-0.084053	-0.546456	0.145158	0.221814
	(0.29448)	(0.17261)	(0.34496)	(0.27969)	(0.10268)
	[0.22447]	[-0.48695]	[-1.58412]	[0.51900]	[2.16029]
C	0.042211	0.048545	0.022448	-0.011803	-0.010118
	(0.02781)	(0.01630)	(0.03257)	(0.02641)	(0.00970)
	[1.51797]	[2.97828]	[0.68914]	[-0.44689]	[-1.04355]
R-squared	0.373723	0.254368	0.203838	0.281367	0.609349
Adj. R-squared	0.222813	0.074697	0.011992	0.108202	0.515217
Sum sq. resids	0.893168	0.306880	1.225636	0.805720	0.108589
S.E. equation	0.103736	0.060806	0.121518	0.098526	0.036170
F-statistic	2.476458	1.415747	1.062508	1.624853	6.473300
Log likelihood	99.81368	155.3662	83.35880	105.1717	209.3885
Akaike AIC	-1.515648	-2.583965	-1.199208	-1.618687	-3.622855
Schwarz SC	-0.981684	-2.050001	-0.665244	-1.084723	-3.088892
Mean dependent	0.057112	0.061297	0.000837	-0.030878	0.046152
S.D. dependent	0.117670	0.063213	0.122254	0.104333	0.051949

Determinant resid covariance (dof adj.)	4.75E-12
Determinant resid covariance	1.54E-12
Log likelihood	676.5863
Akaike information criterion	-10.99204
Schwarz criterion	-8.322227

TABLE A4; VAR RESIDUAL COVARIANCE MATRIX

	DLN_Y_	DLN_M2_	DLN_MPR_	DLN_NEER_	DLN_CPI_
DLN_Y_	0.010761	0.000128	0.000788	-0.004415	0.001170
DLN_M2_	0.000128	0.003697	-0.000735	-0.000319	0.000397
DLN_MPR_	0.000788	-0.000735	0.014767	-0.000585	0.000830
DLN_NEER_	0.004415	-0.000319	-0.000585	0.009707	-0.001170
DLN_CPI_	0.001170	0.000397	0.000830	-0.001170	0.001308

TABLE A5; VAR RESIDUALCORRELATION MATRIX

	DLN_Y_	DLN_M2_	DLN_MPR_	DLN_NEER_	DLN_CPI_
DLN_Y_	1.000000	0.020365	0.062527	-0.431947	0.311898
DLN_M2_	0.020365	1.000000	-0.099454	-0.053308	0.180375
DLN_MPR_	0.062527	-0.099454	1.000000	-0.048837	0.188861
DLN_NEER_	0.431947	-0.053308	-0.048837	1.000000	-0.328241
DLN_CPI_	0.311898	0.180375	0.188861	-0.328241	1.000000

A1; LR test for over-identification; Testing for Contemporaneous Correlation of Shocks

LR (H0/H1) = $2(l_u - l_r)$ *which is* X^2 *distributed with 5 DF.*

Where l_u denotes the maximum likelihood under *H0* (unrestricted model) and l_r denotes the maximum likelihood for the (restricted model) model under *H1*.

Hypothesis

H0; restrictions are not valid, that is $\eta_{12}\ \eta_{13}\ \eta_{14}\ \eta_{15}\ \eta_{23}\ \eta_{24}\ \eta_{25}\ \eta_{45}\eta_{34}\ \eta_{35} = 0$

H1; restrictions are valid, that is$\eta_{12}\ \eta_{13}\ \eta_{14}\ \eta_{15}\ \eta_{23}\ \eta_{24}\ \eta_{25}\ \eta_{45}\eta_{34}\ \eta_{35} \neq 0$

LR= 2(676.5863-617.9432) =117.2862

The 5 percent critical value, with degree of freedom 5 indicates X^2 value = 11.07

LR> CHISQUARE VALUE = 117.2862>11.07

The LR statistics is greater than the critical value. So we reject the null hypothesis that the restrictions are not valid. Therefore we can accept the imposed identification restrictions within matrix B^{-1}. This suggests shocks in the entire equations have contemporaneous correlation in the system.

FIGURE A2; GRAPHS OF THE FIRST DIFFRRENCE OF LOGARITHMS OF TIME SERIES

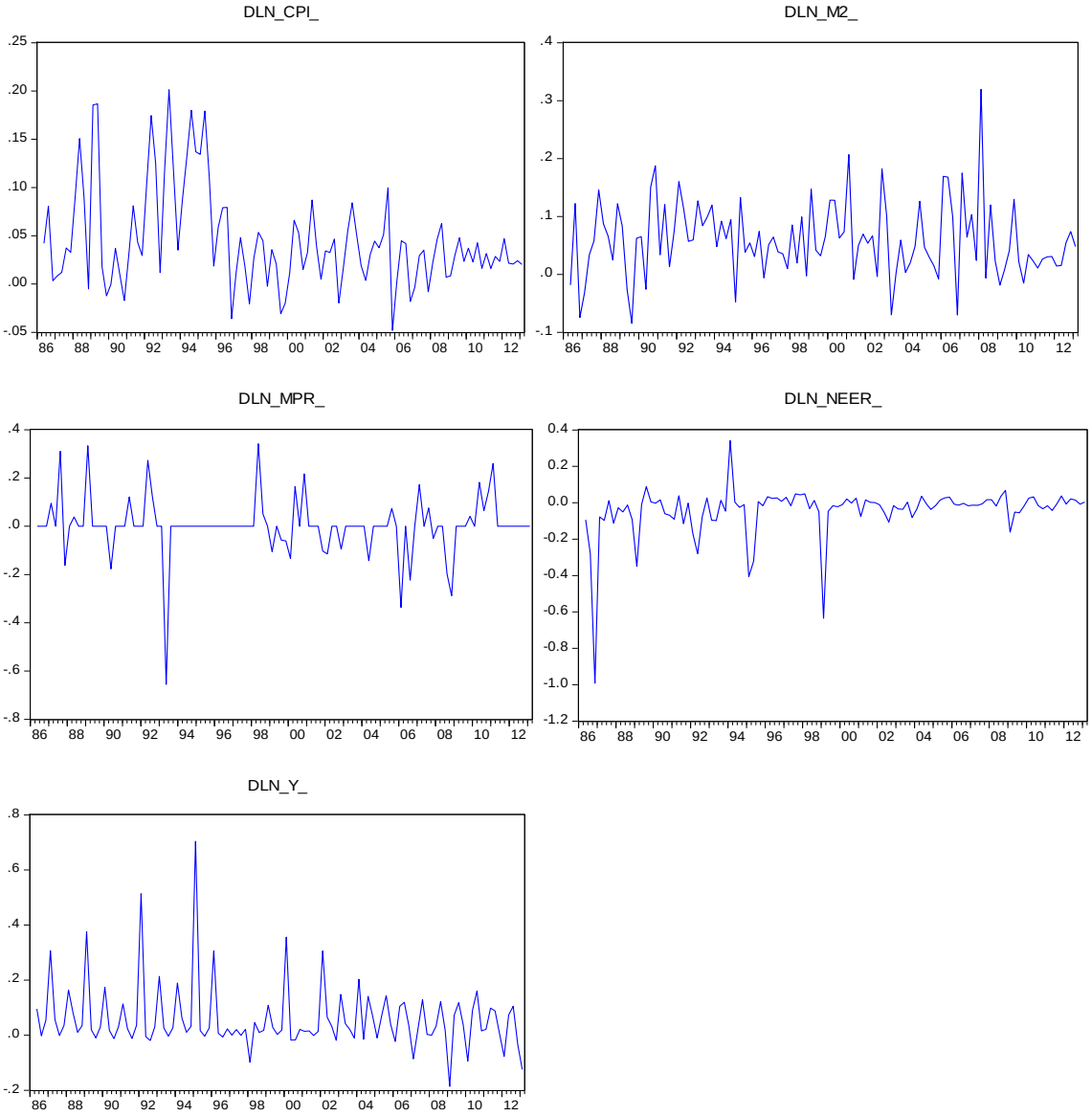
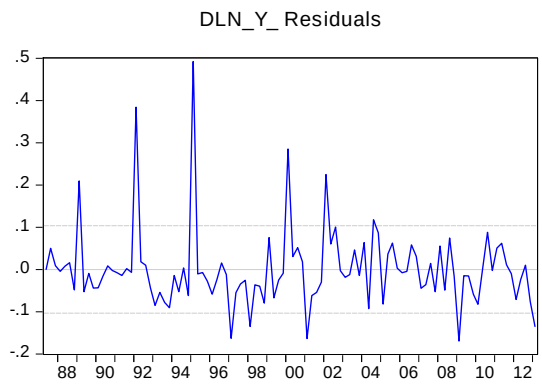
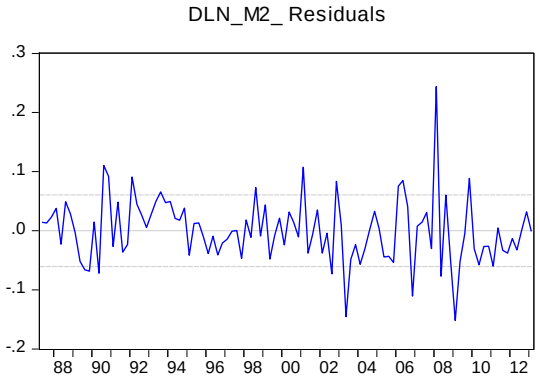
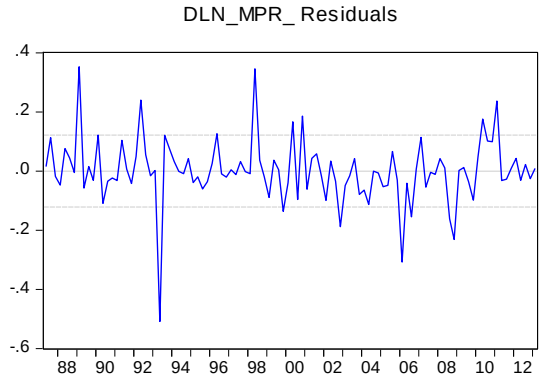
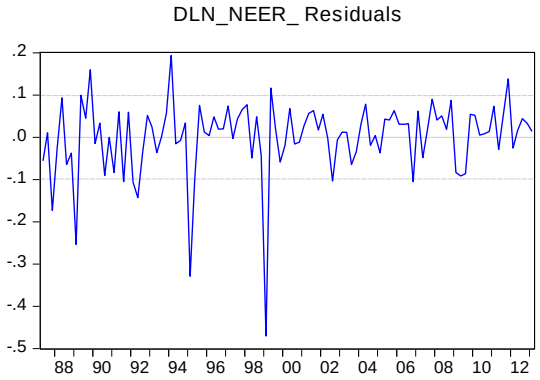


FIGURE A3; RESIDUAL GRAPHS









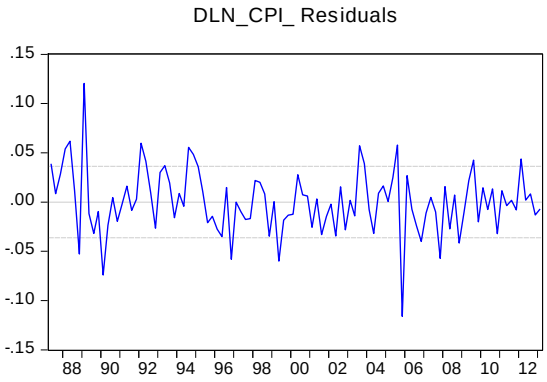


FIGURE A4; IMPULSE RESPONSE GRAPHS

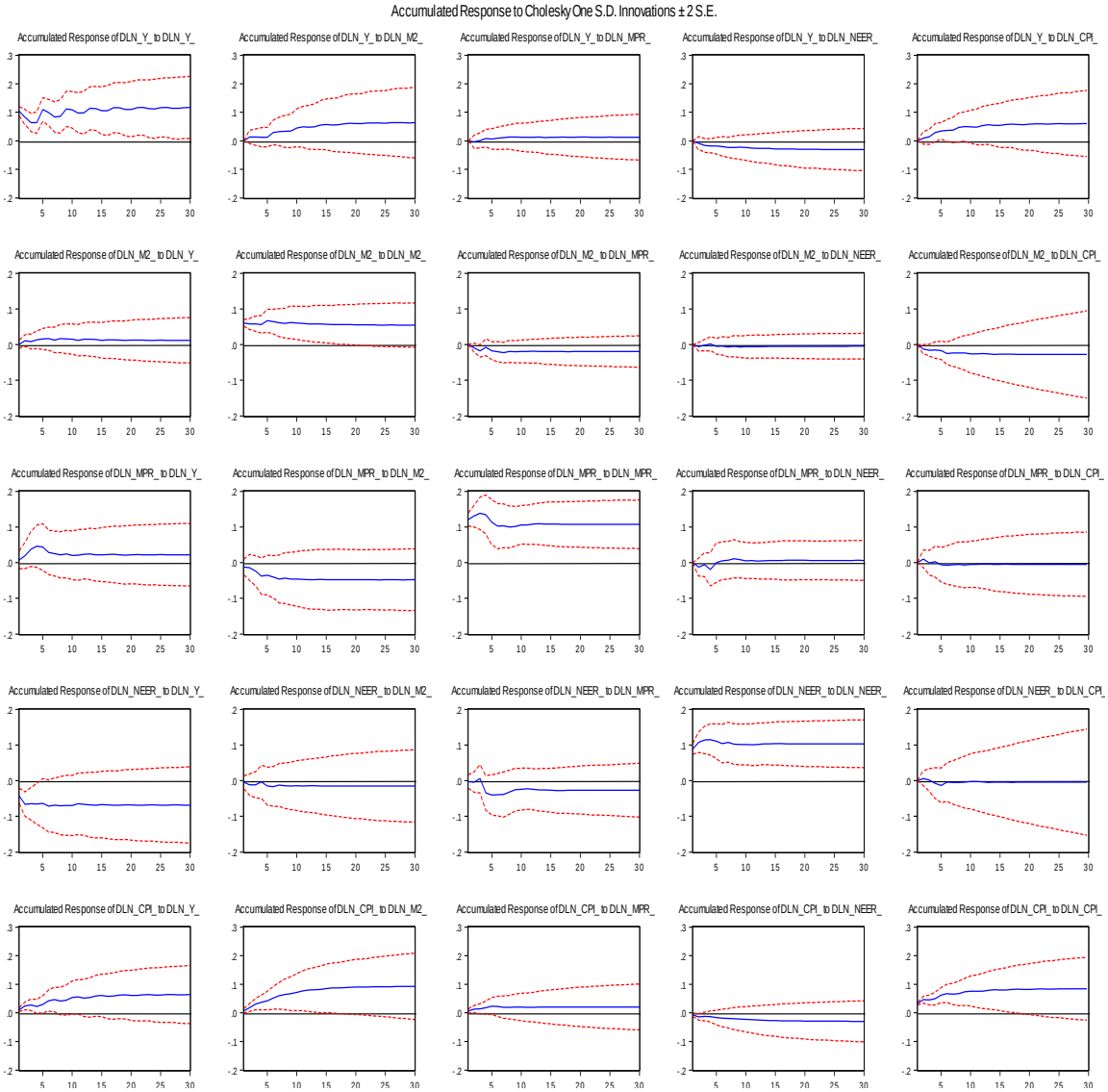
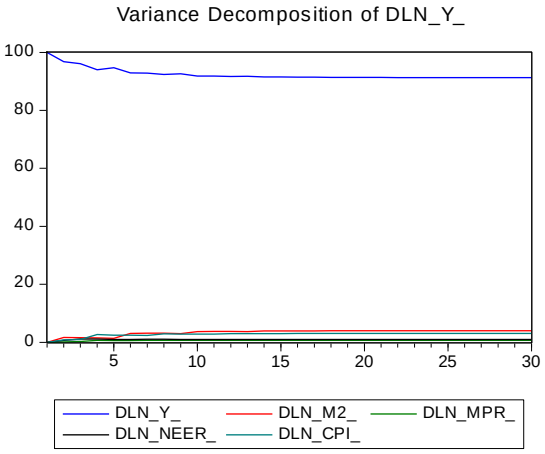
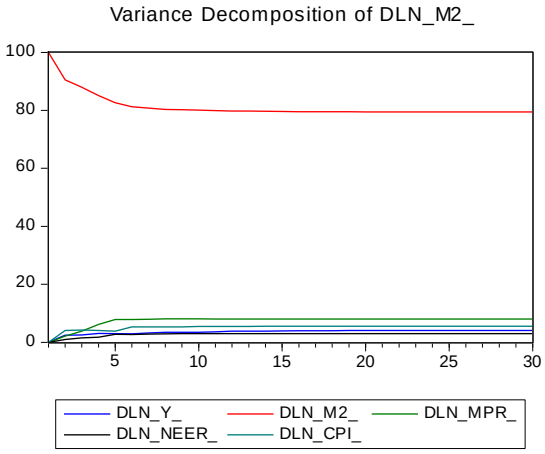
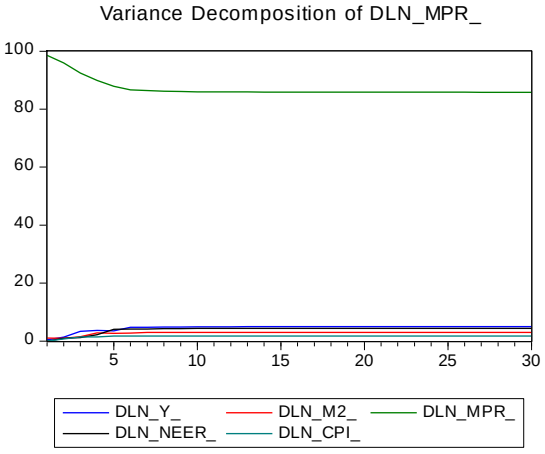
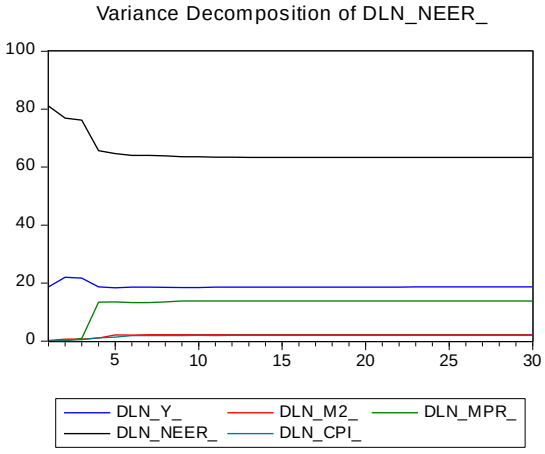


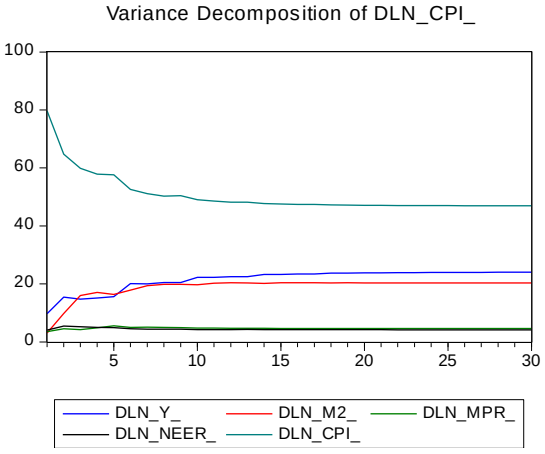
FIGURE A5; VARIANCE DECOMPOSITION GRAPHS











CV: CURRICULUM VITAE

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WORK EXPERIENCE

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