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Notes to Contributors

Information on manuscript submission is provided on the last and inside back cover of the Review

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Institutions, Natural Resources and Economic Growth: An Application of Co-integration with Structural Break on Nigerian Dataset

Garba T., Bello U., Abdullahi H. and Abubakar M. *

Abstract

This study examines the long-run influence of institutions and natural resources on economic growth in Nigeria over the period 1960 – 2014. It is apparent that the Nigerian economy depends largely on natural resources such as petroleum products for its sustainance. An economy with good institutions is more likely to use natural resources optimally, and hence that should translate into sustainable economic growth. In view of this, good institutions are required to restore confidence in the economy and ensure adequate management of the natural resources and distribution of the proceeds realised from them. To achieve the objectives of this study, Gregory & Hansen's (1996a) co-integration approach and vector error correction model have been applied. The results reveal that institutions have a significant positive long-run influence on economic growth in Nigeria. Similarly, natural resources have a significant positive long-run relationship with economic growth in Nigeria. The results thus imply that improving the quality of institutions has the tendency of increasing long-run economic growth in Nigeria. Furthermore, they imply that enhancing the exploitation and maximum utilisation of natural resources will also help promote long-run economic growth in Nigeria. In addition, the findings of this study indicate that accounting for structural break in VECM improves the significance and thus, reliability of the model applied. Therefore, this study recommends the enforcement of rule of law which will ensure equality before the law and promote contract enforcement and property rights, which are proxies for institutions. Furthermore, it recommends that government should further enhance the exploitation and maximum utilisation of natural resources as well as diversify the economy so as to reap the benefits from the production of natural resources.

Keywords: Institutions, natural resources, economic growth, co-integration, VECM, structural break.
JEL Classification Numbers: C32, E02, O43, O55, Q33

I. Introduction

Growth theory has been an interesting field of study that has continued to receive the attention of many researchers. Scholars and policy makers have been exploring the field of economic growth in order to help improve its prospects in different economies. Economic growth is, therefore, considered as crucial for the survival and development of different countries. As a result, the investigation of different factors that determine growth has received the attention of many researchers (Acemoglu, 2009; Barro & Sala-i-Martin, 2004; Farmer, 1997).

Several factors determine economic growth of a country. Acemoglu (2009) classifies the determinants of economic growth into two broad classes, namely, proximate and the fundamental determinants. He observes that the proximate determinants of economic growth include physical capital, human capital and technology. But the fundamental determinants of economic growth include institutions and natural resources, among others (Acemoglu, 2009). This study, therefore, aims at investigating the influence of these fundamental determinants of economic growth (institutions and natural resources) on the

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growth of the Nigerian economy. Eicher, Garcia-Penalosa, & Teksoz (2006) argue that the impact of institutions on growth is through accumulation of physical capital, such as natural resources. Similarly, Gylfason and Zoega (2006) opine that natural resources are an essentially exogenous factor that can affect economic growth through macroeconomic channels as well as through institutions. In view of this, the proxy for natural resources will serve as a mediating variable between institutions and economic growth. Furthermore, it is apparent that that Nigerian economy depends largely on natural resources such as petroleum products for its sustenance, until recently. An economy with good institutions is more likely to use natural resources optimally and hence that should translate into economic growth. Therefore, good institutions are required to restore confidence in the economy and ensure adequate management of the natural resources and distribution of their proceeds.

Institutions are rules that guide human interactions (North, 1990). As rules that guide social interactions within societies, institutions could promote productivity. Hall and Jones (1999) observe that institutions protect output from diversion thus promoting growth. Therefore, good institutions may promote productivity and growth. This study considers that institutions may have a significant positive relationship with economic growth. Furthermore, some natural resources are not found everywhere. They are sporadic across the globe. Thus, they become object of trade among nations in their possession with those in need of them. Therefore, countries with large deposits of highly demanded natural resources may have huge income for growth and development. Sachs and Warner (1999) observe that natural resources boom could serve as a big push to the natural resources abundant countries. However, they empirically find that for the natural resources rich countries, periods of resources boom are often followed by slow growth, and in some cases, no growth at all.

Nevertheless, the focus of growth theory empirical research on institutions is quite a recent phenomenon (Dawson, 2007). Theoretically, however, studies on the links between institutions and growth could trace their roots to the works of North and Thomas (1973) and North (1990). North (1990) examines the nature of institutions and institutional changes and their influence on economic performance. Subsequently, different empirical works have been carried out on the effects of institutions on economic growth across countries and over time (Aron, 2000; Easterly, Kremer, Pritchett & Summers, 1993; Engerman & Sokoloff, 1997; Glaeser et al.,, 2004; Knack & Keefer, 1995).

Various studies investigate different aspects of institutions as they relate to economic growth. For instance, Gastil (1990) and Panahi, Assadeh, and Refaei (2014) investigate the influence of economic freedom on growth in 13 selected Middle East and North African (MENA) countries, while Clauge, Keefer, Knack, and Olson (1995) and Torstensson (1994) study the influence of property right institutions on economic growth in a cross section of 95 countries and 68 countries, respectively. In addition, Helliwell (1994) examine the influence of democratic institutions on growth for a sample of 125 countries. A number of studies also investigate the influence of institutions on output per worker (Eicher et al., 2006; and Hall & Jones, 1999). Many others investigate the role of institutions on growth by controlling different other variables such as investment, infrastructure, and electricity consumption (Dollar & Kraay, 2003; Easterly, Ritzan, & Woolcock, 2006; Engerman & Sokoloff, 1997; Okoh & Ebi, 2013; Olarinde & Omojolaibi, 2014). The results of the various studies are, however, mixed. Some of these studies find significant positive relationship between institutions and economic growth (Acemoglu & Johnson, 2005; Easterly et al.,

2006; Sawar, Siddiqi, & Butt, 2013; Sobhee, 2012), while some other studies find significant negative relationship between the variables (Folster & Henrekson, 2001; Plosser, 1992; Romero-Avila & Strauch, 2008; and Torstensson, 1994). Yet a number of other studies find no significant relationship between the variables (Commander & Nikoloski, 2011; Helliwell, 1994; Kormendi & Meguire, 1985), suggesting that the findings are inconclusive.

As regards natural resources-growth link, the history of the link can be theoretically traced back to the works of Hirschman (1958) and Gelb (1988). Researchers have shown great interest in investigating the relationship between natural resources and economic growth (Barbier, 2003; Philippot, 2010; Sachs & Warner, 1995, Sachs & Warner, 1997, among others). Different studies investigate different aspects of natural resources as they affect economic growth. For instance, Ibrahim-Shwilima (2015) investigates the influence of non-renewable resources on economic growth for a sample of 145 countries, while Akinlo (2012) and Baghebo and Atima (2013) study the impact of oil on economic growth in Nigeria. A number of other studies also re-examine the relationship between the variables to see whether natural resources are blessing or curse for the natural resources abundant countries (Brunnschweiler, 2008; Gylfason, 2001; Sim, 2013; Stijns, 2005). A number of these studies reveal a significant negative relationship between the variables suggesting the existence of "resources curse" in natural resources-abundant countries (Akinlo, 2012; Akpan & Chuku, 2014; Barbier, 2003; Behbudi, Mamipour & Karami, 2010; Sachs & Warner, 1995, 1997), while some others find a significant positive relationship between the variables and thus, disapproving the existence of the resources curse (Brunnschweiler, 2008; Ledermann & Maloney, 2003; Philippot, 2010). However, other set of studies find no significant relationship between the two variables (Ibrahim-Shwilima, 2015; Sim, 2013; Stijns, 2005). This, therefore, suggests that the study of the relationship between the variables is inconclusive.

Most of the studies reviewed in this article are cross-country studies which will not be able to pinpoint the actual relationship among the variable of interest in a specific country. This calls for country-specific studies that will take care of countries heterogeneity. For the few studies that apply country-specific approach, all of them suffer from either insufficient data points that will warrant robust results or inability to conduct one vital diagnostic test (i.e., test for structural break) that will help in arriving at robust findings for appropriate policy formulation. Notwithstanding, few studies have touched on some aspects of the subject matter for the Nigerian economy. For instance Okoh and Ebi (2013) and Olarinde and Omojolaibi (2014) investigate the influence of institutions on economic growth in Nigeria in relation to infrastructural investment and electricity consumption, respectively. In addition, Baghebo and Atima (2013) investigate the impact of petroleum on growth in Nigeria for the period 1980 to 2011.

This study, therefore, differs from other studies in Nigeria in many respects on the subject matter. First, some of the studies suffer from methodological weaknesses. For instance, Okoh and Ebi (2013), Zawojska and Suidek (2013), and Akpan and Chuku (2014) fail to assess the stationarity of the variables before carrying out the analysis. This study addresses this weakness. Second, most of the studies (such as Olarinde & Omojolaibi, 2014; Akpan and Chuku, 2014) used about 30 and 39 number of observations, respectively, while this study uses 55 observations from 1960 – 2014. Third, this study accounts for the influence of structural break in the unit root, co-integration analyses and vector error correction model (VECM) which none of the earlier studies did. This study, therefore, contributes to the debate in investigating the long-run relationship among institutions, natural resources and

economic growth using the Nigerian economy as a case study, by taking care of the aforesaid weaknesses of the previous studies on the subject matter. Therefore, the results of this study are expected to be more robust and reliable.

The rest of the paper is organised into 6 sections. Section 2 deals with theoretical framework and literature review. Section 3 presents the methodology. The results are presented in section 4, while section 5 discusses them. Section 6 concludes the paper and provides policy implications of the findings.

II. Theoretical Framework and Literature Review

This section deals with theoretical framework and review of empirical literature relevant to the study.

II.1 Theoretical Framework

This section reviews theories that link institutions, natural resources, and economic growth. As a fundamental determinant of economic growth, institutions exert their influence on growth indirectly through the proximate causes of growth (efficiency factor or technical progress, stock of capital, and labour). Aron (2000) observes that the impact of institutions on economic growth can be theoretically captured using the Solow growth model given as:

$$Y = Af(K, L)$$

Where Y is output, A is the efficiency factor or technical progress, K is the stock of capital, and L is labour. The influence of institutions on growth can be through either of the proximate causes above. In this regard, Eicher *et al.,* (2006) observe that institution alone cannot produce output, and thus must have an indirect effect on growth. The effects of institutions on growth come through either of two sources, factor accumulation or productivity growth (Eicher *et al.,* 2006). Factor accumulation implies the accumulation of physical and human capital, while productivity growth is the improvement in technology.

Aron (2000) further observes that the influence of institutions on economic growth can come through technical progress. However, Hall and Jones (1999) opine that just less than half of the impact of institutions on growth comes from their influence on factor accumulation, while the remaining is through its impact on technology or productivity growth. Eicher *et al.,* (2006) further argue that the impact of institutions on growth is through accumulation of physical capital (such as natural resources).

Natural resources can, therefore, be considered as another fundamental determinant of economic growth which exerts their influence on growth indirectly. Within the framework of the neoclassical production function, natural resources have always been treated as part of the physical capital stock. Lipsey and Carlaw (2000) observe that since the evolution of capital stock differs from that of the natural resources, they should be treated separately within the production function framework. They propose a production function that captures natural resources separately from the stock of physical capital. They opine that since natural resources are not conventionally measured in the neoclassical model, much of the technical change resulting from the production of natural resources will be measured as increases in capital and labour. A contrary view by Griliches (1994), however,

is that an increase in production from any unrecorded inputs goes to add up to total factor productivity (TFP) growth.

But Sachs and Warner (1997) outline a number of hypotheses that have been developed to explain the negative relationship they observe between natural resources and economic growth. The first model is the Dutch Disease Hypothesis which posits that dependence on natural resources hampers industrialisation, which then negatively impacts on the manufacturing sector and consequently, economic growth. Different models of the Dutch Disease were developed, such as the Matsuyama (1992) two-sector model involving agricultural and manufacturing sectors, and Sachs and Warner (1997) three-sector model which includes the natural resources sector, the manufacturing sector and the non-tradable goods sector. The second hypothesis is the Prebisch-Singer Hypothesis developed by Prebisch (1950) and Singer (1950), who argue that natural resources are likely to hamper industrialisation globally as a result of a decline in the terms of trade of primary products vis-à-vis manufactured ones. The authors opine that the falling prices of natural resources may frustrate resource-based growth. Another argument they pose is that natural resources promote rent seeking activities and thus, frustrate economic growth. They further argue that the reason for a negative relationship between natural resources and growth is that governments of resource-rich countries spend this rent on inappropriate consumption rather than on capital accumulation.

In this study, the neoclassical growth theory will serve as the theoretical base. The choice is made for the fact that the theory sets the foundation for determining the long-run growth of an economy, thus, it is appropriate for the study. Acemoglu (2009) observes that the neoclassical model can explain the influence of fundamental factors that determine growth, such as institutions and natural resources. Aron (2000) has made a similar observation with respect to the impact of institutions on growth. Therefore, all the factors under investigation will be adequately accommodated by the model. Also the model has a sound explanatory power for determinants of growth, especially the variables of interest in this study. Furthermore, the model provides ease of application, especially for empirical study such as this one.

II.2 Review of Empirical Literature

This section reviews the empirical literature relevant to the study. It is divided into two subsections each dedicated to reviewing empirical literature on the relationship between a given independent variable and economic growth. The independent variables of interest are institutions and natural resources endowment.

II.2.1 Relationship between Institutions and Economic Growth

A large number of studies reveal positive relationship between institutions and economic growth (such as Knack & Keefer, 1995; Sobhee, 2012; Okoh & Ebi, 2013) some other studies, however, find a significant negative relationship between the variables (such as Folster & Henrekson, 2001; Glaeser *et al.*, 2004; Plosser, 1992). Yet a number of other studies find no significant relationship between the variables (Commander & Nikoloski, 2011; Helliwell, 1994; Kormendi & Meguire, 1985). This study hopes to add to this growing literature by investigating the relationship between institutions and economic growth in Nigeria.

Knack and Keefer (1995), Sobhee (2012) and Vijayaraghavan and Ward (2001) investigate the role of institutions on economic growth for panels of 97 countries over the period 1974 – 1989, for a sample of 45 Latin American and Sub-Saharan African countries over the period 2002 to 2006, and a panel of 43 countries over the period 1975 – 1990, respectively. They apply ordinary least squares (OLS) regression analysis and find a significant positive influence of institutions on economic growth. However, the methodology applied in the studies would have been more suitable for a cross-sectional dataset rather than the panel datasets that require panel data analysis approaches. Furthermore, Sawar, Siddiqi, and Butt (2013) examine the relationship between institutions and economic growth for a panel of Asian countries covering the period 1995 - 2010 by applying fixed effects and random effects panel regression models, and using political rights and civil liberties as proxies for formal and informal institutions, respectively. The results reveal that institutions exert a significantly positive influence on economic growth. The findings are robust as the study considers different measures of institutions and the methodology they adopt is well suited for the panel dataset. Although panel studies are able to examine changes over time among countries, case studies for identifying country-specific factors that may affect the course of economic growth of a specific country are required.

Olarinde and Omojolaibi (2014) further investigate the long-run and short-run relationship between institutional quality and economic growth in Nigeria, using time series data over the period 1980 - 2011 and applying Autoregressive Distributed Lag (ARDL) bounds test model. The finding indicates a significant long-run positive relationship between institutions quality and economic growth in Nigeria. The Granger non-causality results indicate a unidirectional causality running from institutions to economic growth in Nigeria. Although the methodology they adopt for the study is well suited for the time series dataset, expansion of the period coverage back to the 1960s and beyond 2011 will increase the number of observations and produce a robust insight into the relationship between the two variables. Furthermore, this long period of study taking account of the possibility of structural break will help yield better results. In addition, Okoh and Ebi (2013) examine the effect of institutional quality on economic growth in Nigeria for 39 observations using correlation analysis and pair-wise Granger causality test. They use corruption and contract enforcement as two measures of institutional quality. The results indicate that institutional quality has a significant positive influence on economic growth in Nigeria. However, the authors fail to test for the effects of unit root problem commonly associated with a time series dataset before carrying out the analysis. In addition, the authors indicate only the number of observations used in the study, without specifying the study period coverage.

Moreover, Easterly, Ritzan, and Woolcock (2006) examine the role of institutions in determining the level of economic growth in a panel of 82 developed and developing countries over the period 1960 – 2002 by applying three stage least squares (3SLS) regression analysis, and using 11 indicators of institutional quality. The authors find that institutional quality has a significant positive influence on economic growth. Similarly, Acemoglu and Johnson (2005) evaluate the role of institutions in promoting economic growth using cross-section dataset for a sample of 71 countries comprising former European colonies by applying OLS and two stage least squares (2SLS) regressions. The findings reveal that institutions have a significant positive impact on economic growth. Dollar and Kraay (2003) also investigate the impact of institutions on economic growth for a sample of 100 countries using OLS and dynamic regressions for a cross-sectional dataset. The authors find strong significant evidence that institutions positively influence economic growth.

In addition, Panahi *et al.,* (2014) investigate the impact of institutions on economic growth for a panel of 13 selected Middle East and North African (MENA) countries over the period 2000 – 2009. Using pooled OLS, fixed, and random effect models, the authors find that institutions have a significant positive influence on economic growth. Similarly, Valeriani and Peluso (2011) investigate the impact of institutional quality on economic growth using panel dataset for a sample of 181 countries over the period 1950 – 2009 by applying pooled OLS and fixed effect estimators. The results indicate that all the three indicators of institutional quality used by the authors have a significant positive influence on economic growth, but that the quality of government has stronger impact on growth in developing than in developed countries. In addition, Clauge, Keefer, Knack, and Olson (1999) investigate the relationship between institutions and economic growth using a panel dataset for a sample of 95 countries over the period 1970 – 1992 by applying OLS regression analysis. The results reveal that institutions have a significant positive relationship with economic growth.

On the contrary, however, Folster and Henrekson (2001) examine the impact of institutions on economic growth using panel data for a sample of 23 OECD countries over the period 1970 – 1995 by applying panel regression methods. The results reveal a significant negative relationship between institutions and economic growth. Furthermore, Plosser (1992) also investigates the impact of institutions on economic growth using a panel dataset for a sample of 23 OECD countries over the period 1960 – 1989 and applying OLS regression analysis. The results reveal a significant negative relationship between institutions and economic growth for the sample of countries under investigation. Similarly, using panel data, Torstensson (1994) examines the influence of institutions on economic performance for a sample of 68 countries over the period 1976 – 1985 by applying OLS regression analysis. The results also reveal a significant negative relationship between institutions and economic growth. In addition, Romero-Avila and Strauch (2008) investigate the impact of institutions on economic growth using panel data for a sample of 15 European countries covering the period 1960 – 2001 by applying Generalised Method of Moment (GMM) model. These authors also find a significant negative relationship between institutions and economic growth.

Similarly, Zawojska and Suidek (2013) investigate the relationship between institutions and economic growth in 8 central and Eastern European countries over the period 1990 – 2011 using OLS regression analysis. They use GDP growth as the proxy for economic growth, while highly contract-intensive money serves as the proxy for institutions. Their analyses involve different regressions for each country individually and for the countries as a group. The results reveal that institutions have a significant negative influence on economic growth in the countries. Also, the methodology of the paper has some weaknesses. First, for the individual country regressions, the numbers of observations are not enough to draw reliable conclusions, while OLS regression may not be suitable for the time series dataset. Furthermore, they failed to conduct unit root tests prior to the application of the OLS regressions. Consequently, the results of this study may be spurious.

However, Glaeser et al., (2004) investigate the relationship between institutions and economic growth for a sample of 89 countries over the period 1960 - 2000 using OLS regression analysis. They find that institutions do not have any significant influence on economic growth. Furthermore, Helliwell (1994) examines the relationship between institutions and economic growth using a panel dataset for a sample of 125 countries over the period 1960 – 1985 by applying OLS regression analysis. The results reveal no significant

relationship between institutions and economic growth. Similarly, using panel data, Commander and Nikoloski (2011) also examine the relationship between institutions and economic performance for a sample of 159 countries over the period 1960 – 2009 by applying GMM estimator. The results indicate no significant relationship between institutions and economic growth. Similarly, Kormendi and Meguire (1985) also examine the relationship between institutions and economic growth using panel data for a sample of 47 countries over the period 1950 – 1977 by applying OLS regression model. The results indicate no significant relationship between institutions and economic growth.

But the fundamental determinants of economic growth include institutions and natural resources, among others (Acemoglu, 2009). Eicher, Garcia-Penalosa, & Teksoz (2006) argue that the impact of institutions on growth is through accumulation of physical capital, such as natural resources. Similarly, Gylfason and Zoega (2006) opine that natural resources are essentially exogenous factor that can affect economic growth through macroeconomic channels as well as through institutions.

II.2.2 Relationship between Natural Resources and Economic Growth

A variety of empirical investigations have been carried out on different aspects of the subject matter (Akinlo, 2012; Baghebo & Atima, 2013; Behbudi *et al.*, 2010; Sachs & Warner, 1995, 1997, 1999). While some of the studies find significant negative relationship between natural resources and economic growth (such as Akinlo, 2012; Baghebo & Atima, 2013; Sachs & Warner, 1995, 1997) some other studies reveal a significant positive relationship (Brunnschweiler, 2008, Ledermann & Maloney, 2003, and Mehrabadi, Nabiuny & Moghadam, 2012). A number of other studies, however, find no significant relationship between the variables (Ibrahim-Shwilima, 2015; Sim, 2013; Stijns, 2005).

Sachs and Warner (1997) examine the relationship between natural resources and economic growth using panel dataset for a sample of 87 developing countries over the period 1970 – 1990 by applying OLS regression model. They find a significant negative relationship between natural resources and economic growth. However, panel methods such as the fixed and random effects will be better for the panel dataset used in the study than the OLS. Similarly, Baghebo, and Atima (2013) investigate the impact of petroleum on economic growth in Nigeria using time series dataset over the period 1980 – 2011 by applying Johansen's (1988) co-integration approach. They use real GDP as the proxy for economic growth, while oil revenue serves as the measure of natural resources. The results indicate that oil revenue has a significant negative long-run impact on economic growth, suggesting the existence of resources curse in Nigeria. Furthermore, using time series data, Akpan and Chuku (2014) assess the impact of natural resources on economic growth in Nigeria over the period 1970 - 2008 by applying seemingly unrelated regression (SUR) analysis. They use primary export intensity, which is the ratio of primary exports to GDP, as the proxy for natural resources. They find a strong negative relationship between natural resources abundance and economic growth in Nigeria. However, they fail to test for unit root problem before the analysis. Furthermore, the methodology they use may not be appropriate for the time series dataset under study.

Gylfason and Zoega (2006) use panel data to further investigate the relationship between natural resources and economic growth for a sample of 85 countries over the period 1965 – 1998 by applying bivariate correlation and seemingly unrelated regression (SUR) analysis. They use natural capital estimates developed by the World Bank as the proxy for natural

resources abundance, arguing that natural resources intensity use in their previous studies are imperfect. The results suggest that natural resources have a significant negative impact on economic growth. The indicator of natural capital they use is an improvement in measuring natural resources. In addition, Barbier (2003) examines the relationship between natural resources and economic growth using panel data for a sample of 34 tropical developing countries over the period 1961 – 1994 by applying fixed and random effects models. He runs two separate regressions, one for all the countries in the sample and the other for lower income countries, with the agricultural land long-run change index as the proxy for natural resources. The results indicate that for both regressions, natural resources have a significant negative relationship with economic growth. The methodology appears to be robust and the results are, therefore, reliable.

However, Philippot (2010) assesses the impact of natural resources on economic growth using panel data for a sample of 28 transition economies from Central and Eastern Europe and former Soviet Union over the period 1990 – 2003 by applying random effects model. The rents from natural resources serve as the proxy for natural resources, while annual per capita GDP growth serve as the proxy for growth. The results reveal a significant positive relationship between natural resources and economic growth. They, therefore, rule out the existence of resources curse for the countries under investigation. These results, however, contradict the findings of some of the cross country studies such as Sachs and Warner (1997, 1999), Gylfason and Zoega (2006) among others. Therefore, there is the need to further investigate the relationship between the two variables, especially using a time series dataset.

Mehrabadi *et al.,* (2012), therefore, use time series data to investigate the impact of oil exports on economic growth in Iran over the period 1973 – 2007 by applying Engel-Granger co-integration approach. They use real GNP as a proxy for economic growth and real oil export as the proxy for oil exports. The findings indicate a significant long-run positive relationship between oil exports and economic growth. In addition, Brunnschweiler (2008) examines the effects of natural resources abundance using panel data for a sample of 102 countries over the period 1970 – 2000 by applying OLS, 2SLS and instrumental variable regressions. The authors use new measures of resource abundance such as fuel and non-fuel minerals and natural wealth index developed by the World Bank serve as the proxies for natural resources. The results indicate a significant positive relationship between natural resources abundance and economic growth.

Similarly, Ledermann and Maloney (2003) investigate the relationship between natural resources abundance and economic growth using panel data for a sample of 65 countries over the period 1975 – 1999 by applying OLS regression and GMM. They also find a significant positive relationship between natural resources abundance and economic growth. Furthermore, using a panel dataset, Wizarat (2013) examines the impact of natural resources abundance on economic growth for a sample of 97 countries, divided into 20 developed (DCs) and 77 less developed countries (LDCs) over the period 1980 – 2006 by applying GMM estimators. The results reveal no significant relationship between natural resources abundance in the LDCs, but for DCs, a strong and significant positive impact of natural resources abundance on economic growth exists. However, the production and exports of natural resources are not adequate measure of resources abundance (see Gylfason and Zoega, 2006).

Similarly, Stijns (2005) uses panel data and investigates the relationship between natural resources and economic growth for a sample of 29 countries over the period 1970 – 1989, using OLS regression. The results indicate that land has no significant relationship with economic growth, while the other measures of natural resources have unstable relationship with growth in different regressions. As observed earlier, OLS regression may not be an appropriate methodology for panel data and, therefore, the results may not be robust enough. Sim (2013) also uses panel data and investigates the relationship between natural resources and economic growth for a sample of 86 resources-rich countries over the period 1970 – 2009 by applying OLS, SUR and 3 Stage Least Squares (3SLS). The author uses annual GDP per capita as the proxy for economic growth, while ratio of natural resources rent to GDP and share of primary exports to GDP serve as the proxies for natural resources. The results indicate that natural resources have no significant relationship with economic growth for the overall period (1970 – 2009).

Finally, the major lessons learnt from the aforesaid literature are: First, most of the studies reviewed in this article are cross-country studies which will not be able to pinpoint the actual relationship among the variable of interest in a specific country. This calls for country-specific studies that will take care of countries heterogeneity. Second, for the few studies that apply country-specific approach, all of them suffer from either insufficient data points that will warrant robust results or inability to conduct one vital diagnostic test (i.e., test for structural break) that will help in arriving at robust findings for appropriate policy formulation.

III. Methodology

This section presents the methodology of the paper. It is divided into two sections, i.e., data and variables measurements, and model specification.

III.1 Data

This study uses annual time series data for the period 1960-2014 from secondary sources. For the purpose of this study, data on the relevant variables have been obtained through the websites of Central Bank of Nigeria (CBN) and the World Bank. Data on GDP have been obtained from the CBN Statistical Bulletin (2011 and 2014) and complemented by the World Development Indicators (WDI) published by World Bank (2014). The data on broad money (M2), oil export, commercial banks deposits and currency outside banks have been collected from the CBN Statistical Bulletin (2011 and 2014.

The use of time series data for this study is justified on the grounds that most of the studies conducted on the relationship among institutions, natural resources and economic growth apply panel datasets (Knack & Keefer, 1995; Sobhee, 2012; Vijayaraghavan & Ward, 2001; Sawar, Siddiqi, & Butt, 2013; Easterly, Ritzan, & Woolcock, 2006; Valeriani & Peluso, 2011; Clauge, Keefer, Knack, & Olson, 1999; Folster & Henrekson, 2001; Plosser, 1992; Torstensson, 1994; Romero-Avila & Strauch, 2008; Zawojska & Suidek, 2013; Glaeser, La Porta, Lopez-de-Silanes & Shleifer, 2004; Helliwell, 1994; Commander & Nikoloski, 2011; Kormendi & Meguire, 1985; Sachs & Warner, 1997; Gylfason & Zoega, 2006; Philippot, 2010; Brunnschweiler, 2008; Ledermann & Maloney, 2003; Wizarat, 2013; Stijns, 2005; Sim, 2013), which do not give country-specific outcome of the investigation. In addition, only very few of the studies reviewed in this work apply time series dataset (Olarinde & Omojolaibi, 2014; Okoh & Ebi, 2013; Baghebo, & Atima, 2013; Akpan & Chuku, 2014; Mehrabadi, Nabiuny & Moghadam,

2012) and make use of time series econometric approaches in analysing the datasets that give country-specific results. Table 1 presents the description of the time series dataset used for this study.

Table 1 presents the descriptive statistics of the variables of the study. Nominal Gross Domestic Product (NGDP) had a mean of 9,360,000,000,000 trillion naira, a minimum of 2,230,000,000 billion naira and a maximum of 89,000,000,000,000 trillion naira. This suggested that there were some years when nominal GDP was as low as N2,230,000,000 billion naira and as high as N89,000,000,000,000 trillion in some years.

The results further revealed that the mean Contract Intensive Money (CIM) stood at 0.7012097, with a minimum of 0.4558678, and a maximum of 0.9187016 over the study period. This therefore suggested that the CIM had been as low as 0.4558678 in one period and as high as 0.9187016 in other periods.

Table 1 Descriptive Statistics

Variables	Mean	Minimum	Maximum
Nominal GDP	9,360,000,000,000	2,230,000,000	89,000,000,000,000
Contract Intensive Money	0.7012097	0. 4558678	0. 9187016
Oil Exports	2,290,000,000,000	8,820,000	14,300,000,000,000
Natural Resources Intensity	23.09	0.39	49
Number of Observations: 55			

Source: Computed by the Author using Stata Version 13.0 using data from CBN Statistical Bulletin 2011 and 2014

The nominal value of oil exports (OXP) for Nigeria had a mean of N2,290,000,000,000 trillion naira, a minimum value of N8,820,000 billion and a maximum of N14,300,000,000,000 trillion. This suggested that OXP for Nigeria had been as low as N8,820,000 billion, and as high as N14,300,000,000,000 trillion in other periods.

The results in Table 1 further indicated that the mean Natural Resources Intensity (NRI) for Nigeria over the period 1960 – 2014 stood at 23.09 per cent, with a minimum of 0.39 per cent, and a maximum of 49.00 per cent. This therefore suggested that NRI had values as low as 0.39 per cent in some period and as high as 49.00 per cent in other periods.

III.2 Variables Measurement

This subsection deals with different measures of the variables captured for this study. The variables are measured as follows:

III.2.1 Economic Growth

For the purpose of this study, GDP served as a proxy for economic growth. This follows the works of Baghebo and Atima (2013), Ohwofasa and Aiyedogban (2013) and Olarinde and Omojolaibi (2014) among others. However, in order to standardise the variables of this study to the same measurement standards, nominal value of GDP has been used since the other variables are all in nominal values.

III.2.2 Contract Intensive Money (CIM)

This study adopts the CIM as the proxy for institutions. CIM is a measure of the confidence the people have in the system, contract rights, security of property and rule of law. CIM is calculated using the formulation below:

$$CIM = \frac{(M2-C)}{M2} \quad (1)$$

Where M_2 is broad money supply and C is the currency held outside the banking system. The higher the confidence in the financial system, the more money that is kept in the system and vice versa. Higher values of CIM indicates confidence, trust and preference for long-term contracts, while lack of trust in the economy yields a lower value for CIM. The use of the CIM as proxy for institutions in this study follows the works of Clauge, *et al.,* (1999), Dollar and Kraay (2003), Okoh and Ebi (2013) and Olarinde and Omojolaibi (2014). This proxy for institutions has been adopted for the fact that it captures the most important institutional factors (confidence the people have in the system, contract rights, security of property and rule of law) that can influence economic growth of any country.

III.2.3 Natural Resources Intensity (NRI)

Following the works of Akpan and Chuku (2014), Ledermann and Maloney (2003) and Sachs and Warner (1997), the ratio of natural resources export to nominal GDP serves as the proxy for natural resources. It is computed as follows:

$$NRI_t = \frac{Oil\ Exports_t}{GDP_t} \times 100 \quad (2)$$

Where NRI is the ratio of oil exports to nominal GDP at time t, oil export is the nominal value of oil exports, while GDP is the nominal value of GDP. Data on both oil exports and GDP were obtained from the CBN Statistical Bulletin, 2014.

III.3 Model Specification

This section outlines the specification of the model and the procedure used in achieving the objectives of the study. Here, economic growth has been regressed on institutions and natural resources using Gregory & Hansen (1996a, 1996b) co-integration approach and vector error correction model. However, given the unit root problem that is often associated with time series dataset, stationarity tests have been carried out to ascertain the presence or otherwise of the unit root associated with each of the variables before an appropriate method of estimation can be chosen. If all the variables are stationary at level values, OLS or autoregressive distributed lag models can suffice for the estimation. However, if all the variables are stationary at first differenced values, co-integration approach is the best method of estimation. But if some of the variables are stationary at their level values while others are stationary at their first differenced values, then Autoregressive Distributed Lag (ARDL) bounds tests model is the best alternative (Oktayer & Oktayer, 2013).

There is no conclusive opinion on the most appropriate methodology to undertake unit root tests (Glynn, Perera, & Verma, 2007). Therefore, appropriateness of a method depends on the problem at hand. If break periods are known, modified ADF approaches

such as those of Perron (1989, 1990), Zivot and Andrews (1992), Perron and Vogelsong (1992) among others can be applied (Joyeux, 2001). But if the periods are not known, Clemente, Montanes, & Reyes (1998) unit root test should be applied (Joyeux, 2001). On the other hand, if the results of the Clemente et al., (1998) unit root tests show no evidence of a structural break, the ADF, KPSS and PP tests can be considered (Feridun et al.,, 2009). If mean and trend are unknown in the presence of small sample and absence of structural break, DF-GLS should be applied (Acaravci, 2010).

Given the results of the unit root tests, Gregory & Hansen (1996a, 1996b) co-integration approach and vector error correction model have been applied in this study. The choice of Gregory and Hansen co-integration approaches is informed by the fact that the date of the exact structural break that might affect the co-integration regression has not been known before Clemente et al., (1998) unit root test. Since Clemente *et al.,* (1998) unit root test identifies different break periods for different variables to be captured in the econometric model, it might be difficult to select the appropriate break period when applying Johansen, Mosconi, and Nielsen (2000) and other co-integration approaches. Therefore, to circumvent this problem, Gregory and Hansen (1996a, 1996b) co-integration test that takes account of single unknown break has been applied. This is the line of argument followed by Herzberg (2015).

The Gregory and Hansen (1996a, 1996b) co-integration approach has three methods of optimum lag selection embedded in the model. The first uses the Akaike Information Criterion (AIC), the second is the Bayes Information criterion (SBIC), while the third, which is fixed, uses any lag selected by the user. Using any of these information criteria, the model automatically selects the suitable lags for the regression. This study uses the AIC for the co-integration regression and chooses a maximum of five lags. The theoretical model is specified as follows:

$$NGDP = f(CIM,\ NRI) \qquad (3)$$

Where: NGDP is the nominal Gross Domestic Product a proxy for economic growth,
CIM is the contract intensive money and is a proxy for institutions.
NRI stands for natural resources intensity, the ratio of oil export to nominal GDP and it is a proxy for natural resources.

The functional relationship in equation 3 can be presented empirically in econometric form below:

$$NGDP_t = \beta_o + \beta_1 CIM_t + \beta_2 NRI_t + u_t \qquad (4)$$

Where the variables remain as defined in equation 3 and β_o is the intercept parameter, while β_1, and β_2 are estimated coefficients of institutions and natural resources respectively. The *a priori* expectation of the model is that the estimated parameter are expected to be positive.

Unit root tests have been conducted on each of the variables under investigation before the co-integration test. Since the ADF and Phillips and Perron (1988) unit root tests confuse breakpoints with non-stationarity of a variable, the Clemente *et al.,* (1998) unit root test has also been used to assess the impact of a single break on the series variables under

investigation. But if there is no evidence of structural break, then the results of the ADF unit root test will be used as it is more reliable (Baum, 2005) in this situation.
Gujurati and Porter (2009) and Dickey, Jansen, and Thornton (1991) observe that unit root test is one of the pre-tests necessary before the estimation of a time series econometric model. The existence or otherwise of co-integration among the variables in the presence of structural break has been estimated using Gregory and Hansen (1996a, 1996b) approach. Although there are many other approaches, this model is adopted for its ability to account for structural break in the co-integration process (Gregory & Hansen, 1996a; Herzberg, 2015; Romano & Scandurra, 2009). It accounts for single unknown break which is endogenously determined by the model (Gregory & Hansen, 1996b; Herzberg, 2015). The model is a residual-based test, which is an extension of Engel-Granger two-stage error correction model (Herzberg, 2015). It tests the null hypothesis of no co-integration against the alternative hypothesis of co-integration in the presence of regime shift (Gregory & Hansen, 1996a). The model also tests for the existence of one co-integrating vector among the variables (Sadeghi & Ramakrishna, 2014). The model therefore produces consistent and reliable results as it accounts for the influence of structural break.

Gregory and Hansen (1996a, 1996b) propose four models which account for single break in level shift, C, which occurs when there is change in the intercept while the slope parameters are held constant, given by equation 5; level shift with trend, C/T, which occurs when time trend is introduced into level shift, this is given by equation 6; regime shift, C/S, which occurs when there is change in both the intercept and slope parameters, this is given by equation 7; and regime shift with trend, C/S/T, which occurs when time trend is introduced into regime shift, and this is given in equation 8. These are specified below.

$$Y_t = \alpha_1 + \alpha_2 D_{tk} + \beta_1 X_t + \varepsilon_t \quad (5)$$
$$Y_t = \alpha_1 + \alpha_2 D_{tk} + \delta t + \beta_1 X_t + \varepsilon_t \quad (6)$$
$$Y_t = \alpha_1 + \alpha_2 D_{tk} + \beta_1 X_t + \beta_2 X_t D_{tk} + \varepsilon_t \quad (7)$$
$$Y_t = \alpha_1 + \alpha_2 D_{tk} + \delta t + \beta_1 X_t + \beta_2 X_t D_{tk} + \varepsilon_t \quad (8)$$

Where Y is the dependent variable and X is the independent variable, α_1 is the intercept of the model before the break point (K) and α_2 measures the shift that occurs after the break. β_1 is the slope parameter of the co-integrating vector, β_2 measures the change in the co-integrating vector after the regime shift, δ is the slope parameter of time trend, t , and ε is error term. D is dummy variable which is defined as:
$D_t = \{^{1\ for\ any\ time\ period\ after\ the\ break\ point}_{0\ otherwise}$
D is the dummy variable which accounts for the break period (see Gregory & Hansen, 1996a, 1996b; Joyeux, 2007).
Gregory and Hansen (1996a, 1996b) propose three tests of the residual series as follows:

$$ADF^* = \inf_{\tau \epsilon T} ADF(\tau) \quad (9)$$
$$Z_\alpha^* = \inf_{\tau \epsilon T} Z_\alpha(\tau) \quad (10)$$
$$Z_t^* = \inf_{\tau \epsilon T} Z_t(\tau) \quad (11)$$

Following the existence of co-integration relationship among the variables, VEC models have been specified to get the normalised coefficients of the co-integrating vectors and the short-run relationship among the variables. The VEC model, in which allowance has been made via a dummy variable to account for the identified break, is specified as follows (see Romano & Scandurra, 2009).

$$\Delta X_t = \delta + \psi X_{t-1} + \sum_{i=1}^{p-1} \Phi \, \Delta X_{t-i} + D\vartheta_{k,t} + \mu_t \qquad (12)$$

Where δ is vector of constants, X is the matrix of endogenous variables, and ϑ is the vector of the intervention variables (dummy variables) which is used to account for the influence of structural breaks in the VECM (Romano & Scandurra, 2009). Ψ is a reduced rank coefficients matrix which can be decomposed into a and β, while ϑ, the vector of dummy variables, is defined as:

$$\vartheta_{k,t} = \begin{cases} 1 & for\ any\ time\ period\ after\ the\ break\ point \\ 0 & otherwise \end{cases}$$
$$I_t = \begin{cases} 1 & for\ any\ time\ period = the\ break\ point \\ 0 & otherwise \end{cases}$$

Where ϑ is the break dummy, while I is an indicator variable. The indicator variable provides the structural stability for the model when the breakpoint is known *a priori* (Baum, 2006; Joyeux, 2007).

When series variables are integrated of the same order, but not co-integrated, a VAR model may be specified in the form of the first difference of the integrated variables to run a simple Granger causality test (Acaravci, 2010; Chiou-Wei et al., 2008; Pradhan, 2010; Tehranchian, 2006; Altinay & Karagol, 2005; Omotor, 2008; Esso, 2010). But if there is at least one co-integrating vector, the residuals of co-integrating equation should be estimated and the first lag value of the residuals be added to the next VAR model to form VEC model (Acaravci, 2010). The residual of the co-integration regression is then predicted and its one lag level value is used in the VEC model in equation (13) as the error correction term (Johansen & Juselius, 1990), as follows:

$$\Delta NGDP_t = \beta_o + \sum \alpha_i \, \Delta CIM_{t-i} + \sum \beta_i \, \Delta NRI_{t-i} + \sum \delta_i \Delta DUM_{t-i} + \alpha_i res_{t-1} + \mu_t \quad (13)$$

The error correction term which adjusts for disequilibrium in the model is expected to be negative and significant with absolute value less than one (Johansen & Juselius, 1990).

IV. Results

This section presents the results and interpretations. It has four subsections which deal with unit root tests, co-integration analysis, vector error correction model, and impulse response function.

IV.1 Unit Root Tests and Interpretation of Results

This subsection presents results of unit root tests and their interpretations. It presents unit tests with and without structural breaks.

IV.1.1 Augmented Dickey Fuller and Phillips-Perron Unit Root Tests

This subsection presents the results of Augmented Dickey and Fuller (ADF) (1979) unit root test and the Philips and Perron (1988) (Phillips-Perron) unit root test. The results in Table 2 indicate that all the three variables are not stationary at their level values. Similarly, the results of Phillips-Perron unit root tests in the Table show that none of the variables is stationary at its level value. But all the variables are stationary at their first differenced values for both ADF and Phillips-Perron unit root tests.

IV.1.2 Test for Unit Root with Structural Break and Interpretation of Results

This subsection presents the results of test for unit root with structural break using Clemente *et al.,* (1998) unit root test. The single break additive outlier model which captures sudden change in the mean of series variables has been estimated in this study. The results of the test are presented in Table 3.

Table 2: ADF and Phillips-Perron Unit Root Test Results

Variables	ADF Statistics		Phillips-Perron	
	Level Values	First Difference	Level Values	First Difference
Natural Log of Nominal GDP	-2.654(1)	-4.853(1)***	-2.614(1)	-6.457(1)***
Contract Intensive Money	-1.497(1)	-4.529(1)***	-1.526(1)	-6.815(1)***
Natural Resources Intensity	-1.889(1)	-6.965(1)***	-2.259(1)	-8.530(1)***

Source: Computed by the Author using Stata Version 13.0, using data from CBN Statistical Bulletin (2011 & 2014) and World Bank (2014).

Notes: Values are stationary at 1 per cent (***), 5 per cent (**), and 10 per cent (*). Values in parenthesis are the optimum lag(s).

The results in Table 3 indicate that none of the variables is stationary at its level value but all of them possess a significant break period at 1 per cent level. However, all the variables are stationary at their first differenced values and one log of nominal GDP possesses a significant structural break at 10 level, suggesting weak significant level. Consequently, all the variables are stationary at first difference values, confirming the results of Phillips-Perron unit root tests in Table 2. Since only the ADF unit root test indicates one variable as stationary at its level value, and the Clemente *et al.,* (1998) unit root test indicates existence of a significant structural break associated with dependent variable, the result of Clemente *et al.,* (1998) unit root test have been adopted in this study because the results of the Clemente et al., (1998) unit root tests show evidence of a structural break (Feridun et al.,, 2009).

Table 3: Clemente et al., (1998) Unit Test Results (Additive Outliers One Structural Break)

Variables	Level Values		First Difference Values	
	Structural Break	Unit Root	Structural Break	Unit Root
Log of Nominal GDP	1997***	-1.951(1)	1966*	-6.900(1)**
Contract Intensive Money	2003***	-2.246(1)	1992	-7.530(1)**
Natural Resources Intensity	1984***	-3.178(1)	2003	-7.955(1)**

Source: : Computed by the Author using Stata Version 13.0, using data from CBN Statistical Bulletin (2011 & 2014) and World Bank (2014).

Note: Dates and values are significant at 1 per cent (***), 5 per cent (**), and 10 per cent (*) respectively. Values in parenthesis are the optimum lag(s) used for the tests.

At times, a series refuses to be stationary even after differencing due to structural break. Taking care of structural breaks in unit root test is therefore important to avoid the problem of bias and spurious rejections of a null hypothesis that a series variable is not stationary (Glynn *et al.,,* 2007). Given the fact that all the variables are stationary at their first difference values, the condition for applying co-integration test has been fulfilled.

IV.2 Co-integration Analysis with Structural Break and Interpretation of Results

This subsection presents the results of co-integration analysis in the presence of structural breaks computed using Gregory and Hansen (1996a) approach.

Table 4: Gregory and Hansen (1996a) Co-integration Test with Structural Break

Model	Level shift	Level Shift & Trend	Regime Shift	Regime Shift & Trend
ADF Statistic	-5.52**	-5.36*	-5.00	-4.44
Break Date	1990	1994	1989	1984

Source: Computed by the Author using Stata Version 13.0, using data from CBN Statistical Bulletin (2011 & 2014) and World Bank (2014).
Notes: values are significant at 5 per cent (**), and 10 per cent (*) respectively.

Table 4 presents the results of Gregory and Hansen (1996a, 1996b) co-integration test with single unknown structural break. In this test, the null hypothesis of no co-integration with a structural break is tested against the alternative of existence of co-integration with a structural break. Recall that the Gregory and Hansen (1996a, 1996b) co-integration in the presence of structural break has four models. The results in Table 4 which account for level shift show that the ADF test statistic of -5.52 is significant at 5 per cent level, with a structural break in 1990. This means that the null hypothesis of no co-integration relationship is rejected in favour of the alternative hypothesis. Therefore, there is co-integration relationship among the variables in the model when level shift is considered. In other words, there is long-run relationship among the variables in the models with level shift, i.e., when structural break at level is considered without trend. This break period co-incide with jump in oil prices in 1990 which is associated with Gulf war, together with the effects of structural adjustment programme (SAP). For the model which account for level shift with trend, the results in the Table indicate that there is co-integration with ADF test statistic of -5.36 and structural break in 1994, though weakly significant at 10 per cent level.

The results in the Table 4 further show that for the model with regime shift only, the ADF test statistic of -5.00 is not significant and therefore the null hypothesis of no co-integration relationship among the variables cannot be rejected, though there is a break in 1989. That is, if regime shift only is accounted for in the model without break, co-integration does not exit. Similarly, the Gregory and Hansen (1996a, 1996b) co-integration test that accounts for single break in regime shift with trend suggests that there is no co-integration relationship among the variables in the model. Therefore co-integration strongly exists only when structural break at level is considered without trend and regime shift.

IV.3 Vector Error Correction Results

In the presence of co-integration among integrated variables, the condition for applying Vector Error Correction (VEC) is satisfied and it is estimated to get both short-run and long-run coefficients of the estimated parameters. This section presents the results of VEC in Table 5. The section has two subsections which deal with the long-run and short-run

coefficients of the VEC model. However, vector error correction requires the optimum number of lags to be specified using some information criteria. Table 4 presents the summary of results of the optimum lag selection tests for the model.

Table 5: Summary Results of Optimum Lag Selection Tests

Criteria	LR	FPE	AIC	HQIC	SBIC
Optimum Lag	4	1	1	1	1

Source: Computed by the Author using Stata Version 13.0, using data from CBN Statistical Bulletin (2011 & 2014) and World Bank (2014).

The optimum lags selection reports a maximum of 4 lags required to check for the consistency of the information criteria. The results in the Table 5 show that the Likelihood Ratio (LR) suggests 4 lags for the co-integration test, while the Final Prediction Error (FPE) and Akaike Information Criterion (AIC), Hannan and Quinn Information Criterion (HQIC) and Schwarz Bayesian Information Criterion (SBIC) suggest the use of 1 lag for the co-integration test.

Given the results of the optimum lags selection in Table 5, this study choses to work with 4 lags for the model under investigation. This choice is informed for a reason. Likelihood ratio suggests the use of 4 lags in the vector error correction and Liew (2004) observes that any of the criteria, with the exception of HQIC, produce reliable results when working with small sample of less than or equal to 60 observations, therefore HQIC results can be considered since this study has 55 number of observations.

IV.3.1 Long-run Relationship and Interpretation of Results

This subsection presents the results of the normalised long-run coefficients of the co-integration regression and their interpretations. The long-run explains the static relationship among the variables in the model. In other words, it presents the co-integration parameters of a model.

Table 6 presents the normalised long-run coefficients of the co-integration regressions for the model under investigation. It postulates two major arguments. First, that the variables of interest (CIM and NRI) have significant influence on economic growth. The results in column 2 reveal that contract intensive money (a proxy for institutions) has a significant positive influence on nominal GDP in the long-run and is significant at 1 per cent. Furthermore, the results show that natural resources intensity has a significant positive long-run relationship with nominal GDP at 1 per cent level. In addition, the structural break dummy variable has a significant positive influence on the dependent variable, at 1 per cent level. In this case, the break period (1990) coincides with the increase in crude oil price as a result of the Gulf war in 1990. Therefore the increased government revenue causes structural shift which has significant positive influence on economic growth in Nigeria. Moreover, the adjustment parameter is negative (correct sign), less than unity and significant at 1 per cent level. Its value of -0.350 suggests that about 35 per cent of short-run disequilibrium in the model will be adjusted to reach equilibrium annually. Furthermore, the value of the adjustment parameter suggests that there will be quick adjustment in any short-run disequilibrium in the model. In sum, the results in this column of the Table support the hypothesis that both institutions and natural resources significantly and positively influence economic growth in Nigeria in the long-run.

The second argument derived from the results in Table 6 is that including structural break dummy in the vector error correction regression improves the significance and thus reliability of the model. Column 1 presents the estimates without the break dummy and reveals that a unit improvement in institutional quality leads GDP to increase by 25.625 percentage point. While a unit increase in natural resources increases GDP by 0.205 percentage point. Both variables are statistically significant at 1 per cent. However, the adjustment parameter though less than 1 per cent and negative, is statistically not significant. Column 2, on the other hand, includes the break dummy. From the results in column 2, though the contributions of the variables to GDP have dropped to 16.776 and 0.0288 percentage points respectively for institutions and natural resources, the adjustment parameter is 35 per cent and statistically significant at 1 per cent. Given the role of the adjustment parameter in a VEC model therefore, column 2 presents a more reliable estimate. In addition the structural break dummy contributes to GDP increasing by 4.827 percentage point. Overall, the results of model 2 in Table 6 are in support of the argument that accounting for structural breaks in VECM contributes to the significance and thus reliability of the model. Therefore, the results of the model 2 have been used to draw conclusions and policy implications of the finding of this paper.

IV.3.2 Comparative Results of Long and Short-run Relationships and Interpretation of Results

This subsection presents the comparative results of the long and short-run relationships among the variables in vector error correction models and their interpretations.

Table 6: Summary of the Results of the Normalised Long-run Coefficients of the Co-integration Regression with Structural Break

Dependent Variable: Natural Log of Nominal GDP		
Independent variables	1	2
Contract Intensive Money	25.625	16.776
	(6.25)***	(16.77)***
Natural Resources Intensity	0.205	0.0288
	(8.42)***	(2.98)***
Structural Break Dummy (1990)		4.246
		(19.30)***
Adjustment Parameter	-0.00981	-0.350***
R-Squared	0.628	0.732

Source: Computed by the Author using Stata Version 13.0, using data from CBN Statistical Bulletin (2011 & 2014) and World Bank (2014).

Note: values in parenthesis represent the calculated z-values. Parameters are significant at 1 per cent (***); 5 per cent (**); and 10 per cent (*). Column 1 does not include structural break dummy, while column 2 does. Column 3 does not include natural resources, while column 4 excludes institutions.

Table 7 presents summary of results of the long-run and short-run coefficients of the vector error correction model. The results in the Table 7 indicate that the variables contribute positively to growth in the long-run. However, their short-run contribution to growth is negative and statistically significant. The implication of this is that efforts at improving institutions and natural resources will have negative impact on growth in the short-run while in the long-run they will improve the growth prospects of the economy.

The reason for the immediate negative short-run impact of institutions on economic growth may be based on the fact that at initial stage of implementing most of the programmes there exist some negative externalities. But in the long-run, when they begin to yield results in the long-run, such externalities will be offset. However, the main objective of this study is to investigate the long-run not short-run influence of institutions and natural resources on economic growth of Nigeria.

Table 7: Comparative Results of Long-run and Short-run Coefficients of Vector Error Correction Models

Dependent Variable: Natural Log of Nominal GDP		
Independent variables	**1** **Long-run Coefficients**	**2** **Short-run Coefficients**
Contract Intensive Money	16.776 (16.77)***	-5.151 (-3.11)***
Natural Resources Intensity	0.0288 (2.98)***	-0.00444 (-0.97)
Structural Break Dummy (1990)	4.246 (19.30)***	-0.975 (-2.48)**

Source: Computed by the Author using Stata Version 13.0, using data from CBN Statistical Bulletin (2011 & 2014) and World Bank (2014).
Note: values in parenthesis represent the calculated z-values. Parameters are significant at 1 per cent (***); and 5 per cent (**). Column 1 and 2 present the results of long-run and short-run estimates respectively.

IV.4 Impulse Response Function and Interpretations of Results

This subsection presents the results of impulse response function and their interpretations. Impulse response function examines the effects of shocks on the adjustment of the variables in a model by tracing out the time path of the effects of shocks from the independent variables to the dependent variables. The effect of shocks on a dependent variable is transitory when it is temporary and dies out with time. When the effect does not die out over time, it is called permanent. Following the works of Odeniran and Udeaja (2010) and Olarinde and Abdullahi (2014) a period of 10 years are selected for the impulse response tests.

Table 8 presents the results of the impulse response function of the model over a 10-year period. The results in column 1 present the response of economic growth (nominal GDP) to its own shocks. The results indicate that shocks from economic growth results in a series of increases in itself that does not die out over the periods. This response fluctuates between increases and decrease in economic growth over the response period. This suggests that shocks in economic growth are permanent in nature. From the results in Table 8 it is also clear that shocks from institutions (contract intensive money) to economic growth (nominal GDP) do not die out over the period. This indicates that shocks from institutions have permanent effects on economic growth. This response also fluctuates between increases and decreases in growth over the response period.

Table 8: Summary Results of Impulse Response Function

Step	1	2	3
	OIRF	OIRF	OIRF
0	0.182944	0	0
1	0.168322	0.005398	0.004942
2	-2.6451	-0.404187	-5.25725
3	21.7733	3.526	39.41
4	-113.64	-18.6031	-212.043
5	391.17	69.4821	739.65
6	-189.879	-73.0758	-482.341
7	-9727.99	-1362.23	-17338.1
8	93239.2	14433.3	170322
9	-555495	-90171.5	-1.00E+06
10	2.30E+06	390172	4.30E+06

Source: Computed by the Author using Stata Version 13.0, using data from CBN Statistical Bulletin (2011 & 2014) and World Bank (2014).

IRF NGDP = impulse, and NGDP = response
IRF CIM = impulse, and NGDP = response
IRF NRI = impulse, and NGDP = response

The results in Table 8 also indicate that the shocks from natural resources (NRI) to economic growth (nominal GDP) fluctuate over response period. This suggests that shocks in NRI are permanent in nature.

V. Discussions

This study examines the long-run relationship among institutions, natural resources endowment, and economic growth in Nigeria. The study seeks to find out whether institutions significantly influence long-run economic growth in Nigeria; and whether there is any significant long-run relationship between natural resources and economic growth in Nigeria.

On the relationship between institutions and economic growth, the results indicate that institutions have a significant positive long-run influence on economic growth in Nigeria. This finding concurs with those of Acemoglu and Johnson (2005), Easterly *et al.,* (2006), Knack and Keefer (1995), Okoh and Ebi (2013), Olarinde and Omojolaibi (2014), Sawar *et al.,* (2013) and Sobhee (2012) among others. However, the finding contradicts the findings of Folster and Henrekson (2001), Glaeser, Porta, Lopez-de-Silanes, and Shleifer (2004) and Plosser (1992) who find that institutions have a significant negative relationship with economic growth. As postulated by the theory underpinning this study, institutions are theoretically expected to influence economic growth positively (see Aron, 2000; and Eicher *et al.,*, 2006). The results obtained from this study reveal that institutions influence economic growth positively in the long-run. Therefore, this finding is also in agreement with the postulations of the theory guiding the study.

On the relationship between natural resources endowment and economic growth, the findings of this study reveal that natural resources have a significant positive long-run

relationship with economic growth in Nigeria. This finding confirms the findings of Brunnschweiler (2008) Ledermann and Maloney (2003), Mehrabadi, Nabiuny, and Moghadam (2012) and Philippot (2010), among others. However, it contradicts the findings of Akinlo (2012), Baghebo and Atima (2013), Barbier (2003), Behbudi *et al.,* (2010), Gylfason and Zoega (2006) and Sachs and Warner (1995; 1999) who find that natural resources relate negatively with economic growth. The neoclassical growth model considers natural resources as part of physical capital and as such natural resources are, theoretically expected to influence economic growth positively. The results obtained in this study show that natural resources have positive relationship with economic growth. This finding, therefore, confirms the postulations of the theory underpinning this study. However, natural resources endowment maintains its positive contributions to economic growth only in the presence of strong institutions.

The results further indicate that accounting for the influence of structural break in the vector error correction model improves the significance and reliability of the model. This implies that the underlying causes of structural breaks in time series dataset also play important role in the model estimates. In addition, the results also indicate that better institutions make greater contributions to growth than natural resources. This finding implies that improving the quality of institutions contributes more to growth than exploitation of natural resources.

VI. Conclusions and Policy Implications

The results indicate that both institutions and natural resources have significant positive long-run influence on economic growth. They also indicate that better institutions make greater contributions to growth than natural resources.

The results have important implications for both policy and research. From the policy perspective, the results imply that improving the quality of institutions will increase the prospect of long-run economic growth in Nigeria. Similarly, maximum exploration and optimum utilisation of natural resources will improve the growth prospects of the Nigerian economy in the long-run. This may be achieved through diversification of the exploration and extraction of the natural resources in the country and effective compensation of all affected stakeholders in the process of extraction. However, promoting the quality of institutions will contribute to growth much more than relying on natural resources.

The implications for future research is that accounting for the influence of structural breaks in the vector error correction model produces better and more reliable results. In addition, this study accounted for a single structural break in its analysis. Furthermore, increasing the number of observations would help produce more robust results.

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Quantifying the Macroeconomic Impact of Trade Liberalisation in Nigeria

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Abstract

Trade liberalisation has important implications for macroeconomic stability and development. This paper examines the impact of trade liberalisation on macroeconomic performance in Nigeria utilising a computable general equilibrium model. It overcomes limitations of previous studies that relied on partial equilibrium models that deal primarily with distribution issues, narrow set of macroeconomic variables and ignore economy-wide interactions. Findings reveal that trade liberalisation exerts a negative impact on domestic prices and this retrogressed aggregate output and government savings not only due to revenue decline from import duties but constrained domestic production as well. Consequently, aggregate exports fell, while the volume of imports increased. Notably, the high oil intensity of the economy insulated government's fiscal profile as spending remained positive. In conclusion, the results lend support to the notion that trade liberalisation has mixed effects on macroeconomic performance. This implies that a coordinated interplay of monetary and fiscal policies will be required to minimise contemporaneous distortions that arise from relaxing trade restrictions.

Keywords: Trade liberalisation, Computable General Equilibrium, Macroeconomy, Social Accounting Matrix

JEL Classification: *C68, E10, E16, F13*

I. Introduction

Trade policy is a veritable instrument to support external balance and it has navigated between the pursuit of free trade and protection in Nigeria (Shuaibu, 2016). The main factors that have influenced trade policy in Nigeria include revenue generation drive, domestic industry protection, price stability, and a favourable balance of payment position, as well as, regional and multilateral trade obligations (ibid.). The economy had over the decade up to 2015, recorded about 7.0 per cent growth rate due to favourable international crude oil market conditions in addition to the 2014 GDP rebasing exercise which almost doubled the size of the economy from USD270 billion in 2013 to USD 510 billion in 2014. The acute slump in oil prices beginning from the 3rd quarter of 2014 propelled the 2.7 per cent economic slowdown in 2015 and subsequent recessionary pressure in 2016 with a negative growth of 1.5 per cent (World Trade Organisation, 2017). Consequently, oil revenue to GDP ratio fell from 23.4 per cent to in 2011 to 3.7 per cent in 2015; leading to a 45.0 per cent decrease in exports. This had a retrogressive effect on domestic demand, especially in the non-oil sector (ibid.).

Trade policy pursuit by the government has been through the use of tariff and non-tariff measures. The policy stance of government have been covered under the various General System of Preferences (GSP) and the European Union's (EU) Lome Convention and Cotonou agreement with the Africa, Caribbean and Pacific (ACP) countries. Nigeria has, with a certain degree of flexibility, implemented the five-band common external tariff structure- 0 per cent, 0.5 per cent, 10.0 per cent, 15.0 per cent and 20.0 per cent (World Trade Organisation, 2017). The average applied most favoured nation tariff rate increased from 11.9 per cent in 2011 to 12.7 per cent in 2017, while the disparity between the average final bound tariff rate (117.3 per cent) and low import tariff binding coverage

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(19.2 per cent) provided ample leverage for tariff changes, thus rendering the trade regime less predictable (World Trade Organisation 2017, p.8). By sectoral distribution, average tariffs on agricultural products is 16.6 per cent, which, is higher than that of non-agricultural goods at 12.0 per cent in 2017. Notably, the manufacturing sector is the most tariff-protected sector recording an average duty of 12.9 per cent, followed by agriculture (11.9 per cent), and mining and quarrying (5.1 per cent).

The adoption of the Economic Community of West African States (ECOWAS) common external tariff in fulfilment of a regional trade agreement with the EU's Economic Partnership Agreement (EPA) requires significant reduction of trade restrictions by almost 84.0 per cent (World Trade Organisation, 2011). This forms the basis of the policy scenarios tested in this paper because trade liberalisation implies a reduction of import duties and removal of non-tariff restrictions. This is expected to foster intra-regional trade and cooperation as well as promote macroeconomic stability which, has remained a serious concern for the government. Debates about the nexus between international trade to productivity and macroeconomic performance has persisted for decades. For instance, it is expected that improved trade flows should lead to higher productivity (Dollar and Kraay, 2004 and Greenway, Morgan and Wright, 2002), especially in developing countries, Nigeria inclusive.

Therefore, the analysis of international trade policy and macroeconomic performance is important to fiscal and monetary policy formulation and implementation. This is because it helps in identifying the drivers of growth in the context of trade through its effect on inclusive growth, capital accumulation, technological change and institutional development amongst others (Semancikova, 2016). Furthermore, components of foreign trade constitute part of the country's GDP and, therefore, have implication for the direction of policy. The main transmission channel between the macro economy and external account arises from the identity that expresses current account balance as the excess of national saving over domestic investment. In other words, the current account balance is equal to the gap between a country's current production and domestic spending on commodities (McCulloch, 1988).

The Economic Recovery Growth Plan (ERGP) launched by the Nigerian government in 2017 seeks to achieve diversification and macroeconomic stability; taking into cognisance the binding regional and multilateral trade obligations. As pointed out in page 64 of the document, "the ERGP will focus on three policy enablers to support initiatives in key sectors of the economy: industrial and trade policy, digital-led strategy for growth, and cross-sector strategies." The overall objective is to promote non-oil export through the zero-oil plan and use trade policy tools to tackle dumping and balance of payment crisis to raise non-oil exports as a share of total export from 7.5 per cent to 15.0 per cent by 2020 (Ministry of Budget and National Planning, 2017). Another policy support towards macroeconomic stability and recovery through the monetary authority is the restriction of foreign exchange market transactions to imported essential items. This has resulted in the use of contemporaneous non-tariff barriers to trade such as import prohibition lists made up of non-essential items such as "toothpick" and "tomato paste"[1] in addition to other export incentives such as reviving the export expansion grants in form of tax credit to companies. In addition, the country's trade policy also makes provision for low import

[1] http://www.cenbank.org/Out/2015/TED/TED.FEM.FPC.GEN.01.010.pdf

duties on raw materials and capital goods that cannot be sourced from domestic markets as enshrined in its local content policy.

An important response by government to ensure macroeconomic stability and to spur growth is trade liberalisation. This is because it is expected to enhance efficient production and allocation of resources, especially in the real sector. However, trade distortions may inhibit output performance (See Thirwall and Pacheco-Lopez, 2008) even though a dominant strand of literature suggests otherwise (See Winters and Martuscelli, 2014 and Semancikova, 2016). The literature on the impact of trade liberalisation on the macro economy in Nigeria has remained relatively unexplored, especially in the context of a general equilibrium economy-wide impact. Although several studies have relied on partial equilibrium-based models in Nigeria such as Ogunkola, Bankole and Adewuyi (2006), Olaifa, Subair and Biala (2013), Edeme and Karimo (2014), Sunday and Ganiyu (2015) and Odejimi and Odejimi (2015) amongst others, the outcome of this crucial nexus in Nigeria will be difficult to assess in the absence of a general equilibrium model that takes into cognisance inter-sector linkages and interdependence of economic agents.

In addition, a striking limitation of using partial equilibrium-based analysis to assess the macroeconomic effects of trade liberalisation is its sector-specific focus or emphasis on a limited set of macroeconomic variables. Although a plethora of CGE models has been reviewed, calibrated and examined for Nigeria,[2] considering various trade policy scenarios; the focus of these models were primarily on poverty, welfare and distribution issues (See Yusuf, 2002 and Nwafor, Adenikinju and Ogujuiba; 2007 and Shuaibu, 2016). Furthermore, none of these studies sought to explore the macroeconomic effects of reducing trade restrictions and this forms the objective of this research. The outline of the paper is as follows: Following this introduction section, Section 2 highlights the key theoretical and empirical developments, and Section 3 provides a brief description of the empirical strategy. Section 4 discusses the findings while Section 5 gives the conclusion.

II. Review of Related Studies

II.1 Theoretical Issues

According to the WTO's World Trade Report in 2004, there is an important linkage between trade and macroeconomic performance and policies. The major transmission channel is driven by government's need to restore balance of payment equilibrium and reduce the current account deficit. As pointed out by McCullogh (1988), a country's current account is equal in size but carries an opposite sign relative to the capital account. Thus, the excess of national saving over domestic investment is equal to the nation's current-account balance. This implies, in line with traditional balance of payment theory, that the current account balance is equal to the gap between the nation's current production and net absorption.

The relationship between trade policy and the domestic economy can be traced to classical theories that posit the role of trade as a catalyst for increasing domestic production and widening markets. This is in turn expected to enhance specialisation and

[2] See Adenikinju and AERC (2009) for a comprehensive coverage of CGE-based modeling studies in Nigeria.

productivity gains.[3] However, these models are limited due to the static assumption made and indifference to the products countries specialise in; as well as its assumption of balanced trade and full employment (Thirwall *et al.,* 2008). The neo-classical doctrine, however, attribute differences in relative costs of production to the difference in factor endowment rather than heterogeneity of natural resources and technology.

Stolper and Samuelson (1941) argue that in poor countries, the price of labour-intensive goods rise, thereby shifting resources to those sectors, raising demand, and therefore wages of unskilled labour. On the other hand, the price of skill-intensive products fall thereby, reducing wages and demand for skilled labour. The opposite occurs in developed economies where demand for unskilled and skilled labour fall and rise, respectively. An extension of the Stolper-Samuelson theorem pursued by Samuelson (1953) showed how trade should equalise factor prices across countries, without any factor movement. Though theoretically appealing, the assumptions of perfect competition and constant returns to scale of the neoclassical models are limited in practice. Also, the neo-classical doctrine assumes homogeneity of technology across countries. This may be far from reality because productivity of labour differs between countries due to differences in the amount of human capital embodiment.

The foundation of new trade models *ala* Krugman (1986) and Grossman and Helpman (1991) departs from the neoclassical synthesis in that it is based on increasing returns, imperfect competition and product differentiation to explain why large spatial differences in economic development exist within and between countries. Cororaton and Corong (2006) opine that trade liberalisation under the new trade models leads to efficient resource reallocation and innovation, and this, in turn, stimulates economic activity. Nevertheless, the model was silent on the transmission mechanism from trade policy changes to the economy. Winters (2002) present a transmission mechanism for exploring the links between trade liberalisation and the economy through import prices and its impact on the economy through the product and factor markets. In this framework, trade policy changes trickle-down to households through product and factor markets. A pertinent issue in the literature as pointed out by Hertel and Reimer (2005) is the factor price, income and employment link.

The elasticity of macroeconomic variables to trade liberalisation is transmitted through the wage-price inertia. This tends to slow down adjustment towards optimal resource allocation; therefore, the transitional component (welfare effect) of reducing trade restrictions involves a loss defined by the relatively smaller welfare gain relative to steady state long-run growth (Choudri, Faruqee and Tokaricki, 2006). This loss represents the cost of macroeconomic adjustment to trade liberalisation. In this case, the role of exchange rate regime cannot be downplayed. For instance, under a fixed exchange rate regime, reducing import duties lowers the relative price of foreign products and (if prices do not respond instantaneously) this leads to a contraction of domestic output and employment, thereby worsening the current account balance. However, this effect may be overcome by a depreciation of the domestic currency under flexible exchange rate regime. The trade-offs involved reinforcing the macroeconomic adjustment costs associated with liberalising trade regimes.

[3] In addition to static economies of scale benefits accruable from division of labour, there is also the growth induced effect i.e., the so called "dynamic economies of scale" effect associated with capital accumulation, technical progress embodied in capital, and the spread of knowledge (Thirwall and Pacheco-Lopez, 2008)

II.2 Review of Empirical Studies

Frankel and Romer (1999) estimates cross-country regressions of income per person on international trade and country size using Instrumental Variables (IV), and compared the results with Ordinary Least Square (OLS) estimates of the same equations. They observe that trade has a statistically positive effect on income. However, Srinivasan and Bhagwati (2000) had argued that cross-country regression omits important information and thus advocates studies based on the country-specific analysis in order to get a clearer and detailed picture regarding distributional effects of reforms on economies. According to Greenway et al., (2002), a possible link between openness and growth has been an important factor in stimulating an unprecedented wave of unilateral trade reforms, with over 100 countries committing to some kind of trade liberalisation over the last 20 years. Dollar and Kraay (2004) use cross-country regression technique based on decade-over-decade changes in the volume of trade as a proxy for changes in trade policy in a data set spanning 100 countries. They found that higher growth rates lead to proportionate increases in incomes of the poor. The evidence from individual country cases and cross-country analysis supports the view that globalisation leads to faster growth and poverty reduction in poor countries.

Ahmed and Suardi (2009) examines the effect of financial and trade liberalisations on real output and consumption growth volatility in Africa. The study controls for economic and financial development, institutional quality and other sources of macroeconomic instability, they present robust evidence that trade liberalisation is associated with higher output and consumption growth volatility. They conclude that output volatility and consumption growth as a result of trade liberalisation is negatively associated with financial depth. Abbas (2014) investigates the impact of trade liberalisation on economic growth of selected developing and least developed economies by augmenting the standard production function. Using panel data analysis, the study reveals a significant positive impact of the selected macroeconomic variables on economic growth, except trade liberalisation index. In other words, a unit increase in trade liberalisation worsens output performance of developing countries by USD 280.86 million and least developing by USD 3,555.09 million.

The empirical literature for Nigeria has not differed significantly from mainstream debate. However, Ogunkola et al., (2006) is an exception. The paper evaluates the effect of trade and investment policy reform on macroeconomic performance in Nigeria using ordinary least square and full information maximum likelihood estimator. The results reveal that trade and investment policy reforms do not have a significant impact on aggregate output growth. Also, average import tariff was found to be a significant determinant of export growth. In other words, the sign of the growth elasticity of average import tariff was negative, suggesting that higher duties lower export growth. In the same vein, Balogun and Dauda (2012) shows that output in the agriculture and manufacturing sectors deteriorated consequent upon trade liberalisation. This contradicts the assertion that a positive relationship exists between liberalisation and poverty reduction through improved productivity of labour-intensive smallholder farm enterprises and firms. Olaifa, Subair and Biala (2013) use ordinary least square to assess the link between trade liberalisation and economic growth in Nigeria between 1970 and 2012. The study shows that trade openness supports economic growth amidst strong evidence of structural breaks in 1986 that coincided with the removal of trade restrictions in line with the structural adjustment programme.

Edeme and Karimo (2014) apply marginal impact estimation procedure with standard errors corrected for serial correlation on a dummy variable to assess the economic liberalisation-industrial performance nexus in Nigeria. The findings show that economic liberalisation had a significant positive impact on manufacturing, mining and quarrying as well as aggregate industrial performance. However, the effect on the power (electricity) sub-sector was negative. Sunday and Ganiyu (2015) reinforce the positive association between growth and openness in Nigeria. Odejimi and Odejimi (2015) on the other hand examine the link between trade liberalisation and the labour market in Nigeria. Using ordinary least square, the study shows that trade liberalisation exerts a negative impact on the labour market which, was measured by employment rate.

While the preceding studies are predicated on partial equilibrium models and econometric approach; another strand of literature has relied on the use of dynamic and static CGE models and some of the studies include Araújo and Flaig (2016) for Brazil, Raihan (2010) for Bangladesh, Ayoki and Obwona (2006) for Uganda and so on. Dynamic general equilibrium models could be sequential (recursive) or inter-temporal (truly dynamic). The former is a series of static CGE models that are linked to periods by an exogenous and endogenous variable updating procedure, while the latter is based on optimal growth theory and the behaviour of economic agents is characterised by perfect foresight. However, Annabi *et al.,* (2008) argue that the application of intertemporal models to distribution analysis is not straightforward and thus, remains an important agenda for future research.

Araújo and Flaig (2016) explore three possible policy reforms to strengthen Brazil's integration into the global trade: a reduction in import tariffs, less local content requirements and a full zero-rating of exports in indirect taxes. The simulation analysis was carried out using the Organisation for Economic Cooperation and Development (OECD) Multi-Region Trade CGE model and the results indicate significant scope for trade policy reforms to strengthen industrial development and export competitiveness. Semancikova (2016) finds that trade openness has a positive effect on macroeconomic performance and that trade policy can serve as a major source of growth in Brazil. Likewise, findings from other countries such as Filho (2009) for Brazil and Raihan (2010) for Bangladesh have shown that poverty fell after liberalising trade. In fact, the focus of these studies has been on distribution impact of trade policy shocks without considering the macroeconomic effect of trade which, has important implication for monetary and fiscal policy formulation and implementation.

Quite a number of studies have used CGE models for different policy analyses in Nigeria. Nkang, Omonona, Yusuf and Oni (2013) assess the impact of higher imported food prices on agriculture and household poverty in Nigeria using a computable general equilibrium (CGE). The paper shows that an increase in imported food price leads to an increase in domestic food price as well as other agricultural composites. Also, an increase in imported food price led to an increase in poverty. However, this study did not consider the macroeconomic effect of this policy shocks which, are expected to be affected through the exchange rate pass-through channel. Apata, Folayan, Apata and Akinlua (2011) examine the role of subsistence-based agriculture in Nigeria utilising an applied CGE model and found that subsistence agriculture in Nigeria is an important shock absorber against declines in agriculture output. Akinyemi, Alege, Ajayi and Okodua (2017) rely on a dynamic CGE model to investigate the extent to which subsidy removal influences the level of carbon emissions in Nigeria and find that partial reduction of import duties on

imported petrol leads to a reduction in emissions. However, gradual and complete tariff removal led to a marginal increase in carbon emission.

Nwafor, *et al.,* (2007) examine the effect of liberalising trade on poverty in Nigeria and that the capital-intensive sector was affected by freer trade and capital income improved over time, while returns to land and labour fell. They further noted that this result was positive for urban household but negative for rural dwellers. Okodua and Alege (2014) assess the effect of import tax shocks on household welfare in Nigeria using a CGE model. The study reveals that trade liberalisation in Nigeria has mixed welfare implications for households in the short-run. Specifically, they find that while the policy will lead to a general improvement in consumption of goods and services as well as in real income of all households, it will at the same time hurt households by inducing unemployment in the two key sectors of agriculture and industry. Shuaibu (2016) relies on an integrated CGE microsimulation model to assess the poverty effect of liberalising trade in Nigeria. The author finds that trade liberalisation had poverty-reducing effects albeit marginally in rural and urban areas. A major limitation of these studies is the focus on assessing distribution issues while ignoring macroeconomic effects.

In conclusion, empirical evidence suggests that the literature is characterised by mixed findings with the dominant strand indicating that trade policy leads to higher welfare and growth. This remains knotty in Nigeria where partial equilibrium models have dominated extant literature and trade policy remains a vital component of the ERGP. In this regard, Greenway et al., (2002) argue that the literature is inconclusive given the mixed findings on the trade liberalisation-growth nexus. This may be attributed to the different measures of trade liberalisation used as well as sample coverage of liberalisation episodes of distinct intensities and durations. Instructively, it is important to account for the effect of trade policy changes on a broad set of macroeconomic variables rather than economic growth alone. This is crucial for broad-based policy planning and it is against this background that this paper seeks to contribute to the debate.

III. Methodology

III.1 Empirical Strategy

This study makes use of a general tariff theory in line with the broad-based transmission mechanism of trade policy shocks to the demand and supply-side of the economy proposed by Winters (2002) within an applied general equilibrium framework. The choice of this model is motivated by its ability to capture the demand- and supply-side effects of freer trade on households. A model with 5 goods that is a departure from the conventional two-good model is considered in a bid to reflect the focus of this study and ensure conformity with the macro and micro databases. Given the price relation $P_d = (1+\tau)P_w$ (Where τ denotes import tariff, P_d and P_w are the domestic and world prices respectively), the impact of tariff reduction on macroeconomic activities is transmitted through the price of imports.

The standard CGE model made up of six blocks *ala* Decaluwe, Dumont and Robichaud (2000) of the Partnership for Economic Policy (PEP) is used. The model is presented below (See Appendix for the variable definitions):

Production Module

$$XS_j = \min(CI_j io_j^{-1}, VA_j v_j^{-1}) \quad (1)$$

$$VA_{tr} = A_{tr}^{E}\left[\beta_{tr}^{E} LD_{tr}^{K_{tr}^{E}} + (1-\beta_{tr}^{E}) KD_{tr}^{K_{tr}^{E}}\right]^{\frac{1}{K_{tr}^{E}}} \quad (2)$$

$$VA_{ntr} = LD_{ntr} \quad (3)$$

$$CI_j = io_j XS_j \quad (4)$$

$$DI_{tr,j} = aij_{tr,j} CI_j \quad (5)$$

$$LD_{tr} = (\alpha_{tr} PV_{tr} VA_{tr}) w^{-1} \quad (6)$$

$$LD_{ntr} = (P_{ntr} XS_{ntr} - \textstyle\sum_{tr} PC_{tr} DI_{tr,ntr})\, w^{-1} \quad (7)$$

Income and Savings Module

$$YH_h = w \textstyle\sum_j LD_j + \lambda \sum_{tr} r_{tr} KD_{tr} + DIV + TG \quad (8)$$

$$YDH_h = YH_h - DTH_h \quad (9)$$

$$SH_h = \psi_h YDH_h \quad (10)$$

$$YF = (1-\lambda)\ \textstyle\sum_{tr} r_{tr} KD_{tr} \quad (11)$$

$$SF = YF - DIV - DTF \quad (12)$$

$$YG = \textstyle\sum_{tr} TI_{tr} + \sum_{tr} DTH_{tr} + DTF + \sum_{tr} TIM_{tr} \quad (13)$$

$$SG = YG - G - TG \quad (14)$$

$$TI_{tr} = tx_{tr}(P_{tr} XS_{tr} - PE_{tr} EX_{tr}) + \frac{tx_{tr}}{(1+tx_{tr})} PM_{tr} M_{tr} \quad (15)$$

$$TIM_{tr} = tm_{tr}\, e\, PWM_{tr} M_{tr} \quad (16)$$

$$DTH_h = ty_h\, YH_h \quad (17)$$

$$DTF = tyf\, YF \quad (18)$$

Demand Module

$$C_{tr,h} = \gamma_{tr,h} YDH_h PC_{tr}^{-1} \quad (19)$$

$$INV_{tr} = \mu_{tr} IT\ PC_{tr}^{-1} \quad (20)$$

$$DIT_{tr} = \textstyle\sum_j aij_{tr,j}\, CI_j \quad (21)$$

Price Module

$$PV_j = (P_j XS_j - \textstyle\sum_{tr} PC_{tr}\, DI_{tr,j}) VA_j^{-1} \quad (22)$$

$$r_{tr} = (PV_{tr} VA_{tr} - wLD_{tr}) KD_{tr}^{-1} \quad (23)$$

$$PD_{tr} = (1+tx_{tr}) PL_{tr} \quad (24)$$

$$PM_{tr} = (1+tx_{tr})(1+tm_{tr}) ePWM_{tr} \quad (25)$$

$$PE_{tr} = ePWE_{tr}(1+te_{tr})^{-1} \quad (26)$$

$$PC_{tr} = (PD_{tr} D_{tr} + PM_{tr} M_{tr}) Q_{tr} \quad (27)$$

$$P_{tr} = (PL_{tr} D_{tr} + PE_{tr} EX_{tr}) XS_{tr} \quad (28)$$

$$PINDEX = \textstyle\sum_j \delta_j PV_j \quad (29)$$

International Trade Module

$$XS_{tr} = B_{tr}^{E}\left[\beta_{tr}^{E} EX_{tr}^{K_{tr}^{E}} + (1-\beta_{tr}^{E}) D_{tr}^{K_{tr}^{E}}\right]^{\frac{1}{K_{tr}^{E}}} \quad (30)$$

$$EX_{tr} = \left[\left(\frac{PE_{tr}}{PL_{tr}}\right)\left(\frac{1-\beta_{tr}^{E}}{\beta_{tr}^{E}}\right)\right]^{\tau_{tr}^{E}} D_{tr} \quad (31)$$

$$Q_{tr} = A_{tr}^{M}\left[\alpha_{tr}^{M} M_{tr}^{\rho_{tr}^{M}} + (1-\alpha_{tr}^{M}) D_{tr}^{-\rho_{tr}^{M}}\right]^{-\frac{1}{\rho_{tr}^{M}}} \quad (32)$$

$$M_{tr} = \left[\left(\frac{PD_{tr}}{PM_{tr}}\right)\left(\frac{\alpha_{tr}^{M}}{(1-\alpha_{tr}^{M})}\right)\right]^{\sigma_{tr}^{M}} D_{tr} \quad (33)$$

$$CAB = e\sum_{tr} PWM_{tr}M_{tr} - e\sum_{tr} PWE_{tr}EX \quad (34)$$

Equilibrium Module

$$Q_{tr} = DIT_{tr} + \sum_h C_{tr,h} + INV_{tr} \quad (35)$$

$$XS_{ntr}P_{ntr} = G \quad (36)$$

$$LS = \sum_j LD_j \quad (37)$$

$$IT = \sum_h SH_h + SF + SG + CAB \quad (38)$$

The model is calibrated using a disaggregated version of the International Food Policy Research Institute's (IFPRI) SAM to capture the economy-wide effect of freer trade on macroeconomic activities. The import tariffs used to capture the extent of trade liberalisation is captured in Equation 25 under the price block. In addition to the effect on other prices which, translates to a change in aggregate import (Equation 33), the impact on other macroeconomic variables will depend on the extent to which import duties contribute to government's total revenue (equation 13). This has a multiplier effect on household consumption and other key macroeconomic fundamentals captured in the model. The model assumes producers maximise profit using a given technology, while the prices of goods and services are given. The technology is modeled as a Constant Elasticity of Substitution (CES) function that combines composite capital and labour for given quantities of value added while a Leontief function is relied upon for aggregate intermediate inputs. The value added and aggregate intermediates are complimentary, without possibility of substitution based on Leontief technology.

Households receive income from factors of production and transfers from the rest of the world and government. Firms receive factor incomes and consume from various sectors. The payments to and from firms are modeled in the same way as the payments to and from households. Also, savings and total income of government particularly, taxes from firms and households as well as import duties are captured in the income and saving block. The demand for imported goods and services consists of household, investment, and government. Household consumption is modeled as a Linear Expenditure System (LES) and offers a certain degree of flexibility with respect to substitution possibilities in response to relative price changes (Decaluwe *et al.,*1999). All commodities (domestic output and imports) except for home-consumed output enter the markets. The demand for the output of each activity is represented as a CES function. Domestic output is allocated between exports and domestic sales based on the assumption that firms maximise sales revenue for any given output level, subject to imperfect transformability between exports and domestic sales. This is expressed as a Constant Elasticity of Transformation (CET) function.

The price block consists of equations in which the endogenous model prices are linked to other prices and non-price model variables. This block captures export, import, domestic, value added, and composite commodity prices and the GDP deflator. Domestic exporting firms supply domestic and foreign markets. Therefore, the price of their aggregate output is the weighted sum of the price obtained in each market. It should be noted that commodities purchased in the domestic market are composites in line with the Armington assumption. Given that this is a short-run model, our closure assumes that: (i) capital is sector specific; (ii) current account balance is constant; (iii) government budget and consumption is fixed; and (v) investment is endogenously determined. The choice of macro closures is usually driven by the context of analysis, which deals with exploring the macroeconomic impact of reducing trade restrictions.

III.2 Policy Scenarios

Having replicated the baseline of the CGE model; the pre- and post-simulation values of macroeconomic variables are compared. The policy simulations carried out in this study are based on the reduction of effective import tariff rates on agriculture, manufactured and extractive products in line with the ECOWAS Common External Tariff (CET). This makes it possible to identify the economy-wide impact of trade liberalisation in Nigeria. Nwafor et al., (2007) and Shuaibu (2016) have also tested this policy scenarios but the analysis focused on distributional impact. The motivation for selecting agriculture, manufacturing and extractive sectors as the core of our policy scenarios is driven by the fact that; (i) these sectors constitute over 80.0 per cent of Nigeria's total import mix; and (ii) the agriculture and manufacturing sectors are major employers of the rural and urban poor.

The paper considered four policy scenarios based on the baseline line import tariff regime and implementation of the CET. This implies significant trade liberalisation through the reduction of import duties to meet sub-regional (ECOWAS) trade obligations. Scenario 1 considers a 69.0 per cent reduction of effective rates on agricultural products. This is because prior to the adoption of the CET, the sector was highly protected and liberalising the sector implies a significant reduction of import duties. The second scenario focused on manufactured products and considers a 57.0 per cent import tariff reduction. The duties imposed on imported manufactures were quite high due to pressure on government by the Manufacturers Association of Nigeria (man) amongst other stakeholders. The third scenario entails a 70.0 per cent reduction of effective tariff rates on primarily refined extractive sector commodities. The fourth scenario is a counterfactual simulation where simple average tariff (across sectors) is reduced by 58.0 per cent.

III.3 The Data

The model is made up of 5 sectors: agriculture, extractive, manufacturing, services and non-tradable sectors. The model has 2-factor inputs and they are labour and capital; which generate value added through a CES function. Labour is disaggregated to skilled and unskilled; and assumed to be heterogeneous across activity sectors.

Table 1: Elasticities used to Calibrate CGE Parameters

Elasticity	Agriculture	Manufacturing	Extractive	Services
Export Demand	1.10	1.10	1.10	1.10
Capital/Labour	1.50	1.50	1.10	1.50
CES	2.00	0.90	2.00	0.40
CET	0.40	0.90	2.00	0.40

Source: Nwafor et al., (2007).

The CGE model used in this study was calibrated using a re-aggregated 2006 IFPRI SAM for Nigeria and this is because it is the most recent available. In the CGE modeling literature, elasticities are either *guesstimated* or econometrically estimated or obtained from other similar country-specific studies (See Annabi et al., 2005). Dawkins *et al.,* (2001) note that elasticities are important parameters for CGE models since they are crucial for determining comparative static behaviour and exert a strong influence on the outcome of policy analysis undertaken using these models. Therefore, the export demand, labour-capital substitution, CET (export and domestic demand) and CES (import and domestic

demand) elasticities used in this paper are obtained from the literature and are presented in Table 1.[4] All other parameters in the model were calibrated based on the SAM.

IV. Discussion of Results

Panels 2A and 2B in Table 2 show the negative effect of the various policy simulations on prices. Specifically, Panel 2A shows the impact of trade liberalisation on import prices and the values recorded are relatively higher than domestic prices. The negative impact implies that imports become more attractive relative to domestic products. The highest import price effect of about 11.4 per cent is observed in the agriculture sector and this may be due to the high restrictions in the sector prior to trade liberalisation. Likewise, the import price of manufactured goods and those of the extractive sector fell, but by less than the decline observed in the agriculture sector. The implication of this finding is that trade policy tends to reduce the general price level and the impact on the domestic economy will depend on the productive capacity of domestic producers and the existing price of domestic competition. This result is similar to the findings of Warr (2001) who observed that domestic prices fell after sectoral import tariff cuts in Thailand and several other empirical studies.

Table 2: Effect of trade tariff reduction on prices (per cent change from baseline values)

2A: Change in price of import				
Sector	**Scenario1$_{AGR}$**	**Scenario2$_{MAN}$**	**Scenario3$_{EXT}$**	**Scenario4$_{SAT}$**
Agriculture	-11.36	0.00	0.00	-8.07
Manufacture	0.00	-1.24	0.00	-0.33
Extractive	0.00	0.00	-1.21	-0.34
2B: Change in local prices				
Sector	**Scenario1$_{AGR}$**	**Scenario2$_{MAN}$**	**Scenario3$_{EXT}$**	**Scenario4$_{SAT}$**
Agriculture	-1.86	0.06	-0.32	-8.07
Extractive	-1.52	0.00	-0.56	-0.33
Manufacturing	0.12	-0.48	0.00	-0.34
Services	-1.38	-0.02	-0.37	na

Source: Computed using GAMS

The change in volume of production is presented in Table 3. The results reveal import tariff reductions on agriculture products led to a 0.82 per cent output contraction in the agriculture sector while the other sectors recorded increments. The reason for this may be traced to the fact that the agriculture sector recorded the highest price reduction consequent upon import tariff reduction and this may affect domestic producers of similar products who may not be able to compete favourably with the imports. In the case of the manufacturing sector, a 0.01 per cent increase in production was recorded in agriculture, manufacturing and services sector while non-tradable sector output increased by 0.06 per cent. A similar pattern was observed consequent upon tariff cuts in the extractive sector, notably the output of the sector fell by 0.07 per cent. In the case of simple average tariff reduction, only the agriculture sector recorded a decline of -0.54 per cent while the productivity increased in other sectors. These findings are not far-fetched since trade

[4] This is in view of the fact that the main determinants of trade liberalisation effects are the values of trade elasticities, the share of imports and exports, the cost of inputs, and the general equilibrium effects of supply and demand (Annabi *et al.,* 2005).

liberalisation engenders reallocation from sectors with initially high protection (such as manufacturing and agriculture), in favour of less protected sectors (extractive and services); with the non-tradable sector remaining relatively unchanged. This was a departure from Cockburn's (2001) result for Nepal because the initial import shares and import duties were relatively high in the mining subsector of the extractive industry of Nepal which in Nigeria makes up a small fraction of the extractive industry's total output. However, this conforms with the findings of Nwafor et al., (2007) and Okodua and Alege (2013) for Nigeria.

It should be noted that sectors which were initially heavily protected with baseline tariffs between 100.0 and 150.0 per cent were expected to gain most from trade liberalisation. On the contrary, our findings showed that agriculture product imports fell under the import tariff cuts on the sector's production and the simple average tariff. This may be explained by the increased competition occasioned by the inflow of competing goods which, serves as a disincentive for domestic producers.

Table 3: Effect of trade tariff liberalisation on production (per cent change from baseline values)

Sector	Scenario1$_{AGR}$	Scenario2$_{MAN}$	Scenario3$_{EXT}$	Scenario4$_{SA(i)}$
Agriculture	-0.82	0.01	0.08	-0.54
Extractive	1.00	-0.04	-0.70	0.49
Manufacturing	0.01	0.01	0.01	0.01
Services	0.44	0.01	0.01	0.31
Non-Tradable	1.43	0.06	0.42	1.11

Source: Computed using GAMS.

Table 4 shows that real gross domestic product fell consequent upon reduction of import duties on the various product. A 1.48 per cent and 0.13 per cent reduction for the agriculture and manufacturing sectors were recorded while the extractive sector and simple average tariff reductions stimulated 0.71 per cent and 1.22 per cent declines, respectively. This suggests that import tariff cuts dampen productivity and this may be due to the constrained domestic production due to the influx of similar imported products. Interestingly, government expenditure recorded an increase of 1.43 per cent and 0.06 per cent following reductions in import duties on agriculture and manufactured goods. This is not expected because the revenue fall from import duties should constrain government expenditure. Also, the fact that simple average tariff reduction led to 1.11 per cent increase in government spending while that of the extractive sector induced a 0.42 per cent increase. This indicates that the Nigerian economy does not solely depend on revenue from import duties and therefore has a narrow fiscal profile. This is due to the country's huge reliance on oil revenue inflows which constitutes over 90.0 per cent of its total income receipts. This contradicts the finding by Nwosa, Saibu and Fakunle (2012) who found that trade liberalisation and degree of openness had a positive relationship with trade revenue. This may be attributed to the partial equilibrium model utilised in addition to the use of a dummy variable to capture liberalisation episodes.

The Table also shows that government savings or overall fiscal position face severe pressure consequent upon liberalisation in the agriculture sector (4.54 per cent) and simple average (3.74 per cent). This is, perhaps due to the reduced contribution of imports

duties' to government revenue despite its minimal share. Consequently, aggregate investment also falls due to the credit shortage occasioned by lower savings following simple average and agriculture import tariff reduction, recording 7.62 per cent and 9.31 per cent, respectively. As expected, the volume of aggregate imports and exports increased following the various tariff reduction scenarios considered while domestic prices recorded marginal declines with the highest fall observed following tariff reductions on agricultural products. The negative effect of liberalisation on growth clearly contradicts the results of Dollar and Kraay (2004) and Frankel and Romer (1999) where trade was found to exert a positive effect on growth in their cross-country regressions. This disparity may be attributed to the use of partial equilibrium models that failed to capture the complete workings of the case studies considered. Therefore, our findings underscored the need for more disaggregated economy-wide models for assessing the trade policy-macroeconomy nexus.

Table 4: Macroeconomic impact of import tariff reductions (% change from baseline values)

Variable	$Scenario_{AGR}$	$Scenario2_{MAN}$	$Scenario3_{EXT}$	$Scenario4_{SA\ (i)}$
Real GDP	-1.48	-0.13	-0.71	-1.22
Government Saving	-4.54	-0.39	-2.18	-3.74
Investment	-9.31	-0.73	-4.28	-7.62
Government Expenditure	1.43	0.06	0.42	1.11
Aggregate Exports	0.20	0.05	0.04	0.16
Aggregate Imports	0.43	0.07	0.09	0.34
Domestic Price	-1.16	-0.11	-0.31	-0.91

Source: Computed using GAMS.

Table 5 shows the positive changes in household demand induced by the negative price effects of reducing import duties. The results showed that following tariff reduction on agriculture produce, the demand for agriculture and manufactured goods increased by an average of about 0.83 per cent and 0.24 per cent, respectively. Likewise, tariff reduction in the manufacturing sector led to a marginal increase of 0.01 per cent in the demand for agriculture commodities while a relatively large 0.90 per cent increase in demand for manufactured goods was recorded. This conforms to the results obtained by Okodua and Alege (2013) for Nigeria. A similar pattern was observed when the extractive sector was liberalised. However, tariff reductions in the sector, contrary to *a priori*, and despite the price reductions recorded, demand for services fell. In the case of the simple average tariff reduction scenario, mixed findings were recorded.

Table 5: Change in household demand (per cent change from baseline values)

Sector	$Scenario1_{AGR}$	$Scenario2_{MAN}$	$Scenario3_{EXT}$	$Scenario4_{SA\ (i)}$
Agriculture	0.83	0.01	0.08	-0.56
Extractive	0.90	-0.04	0.74	0.41
Manufacturing	0.24	0.90	0.01	-0.08
Services	0.30	0.00	-0.03	0.20

Source: Computed using GAMS

Contrary to expectations, the demand for manufactures and services fell following simple average tariff reduction, with the fall in demand for agriculture goods being higher with 0.56 per cent. This may be explained by the fact that the price fall was quite negiligible and the initial consumption of commodities from this sector was high. Therefore, the incentive to consume more was predominantly eroded by the marginal price change. As expected, demand for services increased by about 0.20 per cent as a result of simple average import tariff reduction while manufacturing declined by nearly 0.1 per cent due to the high protection of the sector prior to liberalisation.

he effect of trade liberalisation on imports and exports is shown in Table 6. The price fall that negatively influenced domestic producers invariably led to a decline in exports. The positive effect of liberalisation on services exports may be traced to the induced shift in domestic labour towards more efficient sectors and perhaps engagement by foreign firms. In sum, removing trade restrictions contemporaneously distorts export competitiveness and should be viewed with caution. This argument has been at the heart of negotiations between the Nigerian government and the Manufacturers Association of Nigeria (MAN). Another plausible explanation for the positive response in the services sector after import duties was reduced is the low share of services exports in Nigeria's total export mix and resultant reallocation of resources towards export-oriented sectors. Specifically, import duties reduction on agriculture commodities led to 2.95 per cent, 4.03 per cent and 0.01 per cent declines in the exports of agriculture, extractive and manufacturing sectors, respectively. The declines recorded was as a result of the fall in domestic production irrespective of the relatively cheaper imported intermediate input advantage that may have arisen from the price falls. However, services exports increased by 3.12 per cent. Comparatively, an import tariff reduction in the manufacturing sector led to a 0.11 per cent decrease in agricultural exports, while declines of 0.05 per cent and 0.05 per cent, respectively were recorded in the extractive and manufacturing sectors.

Table 6: Trade effect of trade policy changes (per cent change from baseline values)

A: Change in export volumes				
Sector	**Scenario1$_{AGR}$**	**Scenario2$_{MAN}$**	**Scenario3$_{EXT}$**	**Scenario4$_{SA\ (i)}$**
Agriculture	-2.95	-0.11	-0.72	-2.17
Extractive	-4.03	-0.05	-0.37	-2.84
Manufacturing	-0.01	-0.05	0.00	-0.01
Services	3.12	0.04	0.73	2.34
B: Change in import volumes				
Sector	**Scenario1$_{AGR}$**	**Scenario2$_{MAN}$**	**Scenario3$_{EXT}$**	**Scenario4$_{SA\ (i)}$**
Agriculture	4.56	0.11	0.57	14.52
Extractive	2.14	0.03	0.58	1.30
Manufacturing	0.48	0.62	0.01	0.51
Services	-2.45	-0.05	-0.77	1.89

Source: Author's Computation using GAMS.

Table 6 also shows that the volume of imports increased (See Panel B) especially for agriculture products. The sectoral effects on import volumes may be traced to the import price-reducing effect in addition to the low Armington elasticity that distinguishes domestic and imported goods. The results from changes in imports after the various policy

experiments showed that a reduction of tariffs increased the inflows of imported commodities across all the sectors considered. However, this was not the case in the services sector where exports fell, perhaps, due to the decline in domestic production that also means domestic firm demand for services decline.

In terms of imports, the effect of trade tariff reduction in the agriculture sector induced a 4.7 per cent increase in agricultural imports while that of manufacturing increased by 0.48 per cent. This increase may be accounted for by the output expansion effect of trade tariff reduction recorded in the agricultural sector as well as the reliance of the manufacturing and agricultural sector on inputs from the extractive sector such as oil and allied products. Reduction of import duties in the manufacturing sector reveals mixed outcomes as agricultural imports increased by 0.11 per cent while imports in agriculture and manufacturing increased by an average of 0.11 per cent and 0.62 per cent, respectively. Thus, excluding other non-tariff barriers to trade, imports in Nigeria are an increasing function relative to the level of reduction of import duties and other non-tariff barriers such as exchange rate restrictions, bans, quotas, etc. In all, findings suggest that freer trade lead to a decrease in aggregate output performance but retrogress export growth in the short-run.

V. Conclusion

This paper was prompted by the need to understand the response of some macroeconomic variables to trade tariff liberalisation policy in Nigeria. This is particularly important in view of the government's revenue diversification drive and the need to meet its multilateral trade obligations. A standard CGE model was utilised to calibrate the parameters of the model using the SAM for Nigeria developed by the International Food Policy Research Institute (IFPRI). Quantitative findings suggest that the impact differs based on the particular macroeconomic variable as well as the domestic capacity of the liberalised sector. First, the results indicate that freer trade is transmitted to the economy through the price of imported commodities. While macroeconomic variables such as real GDP, government saving and investment, general prices, exports, domestic production were negatively affected by the reduction of import duties, other variables such as government absorption and imports were positively affected. The positive impact on government expenditure despite the shortfall in government import tax revenue following import tariff reduction can be traced to the high oil dependence of the Nigerian economy. The most profound effect of trade liberalisation on the Nigerian economy is its effects on the production of domestic manufactures and agriculture products. This result may be viewed with caution as the model did not capture the dynamic adjustments that would have been able to show the long-term path of these variables whose impact are likely to change with time.

Nevertheless, this paper lends support to the positive impact of the free trade literature, albeit; making a case for contemporaneous fiscal and monetary policy interventions to help mitigate the negative short-term domestic supply side shocks that emanate from trade policy changes.

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Appendix

A1: Variable Definition

A2i: Endogenous Variables

$C_{tr,h}$	Household *h's* consumption of good *tr* (volume)
CI_j	Total intermediate consumption of activity *j* (volume)
D_{tr}	Demand for domestic good *tr*
$DI_{tr,j}$	Intermediate consumption of good *tr* in activity *j* (volume)
DIT_{tr}	Intermediate demand for good *tr*
DTF	Receipts from direct taxation on firms' income
DTH_h	Receipts from direct taxation on household *h's* income
e	Exchange rate
EX_{tr}	Exports in good *tr* (volume)
INV_{tr}	Investment demand for good *tr* (volume)
IT	Total investment
LD_j	Activity *j* demand for labour (volume)
M_{tr}	Imports in good *tr* (volume)
P_i	Producer price of good *i*
PC_{tr}	Consumer price of composite good *tr*
PD_{tr}	Domestic price of good *tr* including taxes
PE_{tr}	Domestic price of exported good *tr*
$PINDEX$	GDP deflator
PL_{tr}	Domestic price of good *tr* (excluding taxes)
PM_{tr}	Domestic price of imported good *tr*
PV_{tr}	Value added price for activity *j*
Q_{tr}	Demand for composite good *tr* (volume)
r_{tr}	Rate of return to capital in activity *tr*
SF	Firm's saving
SG	Government's saving
SH_h	Household *h's* saving
TI_{tr}	Receipts from indirect tax on *tr*
TIE_{tr}	Receipts from tax on export *tr*
TIM_{tr}	Receipts from import duties *tr*
VA_j	Value added for activity *j* (volume)
VA_{tr}	Value added for tradable
VA_{ntr}	Value added for non-tradable
w	Wage rate
XS_j	Output of activity *j* (volume)
YDH_h	Household *h's* Disposable Income
YF	Firm's Income
YG	Government's Income
YH_h	Household h's income

A2ii: Exogenous Variable

CAB	Current account balance
DIV	Dividend paid to households
G	Government spending
KD_{tr}	Demand for capital in activity *tr* (volume)
LS	Total labour supply (volume)
PWE_{tr}	World price of export *tr*

PWM_{tr}	World price of import *tr*
TG	Public transfers

A2iii: Parameters

Production Functions

A_j	Scale coefficient
$aij_{tr,j}$	Input-output coefficient
α_j	Elasticity (Cobb-Douglas production function)
io_j	Technical coefficient (Leontief production function)
v_j	Technical coefficient (Leontief production function)

Constant Elasticity of Substitution (CES)

A_{tr}^{M}	Scale coefficient
α_{tr}^{M}	Share parameter
ρ_{tr}^{M}	Substitution parameter
σ_{tr}^{M}	Substitution elasticity

Constant Elasticity of Transformation Function (CET)

B_{tr}^{E}	Scale coefficient
β_{tr}^{E}	Share parameter
κ_{tr}^{E}	Substitution parameter
τ_{tr}^{E}	Substitution elasticity

Tax Rates

te_{tr}	Tax on exports *tr*
tm_{tr}	Import duties on good *tr*
tx_{tr}	Tax rate on good *tr*
tyh_{tr}	Direct tax rate on household *h's* income
tyf_{tr}	Direct tax rate on firms' income

Other Parameters

δ_j	Share of activity *j* in total value added
$\gamma_{tr,h}$	Share of the value of good *tr* in total consumption of household *h*
λ	Share of the value of capital income received
λ^{ROW}	Share of capital income received by foreigners
ψ_h	Propensity to save
μ_{tr}	Share of the value of good *tr* in total investment

Sets

$i, j \in I = \{AGR, EXT, MAN, SER, NTR\}$	All activities and goods (*AGR*: agriculture, *EXT*: extractive, *MAN*: manufacturing, *SER*: services, *NTR*: non-tradable services)
$tr \in TR = \{AGR, EXT, MAN, SER\}$	Tradable activities and goods
$h \in H$	Households

Investigating the Relationship between Broad Money Velocity, Inflation and Nominal Output Growth in Nigeria

Adenekan A. *

Abstract

This study examines the dynamic relationship among the velocity of money, inflation and nominal output growth in Nigeria, using quarterly data from 1995 to 2016. The motivation for this study is predicated on the importance of velocity within the context of a central bank objective of ensuring price stability without losing focus on growth, hence the need to assess its relationship with inflation and growth. A Toda-Yamamoto augmented VAR approach is used to examine this relationship. Granger Non-Causality test indicated a bi-directional causality between velocity and inflation, but no causality between velocity and nominal output growth. Findings also indicated that the velocity has a positive response to inflation; against the nominal output growth, it was initially negative before reverting to a positive direction. An implication from these findings is that the observed protracted decline in broad money velocity in Nigeria could be seen as an early symptom of a shift in monetary regime, hence the necessity for the monetary authority to reassess monetary targeting options or strategy.

Keywords: Money Velocity, Inflation, Output growth, Nigeria

JEL Classification Numbers:

I. Introduction

Monetary policy has considerable impact on the distribution of income and overall level of economic activities. The effectiveness of monetary policy rests on the important assumption of stable money demand and, by implication, the velocity of money. This is because the stability of velocity of money is fundamental to predicting the relationship between monetary aggregates, inflation and growth. To this end, understanding the development about velocity of money and its short-or long-run relationship with output and prices would help monetary authority clarify the patterns in monetary trend, particularly, the deviations from the normal trend that may generate shocks to money demand. This is particularly important to the regimes that adopts monetary targeting framework.

Monetary targeting framework presumes a stable demand for money to ensure the effectiveness of monetary policy decisions. The monetary authority controls money supply, but economic agents determine how much to hold as money balances. Accordingly, the effectiveness of monetary aggregate targeting is therefore reflected in the velocity of the balances. Depending on the behaviour of monetary velocity, a given change in the quantity of money will have a widely varying effect on the level of prices and income (Selden, 1956). Friedman (1959) also noted that a successful estimation of velocity would imply monetary changes to be generating predictable changes in aggregate spending. For the demand for money to be stable in its functional relationship with income, interest

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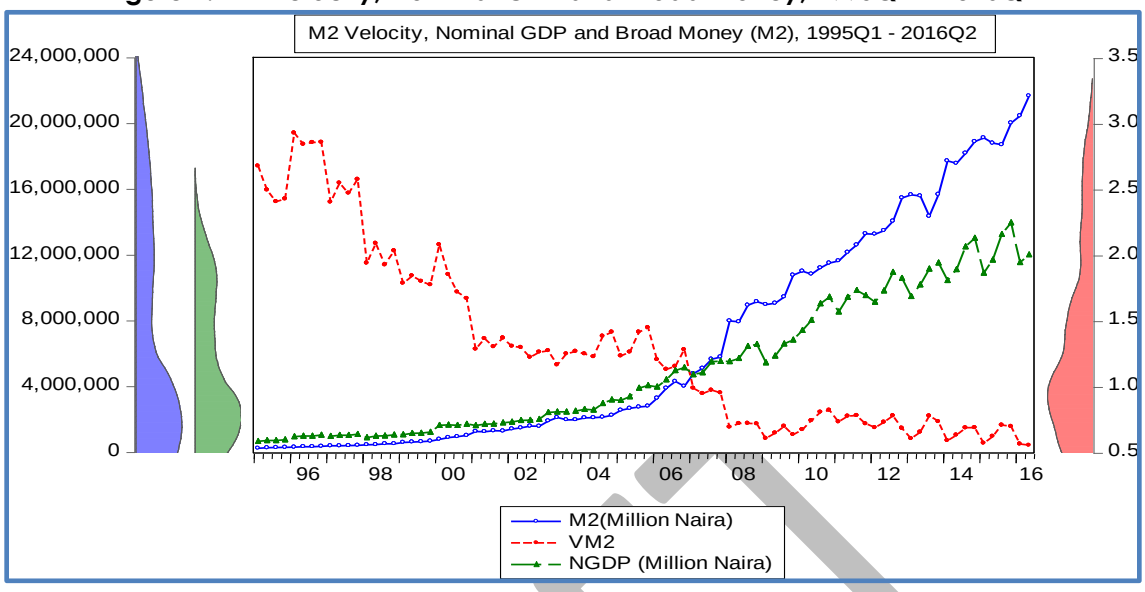
rate or other monetary variables, the velocity should reflect a constant, stable and predictable behaviour.

While substantial attention has focused on money demand stability, understanding the behaviour of velocity of money has not been accorded similar consideration, even though it is expedient to take cognisance of its stability in the monetary decisions like other wide range of macroeconomic factors. The central belief in administering monetary policy is the predictability, stability or constancy of the income velocity of money. If not, it will be difficult to predict how quantity of money relates to price level. The volatility in money velocity makes it difficult to generate reliable inflation forecast that is based on money growth, or the target setting for money growth based on inflation. Without reference to trends in velocity and its determinants, particularly in the event of short-term shocks to velocity, communicating the trends in actual money growth as well as the indicative money growth trajectory could be a challenge (Pattanaik and Subhadhra, 2013).

The major macroeconomic fundamentals of interest within the context of a central bank objective is to ensure price stability without losing focus on growth, it is therefore important to understand whether velocity is a useful indicator of the health of the economy. Several studies, including Okafor, et. al., (2013) in the case of Nigeria, have focused on the determinants of velocity of money and how factors account for its behaviour. Theories contend that barring an expectation of inflation or deflation, exogenous factors (for example, technology and other innovations) drive the velocity. The implication is that the credibility of the monetary authority, with respect to the commitment to price stability, significantly influences what happens to velocity. Without the fear or signal that overall prices will or have changed, such expectations will not arise. In the case where inflation uncertainties raise inflation rates, the tendency is for velocity to increase. In Nigeria, Adenekan (2012) found that inflation uncertainty leads to high inflation, which to an extent may have implications for the behaviour of money velocity. Furthermore, the cash-lite innovations have intensified the use of Automated Teller Machine (ATM), debit and credit cards, internet and mobile banking, among others, just as the various evolving innovations and other financial deepening reforms that have allowed for flexibility in non-interest bearing instruments in the country. These innovations have all reduced the use of cash, representing sources of shock to the money velocity.

As portrayed in Figure 1 (highlighted with the kernel density function distribution), the variability and non-constancy in the broad money velocity is evident, as it exhibited a persistent downward trend during the period under study. It is also noteworthy that, up until 2006/07, the divergence between level of broad money (M2) and nominal gross domestic product (NGDP) had been very minimal. Since 2007, M2 has grown substantially, with wider and increasing divergence over the output level (NGDP). Such behaviour accounts for the observed decreasing broad money velocity.

Figure 1: M2 Velocity, Nominal GDP and Broad Money; 1995Q1 – 2016Q2



The objective of this paper is to examine if there is any causal relationship among broad money velocity, inflation and output. The paper contributes to the body of literatures by assessing how the behaviour of velocity, indeed, helps to understand the movements in price level and nominal output. Further contribution include in the application of contemporary econometric tool—the Toda-Yamamoto (1995) model—in investigating the causal relationship among variables of interest. The rest of this paper is structured as follows: Sections 2 reviews the theoretical underpinnings and empirical studies on monetary velocity. Section 3 discusses the empirical model. The estimation procedure and results are presented in Section 4, while Section 5 contains the summary and concluding remarks.

II. Literature Review

II.1 Theoretical Underpinning

The velocity of money is defined as the rate at which money is exchanged from one transaction to another over a period of time. It measures how fast money passes from one holder to another. The concept, which formed the bedrock of the Quantity Theory of Money (QTM), is derived from the famous Fisher (1911) equation of exchange:

$$MV = PT \qquad (1)$$

Where M is defined as the stock of money in circulation; V, the velocity, i.e., the number of times a unit of currency is used in a given period; P is the price level and T, the value of total transaction. The equation of exchange (1) is more of an identity than equation, and can be expressed to define velocity, that is:

$$V = PT/M = PY/M \qquad (2)$$

Velocity of money is usually measured as a ratio of GDP (defined as PY in (2) above) to a country's total supply of money. It provides insight into whether consumers and businesses are saving or spending their money, hence another perceptive on the theory of demand for money. When the Fisherian equation of exchange was converted into money-demand theory, a convenient underlying assumption was a stable relationship between the value of transactions and national income. Accordingly, the discrepancy in the proportional changes in the money balances and output (or total transactions), or lack of, is accounted for by the adjustment in velocity. This is premised on the assumption that changes in velocity are of exact mathematical extent to account for the discrepancies between increases in money supply and price level.

In addition, without stability in the velocity, the quantity of money bears no predictable relation to the price level. Theories contend that, barring an expectation of inflation or deflation, exogenous factors drive the velocity, hence it should be stable Bain and Howell (1991) noted that "velocity has been converted into a reflection of the demand for conventional measures of money, which bears uncertain and changing relationships with a theoretical notion of money which, by definition, should (in the absence of changes in financial institutions and arrangement) be stably related to the total value of transactions."

The assumptions regarding the constancy in money velocity, and by implication its stability, has always been question or vehemently challenged. According to Mundell (1965), "the simplest hypothesis that velocity is constant, is clearly inadmissible when different rates of inflation are involved." The Neo-Keynesians generally believe that the hypothesis of constant unitary velocity is because money demand is not formally modeled, but postulated. To them, unitary velocity implies that the policy maker chooses a time path of the money supply, which just supports nominal GDP, while making strong assumptions about money demand behaviour.

Money velocity may not be constant in the short- or long-run, because its variability is a function of the developments in other macroeconomic variables. For example, with accelerated growth in GDP accompanied by higher inflation, it is expected that money would grow faster, rather than decelerate. The information content in money growth could then reflect a source of instability in demand for money and the resultant changes in velocity shock to the demand for money, whether anticipated or not, could make velocity unstable and generate further noise in money growth.

Furthermore, an expansionary monetary policy with an unanticipated inflationary effect can lead to reduced velocity when opportunity cost of holding money is reduced. The reaction of real balances to changes in the nominal interest rates brings about variability of income velocity. Higher (lower) interest rates lead to lower (higher) demand for money as agents looks for alternative means of payment (Lucas and Stokey, 1983 and 1987; and Jones and Manuelli, 1995). By the same token, a lower interest rate boost aggregate demand, and the increased demand will result in higher nominal and real interest rate, hence increased velocity of money amplifying further the impact of expansionary monetary policy. This will be particularly pronounced where close money substitutes are more available. Interest rate and velocity are positively related, but such relationship

operates through and by virtue of interest rates effects on the asset demand for money balances. Income velocity and holding on asset money balances, however, have inverse relationship (Geithman, 1971).

The departure from stability is likely to occur given that different definitions produce different values of velocity. Bain and Howell (1991) noted such plausible instance with the inclusion in the money supply measures, the saving deposits (idle balances) that vary with the rate of interest. Arguing further, they claimed that a measure of the money supply which excluded all savings deposit should not be expected to be stable, as the relationship between the value of transactions and national income is subject to frequent and rapid change in a world with large and volatile financial transactions. In addition, innovations in financial technology as well as other institutional deepening reform in the banking system affect the velocity, through their transaction cost reduction and financial asset liquidity impact. Several others factors include inflation and inflation expectations; employment uncertainties, wealth or net worth, market optimism or pessimism and the state of economic development and the overall economic outlook.

II.2 Empirical Review

Empirically, velocity has been found to depend on some measures which include income and inflation, among others. Short (1973) found velocity to be positively related to number of banks offices and negatively related to per capita gross domestic product (GDP). Ahmed (1977) estimated money demand function using log-linear specification. He found that velocity to be positively related to interest rate and inflation, but negatively related to past year's real GDP. Using Box-Cox procedure to select the functional form that maximises the likelihood function in the sample, Murty and Murty (1978) found that income velocity and interest rate are positively related. The study however found that the impact of real GDP on velocity to be ambiguous.

Changing (non-constant) velocity has been recognised by several empirical studies and the need to capture the implication of non-constant velocity continue to be on the rise (Orphanides and Porter, 1998; Hodrick, Kocherlakota and Lucas, 1991; Wang and Shi, 2006). There has also been some consensus that velocity varies over time (Friedman and Kuttner, 1992; Gould and Nelson, 1994). Friedman and others found that M2 velocity behaviour in the post-war period could be accounted for by opportunity cost variable.

Howlader and Khan (1990) found that income velocity is negatively related to the ratio of demand deposit to currency in circulation (CIC) and negatively related to national income and inflation rate. Hassan, et al., (1993) examines the determinant of income velocity of money in Bangladesh, employing a Savin-White Box-Cox parametric transformation with first-order serial auto-correlation estimation procedure. Their findings indicated that inflation and income variable affect velocity positively, while financial development affects it negatively. Hassan, et al, concluded that by the implication of their finding, as national income increases and velocity rises, central bank can reduce money supply to control inflation without affecting overall expenditure in the economy adversely.

Canzoneri and Dellas (1998), Collard, Dellas and Ertz (2000), Caballe and Hromcova (2001) showed that when agents are allowed to exchange a fraction of the current period income for consumption without using money, as the fraction increases, individuals economise on real balance holdings, which by implication is change in money velocity. Jafarey and Masters (2003) consider the role of the sources of technological innovations on the relationship between process, output and velocity of money. They develop a monetary search model which matched specific references and traded quantities to assess how aggregate output, prices and velocity of money are influenced by various forms of technological change. Their findings suggest that improvements in productive technology have no effect on monetary velocity, but lead to increased output and lower prices. By contrast, innovations that improve the frequency or reduce the cost of trade result in increased velocity, but ambiguous with respect to the co-movement between output and prices.

A study by Nelson (2007) also concluded that velocity in the 1980s was explicable "despite all the talk about how the relation between money and other variables has shifted drastically in recent years." Hromcova (2007) evaluates the effect of precautionary money demand on the equilibrium of the economy. The finding indicated that precautionary money demand may introduce significant changes in the volatility of the income velocity if it happens almost always. Its presence can alter the relationship between the average growth rate of money supply and the average growth rate of the economy.

Evans and Nicolae (2010) in their study that relaxed the assumption of constant velocity found "that the early output loss that follows a disinflationary policy announcement is considerably larger when time varying velocity is introduced to their model, and such output loss may not be compensated for, by later output gains. Depending on the velocity, disinflationary boom may disappear, even under perfect credibility and that output loses may be larger than previously thought. "

Akinlo (2012) paper investigates the impact of financial development on the velocity of money in Nigeria, over the period 1986:1 — 2010:4. The paper confirms the existence of a unique and statistically significant relationship between velocity of money (narrow and broad) and measures of financial development. The error-correction results show that current exchange rate has statistically significant negative effect on velocity of money in Nigeria. Per capita income has statistically significant relation with velocity of money (narrow and broad), which clearly supports the quantity theory. The results show that money issuing authorities cannot obtain additional leverage by issuing more money without generating high inflationary pressure. The results also show the importance of financial sector innovations for velocity. To the best of the author's knowledge, the studies reviewed generally looked at the determinants of velocity and not the interaction or its impact on the macroeconomic fundamentals, such as inflation or growth. This lacuna is what this paper endeavors to address, with particular reference to Nigeria.

III. Model Formulation

In a logarithm representation, the velocity of money is defined as:

$$v_t = p_t + y_t - m_t \quad (3)$$

Where v_t is velocity, $p_t$is the price level, y_t is the total output, m_t, is the money stock and subscript t denote time t. Whether velocity is constant or not, it is the relative stability of velocity with output growth and inflation that is important in understanding the behaviour of money balances and its implication in the monetary policy process. Monetary targeting framework presumes a stable demand for money to ensure the effectiveness of monetary policy decisions. It should be noted that he monetary authority may control money supply, but it is the economic agents that determine how much to hold as money balances.

For convenience, we follow Cagan (1956) which states that:

$$(m_t - p_t) = \alpha_0 + \alpha_1 y_t + \alpha_2 R_t \quad (4)$$

where m_t, p_t, y_t, are as previously defined in equation (3); R_t is nominal interest rate, which according to Fisher's postulation is defined as real interest rate plus expected inflation in the next period, conditioned on the information set at the current period (Ω_t)., i.e.,

$$R_t = r_t + E\{\pi_{t+1}|\Omega_t\} \quad (5)$$

Within the framework of IS relations, real interest rate and output in market equilibrium follows a representation of the form:

$$r_t = \lambda_0 + \lambda_1 y_t + \varepsilon_t \quad (6)$$

With $\lambda_0 > 0 \; and \; \lambda_1 < 0$ and ε_t is a stationary error.

In a rational expectation hypothesis environment, π_t is the optimal linear forecast of E$\{\pi_{t+1}\}$, therefore:

$$E\{\pi_{t+1}|\Omega_t\} = \pi_t + \mu_t \quad (7)$$

Combining equations (5) to (7) and plugging in (4) gives the expression equation (8) below:

$$(m_t - p_t) = \beta_0 + \beta_1 y_t + \beta_2 \pi_t + \xi_t \quad (8)$$

Where: $\beta_0 = (\lambda_0 + \lambda_1 \alpha_0)$; $\beta_1 = (\lambda_1 + \lambda_2 \alpha_1)$; $\beta_2 = \lambda_2$; and, the composite error-terms, $\xi_t = -\lambda_1 \varepsilon_t + \mu_t$. Finally, plugging equation (8) into the velocity definition in (3) derives how velocity relates to inflation and output growth as expressed below:

$$v_t = -\beta_0 + (1 - \beta_1)\dot{y}_t - \beta_2 \pi_t + \xi_t \quad (9)$$

The derived reduced form equation (9) represents the empirical model to be estimated. The model shows how the secular movement in velocity can be explained by inflation and growth. However, this relationship remains an empirical issue.

IV. Data Source, Estimation Procedures and Results

IV.1 Data Source

The study employs quarterly data series, 1995Q1 to 2016Q2, obtained from the Central Bank of Nigeria Statistical Bulletin. The stationarity issue or possible presence of unit roots in the series is investigated by conducting individual univariate analysis, following Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) t-tests. The unit root test results presented in Table 1 below indicates that the series under study exhibits different orders of integration. The broad money velocity is integrated of order 1; while output growth and inflation are integrated of order zero, respectively.

Table 1: Unit Root Tests for Endogenous Variables

	ADF in Levels						**Phillips Perron in Levels**					
	Intercept Only		**Intercept and Trend**		**None**		**Intercept Only**		**Intercept and Trend**		**None**	
	t-stat	*Prob*	*t-stat*	*Prob*	*t-stat*	*Prob*	*t-stat*	*Prob*	*t-stat*	*Prob*	*t-stat*	*Prob*
$v2$	-1.5	0.51	-2.59	0.29	-1.89	0.06	-0.67	0.84	-3.46	0.06	-1.43	0.14
$\dot{y}$	-9.8	0.00	-10.0	0.00	-2.96	0.00	-10.7	0.00	-11.8	0.00	-8.41	0.00
π	9.43	0.00	-9.42	0.00	-2.40	0.02	-14.9	0.00	-17.6	0.00	-5.72	0.00
	ADF in First Difference						**Phillips Perron in First Difference**					
D($v2$)	-4.17	0.00	-4.25	0.00	-3.48	0.00	-18.2	0.00	-18.7	0.00	-10.4	0.00

Given that the variables under study have different order of integration, co-integration test for these series is thus not required. This outcome justifies the need to adopt Toda and Yamamoto (1995) model (T-Y Model). According to T-Y Model, if one or both variables are non-stationary, a standard Granger causality is no longer valid as the Wald test statistic does not follow its usual asymptotic chi-square distribution under the null hypothesis. T-Y model therefore introduces additional lags within the VAR (K) to take care of this problem. This procedure guarantees that the asymptotically distribution of the Wald test statistic still holds. It is important to note that the augmented lags-- the maximum order of integration of the time series variables-- are not included in the Wald test.

The TY model is as specified in equations (10) to (12) below:

$$V2_t = \propto_0 + \sum_{i=1}^{k} \propto_{1i} V2_{t-1} + \sum_{j=k+1}^{k+dmax} \propto_{2j} V2_{t-j} + \sum_{i=1}^{k} \gamma_{1i}\, y_{t-1} + \sum_{j=k+1}^{k+dmax} \gamma_{2j}\, y_{t-j} + \sum_{i=1}^{k} \delta_{1i}\, \pi_{t-1} + \sum_{j=k+1}^{k+dmax} \delta_{2j}\, \pi_{t-j} + \epsilon_{1t} \quad (10)$$

$$y_t = \propto_0 + \sum_{i=1}^{k} \propto_{1i} V2_{t-1} + \sum_{j=k+1}^{k+dmax} \propto_{2j} V2_{t-j} + \sum_{i=1}^{k} \gamma_{1i}\, y_{t-1} + \sum_{j=k+1}^{k+dmax} \gamma_{2j}\, y_{t-j} + \sum_{i=1}^{k} \delta_{1i}\, \pi_{t-1} + \sum_{j=k+1}^{k+dmax} \delta_{2j}\, \pi_{t-j} + \in_{1t} \quad (11)$$

$$\pi_t = \propto_0 + \sum_{i=1}^{k} \propto_{1i} V2_{t-1} + \sum_{j=k+1}^{k+dmax} \propto_{2j} V2_{t-j} + \sum_{i=1}^{k} \gamma_{1i}\, y_{t-1} + \sum_{j=k+1}^{k+dmax} \gamma_{2j}\, y_{t-j} + \sum_{i=1}^{k} \delta_{1i}\, \pi_{t-1} + \sum_{j=k+1}^{k+dmax} \delta_{2j}\, \pi_{t-j} + \in_{1t} \quad (12)$$

Where k = the optimal lag length and d = maximum order of integration.

Estimating the T-Y Model requires the need to decide on the appropriate lag length. The diagnostic test for the lag selection criteria from the multivariate VAR estimation suggested the most common appropriate lag selection is 2 (see Appendix 1). Accordingly, the multivariate VAR estimates following the T-Y Model are presented in Appendix Table 2.

Using the multivariate VAR model, further tests were conducted on the model using the Granger Non-Causality, Impulse Response Function (IRF) and Forecast Error Variance Decomposition (FEVD). These instruments are useful in evaluating causality relationship among the endogenous variables (in the case of GNC) and the how shocks to the endogenous variables within the multivariate VARs rebound through the system (IRF and FEVD).

Before proceeding however, it is necessary to verify the reliability of the model specification. The diagnostic test was conducted using the LM Test of the VAR residual serial correlation. As the result indicated (Appendix Table 3), the null hypothesis of no serial correlation cannot be rejected; hence, there is no serial correlation[1]. Also, associated correlograms Chart for the residual test is presented in Appendix Figure 1.

IV.2 Granger Non-Causality Test

Testing for Granger Non-Causality (GNC) among variables under consideration using the T-Y model follows the following null hypotheses:

1. From Equation 10, nominal output growth and inflation are said to Granger-cause broad-money velocity if $\gamma_{1i}\ and/or\ \delta_{1i}$ are statistically different from zero, otherwise, both or either do not;

[1] The hypothesis of no serial correlation is, at 5.0 per cent level of significance, for the first two-lags. To resolve this, the optimal lag length is increased and then re-estimated.

2. From Equation 11, velocity and inflation are said to Granger-cause nominal output growth if $\propto_{1i}\ and/or\ \delta_{1i}$ are statistically different from zero, otherwise, both or either do not; and,
3. From Equation 12, velocity and nominal output growth are said to Granger-cause inflation if $\propto_{1i}\ and/or\ \aleph_{1i}$ are statistically different from zero, otherwise, both or either do not.

As Table 4 illustrates, the result from equation 10 indicates that while inflation Granger-causes velocity, nominal output growth does not. Testing for the nominal output growth in equation 11 only suggests that velocity does not granger output, but inflation does. Finally, the test on inflation shows that both velocity and nominal output growth granger causes inflation. The conclusion here is that there is a bi-directional causality between inflation and velocity, and between inflation and nominal output growth. On other hand, there is no evidence of causality between velocity and nominal output growth. The evidence of Granger non-causality between velocity and nominal output growth is particularly interesting given the conventional economic thinking of a strong link between velocity and transactionary activities; the implication of this finding is a plausibility of some monetary coagulation within the economy.

Table 4: VAR Granger Causality/Block Exogeneity Wald Tests

Dependent variable: Broad-money Velocity			
Excluded	Chi-sq	df	Prob.
Nominal Output Growth	2.071872	4	0.7225
Inflation	23.43416	4	0.0001
All	30.99521	8	0.0001
Dependent variable: Nominal Output Growth			
Excluded	Chi-sq	df	Prob.
Broad-money Velocity	4.218985	4	0.3772
Inflation	26.10734	4	0.0000
All	34.22382	8	0.0000
Dependent variable: Inflation			
Excluded	Chi-sq	df	Prob.
Broad-money Velocity	25.76651	4	0.0000
Nominal Output Growth	12.16367	4	0.0162
All	38.15940	8	0.0000

IV.3 Impulse Response Function (IRF) and Forecast Error Variance Decomposition (FEVD)

The IRF traces the response of an endogenous variable to Cholesky One-standard deviation orthogonalised innovations in the variables within the system. Specifically, it traces such effect on the current and future values of broad money velocity, nominal GDP growth and inflation. As shown in Appendix Figure 2, the initial response of velocity to its own shock was positive and substantial, but decline steadily and asymptotically, but never fizzled out, toward tenth-period ahead. A cursory observation also reveals that the response in money velocity to itself is more protracted than any other variables.

The response of velocity to the innovations in nominal GDP was initially negative through three periods ahead, before reverting and slowly fizzled out by the tenth period. In contrast, broad money velocity responds positively in the first two periods to the shock in inflation, and then decline through the next two periods ahead, before it fizzled out afterward. This indicates that while the money velocity declines initially, but rebounds in relation to growth, it rises in relation to inflation about the same period, before fading in the periods ahead. The response of NGDP growth also indicated a sharp rise to shocks in the velocity in the first period, with a rapid drop in the second period before reverberating through sixth period ahead, after which it begins to vanish. On the other hand, inflation responded negatively to velocity, and then oscillated through the fourth period ahead before it begins to decline and disappears. NGDP growth and inflation respond sluggishly, but positively, to their innovations respectively, with the responses fading out more quickly.

The variance decomposition result displayed in Appendix Table 4, shows the proportion of the movements in the broad money velocity that is due to its own innovation against the innovations from other variables in the system. Over a 10-quarter distance into the future, 90.9 per cent of the innovations in velocity are accounted for by its own past values, while 6.0 and 3.1 per cent of the movement in velocity are attributed to innovations in inflation and NGDP, respectively. The decomposition of the NGDP growth indicated that, throughout the 10-quarter horizon, approximately 40.0 per cent of its movement is explained by own shocks, while velocity shocks explain 56.0 per cent, and 4.0 per cent, due to inflation. Over the same horizon, the result also suggested that the 89.04 percent of the movement in inflation is due to its own shock, while innovations in velocity and NGDP growth explain 5.4 and 5.6 per cent, respectively.

V. Summary and Conclusion

This study explores the dynamic relationship among the velocity of money, inflation and nominal GDP, with the motivation to understand whether the information content in money velocity can provide any useful indications for the health of the economy. The exercise is premised on the idea that the effectiveness of monetary policy hinges on the important assumptions of stable money demand and, by implication, the velocity of money. Depending on the behaviour of monetary velocity, a given change in the quantity of money will have a widely varying effect on the level of prices and income. The behaviour of velocity is not only important in determining to what extent monetary policies

are effective, but rather crucial in determining whether short-term monetary policy is effective at all. As the results showed, especially the Granger non-causality investigation, the information content in velocity is potent in understanding the inflation in Nigeria, but less useful in relation to the development nominal output growth.

Historical evidence has also shown that velocity of money is not generally constant as assumed by the Quantity Theorist. This evidence is also consistent with what the data revealed in Nigeria during the period under review. This paper also develops a theoretical framework that helps to understand how velocity of money can be related to the growth, in nominal term, and inflation. The derived reduced form equation is then estimated, following Toda-Yamamoto VAR model, given that the variables under consideration are of different order of integration.

Findings indicated that the velocity responds positively to inflation before declining protractedly and asymptotically over time. Against the nominal output growth, the response was initially negative before reverting positively to fade out. The interpretation is that the money velocity declines initially, but rebounds in relation to growth; by the same token, it rises in relation to inflation about the same period before fading off. Furthermore, the inflation contributes more to variation in the broad money velocity than nominal GDP. The protracted decline in broad money velocity in Nigeria could be interpreted as an early symptom or indication of a plausible shift in monetary regime; monetary authority is therefore urged to closely monitor this developments. It also has an implication of a plausibility of monetary coagulation—because, given the high liquidity environment within the economy, low velocity of money over time implies the money is not circulating in consistent economic activities. This calls for the monetary authority's reassessment of its policy tools. to engender healthy flow.

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Appendix Table 1

VAR Lag Order Selection Criteria
Endogenous variables: VM2LOG01 CHGNGDPLOG CHGCPILOG
Exogenous variables: C
Sample: 1995Q1 2016Q2
Included observations: 73

Lag	LogL	LR	FPE	AIC	SC	HQ
0	215.9475	NA	5.87e-07	-5.834178	-5.740049	-5.796666
1	355.7177	264.2231	1.63e-08	-9.416923	-9.040409*	-9.266875
2	374.0927	33.22598	1.26e-08*	-9.673771*	-9.014872	-9.411189*
3	377.5165	5.909603	1.48e-08	-9.520999	-8.579714	-9.145881
4	384.8142	11.99630	1.56e-08	-9.474362	-8.250692	-8.986708
5	391.0672	9.765003	1.70e-08	-9.399103	-7.893047	-8.798914
6	398.1982	10.54993	1.81e-08	-9.347896	-7.559456	-8.635172
7	405.8352	10.67080	1.92e-08	-9.310552	-7.239726	-8.485292
8	410.8090	6.540971	2.21e-08	-9.200247	-6.847036	-8.262452
9	415.3788	5.633979	2.59e-08	-9.078871	-6.443274	-8.028540
10	436.9230	24.79054*	1.93e-08	-9.422547	-6.504565	-8.259681
11	446.7544	10.50481	2.00e-08	-9.445326	-6.244958	-8.169924
12	458.3682	11.45474	2.01e-08	-9.516938	-6.034184	-8.129000

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5 per cent level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Appendix Table 2: Vector Autoregression Estimates

Standard errors in ( ) & t-statistics in [ ]

	VM2LOG01	CHGNGDPLOG	CHGCPILOG
VM2LOG01(-1)	0.755730	-0.056669	-0.057781
	(0.18761)	(0.15516)	(0.05140)
	[4.02817]	[-0.36523]	[-1.12409]
VM2LOG01(-2)	0.122973	-0.108592	-0.029786
	(0.24153)	(0.19975)	(0.06617)
	[0.50915]	[-0.54364]	[-0.45011]
CHGNGDPLOG(-1)	-0.128972	-0.088579	0.060979
	(0.22809)	(0.18864)	(0.06249)
	[-0.56544]	[-0.46957]	[0.97576]
CHGNGDPLOG(-2)	-0.399257	-0.261509	0.100811
	(0.22819)	(0.18872)	(0.06252)
	[-1.74964]	[-1.38567]	[1.61242]
CHGCPILOG(-1)	1.378873	0.372902	0.187231
	(0.41701)	(0.34488)	(0.11425)
	[3.30657]	[1.08125]	[1.63872]
CHGCPILOG(-2)	-0.061872	-0.333675	-0.367227
	(0.42019)	(0.34751)	(0.11513)
	[-0.14725]	[-0.96019]	[-3.18979]
C	-0.043757	0.034061	0.018083
	(0.02685)	(0.02220)	(0.00736)
	[-1.62994]	[1.53412]	[2.45842]
VM2LOG01(-3)	0.103046	0.173439	0.085430
	(0.18331)	(0.15161)	(0.05022)
	[0.56213]	[1.14402]	[1.70094]
CHGNGDPLOG(-3)	-0.247776	-0.154753	0.019267
	(0.15095)	(0.12484)	(0.04136)
	[-1.64147]	[-1.23963]	[0.46586]
CHGCPILOG(-3)	0.477490	0.393578	0.212741
	(0.37606)	(0.31101)	(0.10303)
	[1.26972]	[1.26548]	[2.06477]
R-squared	0.965315	0.219708	0.233699
Adj. R-squared	0.960979	0.122172	0.137912
Sum sq. resids	0.639516	0.437415	0.048007
S.E. equation	0.094245	0.077944	0.025822
F-statistic	222.6468	2.252576	2.439767
Log likelihood	82.65134	98.22431	188.8155
Akaike AIC	-1.771984	-2.151812	-4.361353
Schwarz SC	-1.478482	-1.858310	-4.067850
Mean dependent	0.102510	0.033456	0.027705
S.D. dependent	0.477103	0.083191	0.027811
Determinant resid covariance (dof adj.)		1.36E-08	
Determinant resid covariance		9.22E-09	
Log likelihood		409.5249	
Akaike information criterion		-9.256704	
Schwarz criterion		-8.376197	

Appendix Table 3: VAR Residual Serial Correlation LM Tests

Null Hypothesis: no serial correlation at lag order h

Lags	LM-Stat	Prob
1	8.908576	0.4458
2	8.461520	0.4884
3	7.434040	0.5920
4	8.027827	0.5313
5	6.281945	0.7114
6	14.01595	0.1218
7	8.096334	0.5245
8	6.038171	0.7361
9	11.11579	0.2679
10	14.01740	0.1217
11	14.46842	0.1066
12	4.856886	0.8466

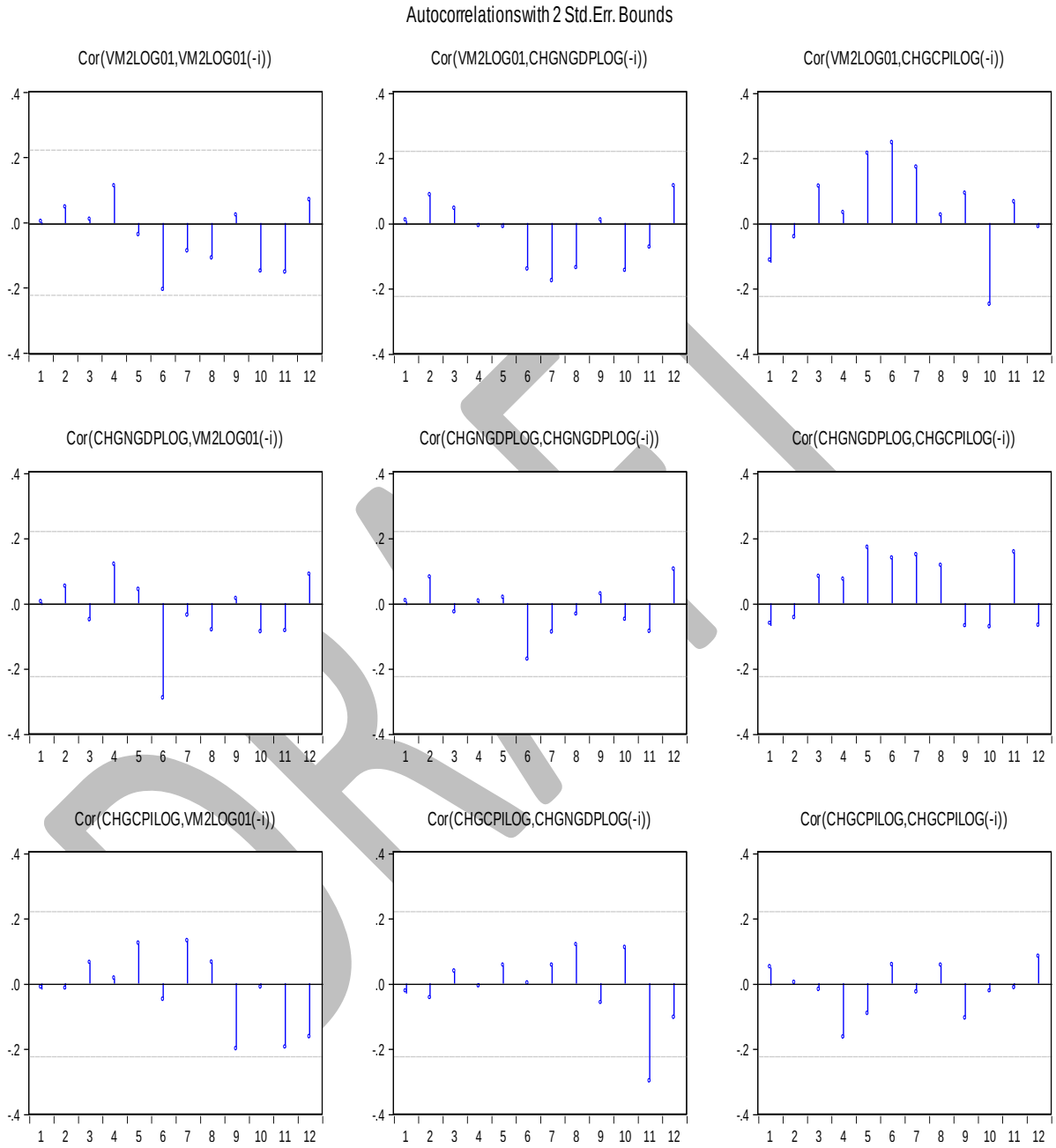
Probs from chi-square with 9 df.

Appendix Table 4: Variance Decomposition

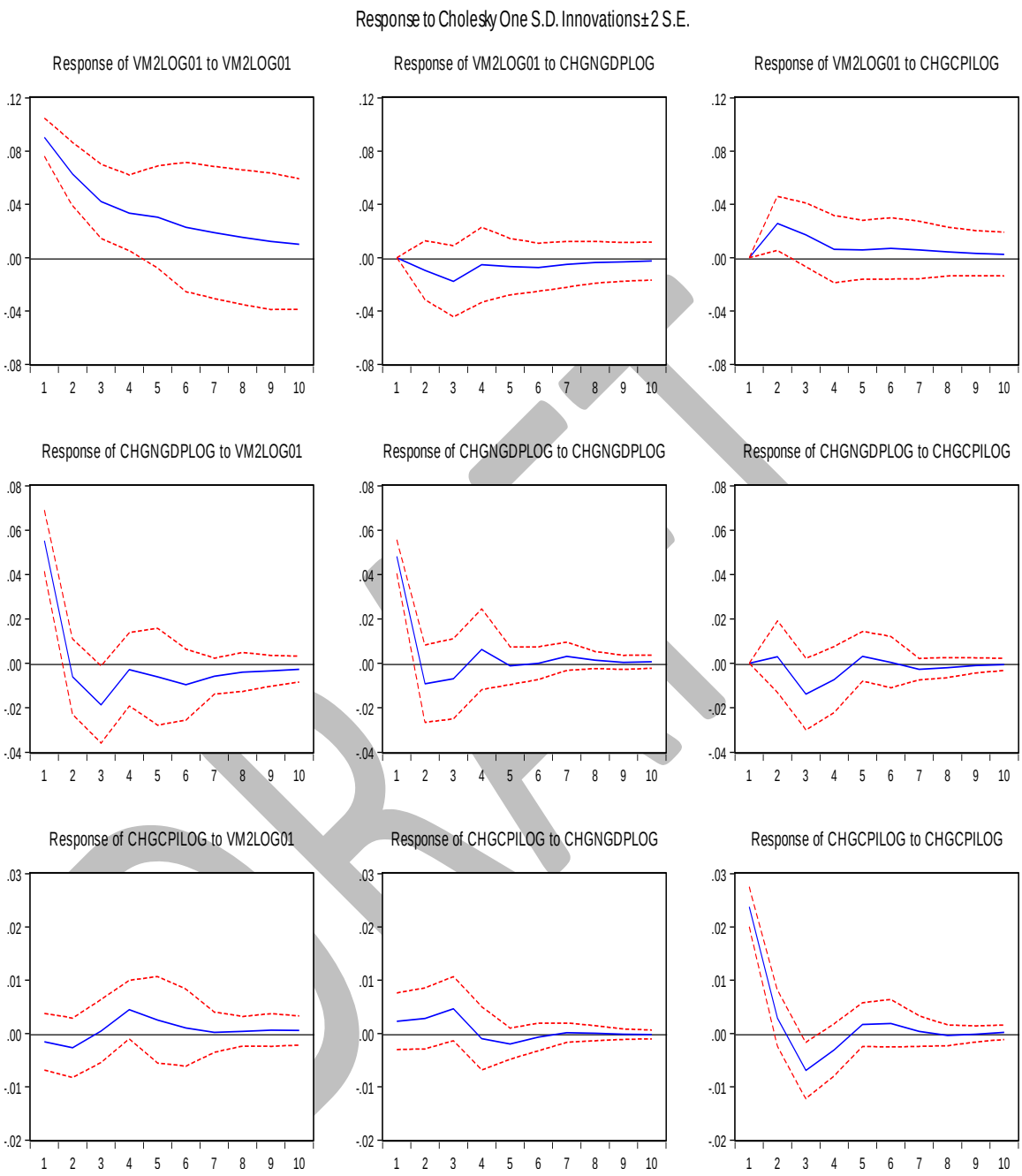
Variance Decomposition of VM2LOG01:				
Period	S.E.	VM2LOG01	CHGNGDPLOG	CHGCPILOG
1	0.090469	100.0000	0.000000	0.000000
2	0.113435	94.16321	0.717429	5.119357
3	0.123478	91.11670	2.653847	6.229451
4	0.128209	91.34489	2.635946	6.019163
5	0.132080	91.38184	2.744894	5.873266
6	0.134429	91.12197	2.943633	5.934400
7	0.135951	91.00462	3.011914	5.983464
8	0.136918	90.95519	3.037978	6.006835
9	0.137541	90.92466	3.063636	6.011700
10	0.137960	90.90908	3.079102	6.011819
Variance Decomposition of CHGNGDPLOG:				
Period	S.E.	VM2LOG01	CHGNGDPLOG	CHGCPILOG
1	0.073315	56.88877	43.11123	0.000000
2	0.074192	56.21913	43.62122	0.159642
3	0.078061	56.48926	40.19923	3.311509
4	0.078709	55.68642	40.18605	4.127534
5	0.079015	55.85355	39.89624	4.250207
6	0.079592	56.48821	39.31926	4.192531
7	0.079909	56.56548	39.16352	4.271003
8	0.080041	56.62017	39.06553	4.314306
9	0.080120	56.68939	38.99057	4.320040
10	0.080170	56.72996	38.94994	4.320104
Variance Decomposition of CHGCPILOG:				
Period	S.E.	VM2LOG01	CHGNGDPLOG	CHGCPILOG
1	0.023946	0.429830	0.901540	98.66863
2	0.024433	1.621817	2.207749	96.17043
3	0.025827	1.481122	5.228563	93.29032
4	0.026410	4.292503	5.128369	90.57913
5	0.026656	5.128049	5.565155	89.30680
6	0.026752	5.251386	5.585692	89.16292
7	0.026757	5.257791	5.586638	89.15557
8	0.026762	5.279114	5.584451	89.13643
9	0.026770	5.330520	5.583881	89.08560
10	0.026778	5.368928	5.586171	89.04490

Cholesky Ordering: VM2LOG01 CHGNGDPLOG CHGCPILOG

Appendix Figure 1: Residual Test of Autocorrelation



Appendix Figure 2: Impulse Response Function of Endogenous variables



Does Cash Reserve Requirement (CRR) influence Bank lending in Nigeria?

Rapu, S., G. Sanni, D. Penzin, N. Nkang, P. Golit, H. Okafor and E. Ibi*

The need to reverse the declining GDP growth trend in the first two quarters of 2015 in the face of rising inflation and the liquidity squeeze in commercial banks following the implementation of the TSA, necessitated the reduction of the CRR from 31 to 25 per cent in September 2015, in order to increase liquidity to the banks and encourage more lending to the economy. This paper, therefore, uses monthly data from 2009:12 to 2015:08 to analyse the impact of CRR adjustment on bank lending with the aid of a modified reduced-form VAR model linking two transmission channels of CRR impulses to bank lending behaviour. Results show that CRR adjustments have a marginal effect on bank lending in Nigeria, and such adjustments are more effective in controlling liquidity than influencing lending. The study concludes that banks' lending in Nigeria is based on factors other than CRR adjustments, some of which may include prevailing economic conditions, risk profile of the customers, returns on other alternative investments.

Keywords: *GDP growth, Liquidity, banks, lending, reserve requirement*
JEL Classification: *E51, E52, E58*

I. Introduction

Reserve requirements is popularly used by the monetary authorities to regulate domestic liquidity and influence the cost of credit. Reserve requirement policies, however, have implications for banking sector liquidity and the credit capacity of banks. Aside from increasing the cost of intermediation – as more bank deposits are held in assets with little or no interest earnings at the central bank – an increase in the CRR comes with a cost to the banks and should affect their lending and investment behaviour. Thus, banks may transfer this cost to borrowers, depositors or shareholders via upward or downward adjustments in the lending or deposit rates, or lowering of dividends paid to shareholders. Consequently, the capacity of the banks to create money and galvanise economic activities for higher economic growth and increased employment would be seriously impaired.

According to the National Bureau of Statistics (NBS), Nigeria's real Gross Domestic Product (GDP) recorded a growth of 2.35 per cent in the second quarter of 2015, compared with 3.96 per cent in the preceding quarter, showing a decline of 1.61 percentage points. The growth was also lower than that recorded in the corresponding period of 2014. On a half-yearly basis, the GDP growth dropped to 3.1 per cent in the first half of 2015, from the 6.4 per cent recorded in the corresponding period of 2014. Following this trend, the GDP growth was projected to slide further to 2.0 and 1.8 per cent in the third and fourth quarters of 2015, respectively, raising fears that the economy may slide into recession. Headline inflation rose from 8.2 per cent in January 2015 to 8.5 per cent in March and then 9.17 per cent in June 2015.

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The slow growth of the economy which was preceded by a collapse of crude oil prices in the international oil market had impacted the stock of external reserves and government fiscal revenues adversely, thus putting pressure on the monetary authority to further depreciate the exchange rate.

The new administration, in an effort to combat endemic corruption through blocking leakages of government revenue, and to engender efficient management of government resources, undertook the full implementation of the Treasury Single Account (TSA). The TSA helped to consolidate all inflows from all government ministries, departments and agencies (MDAs) for effective financial accountability. However, it led to the withdrawal of a whopping ₦2.0 trillion from the banking system into a single government account with the CBN, with attendant implication for banking system liquidity.

Following the TSA policy and given the need to reverse the declining growth trend in the face of rising inflation, bank lending rates and the worsening liquidity position of the commercial banks, the Monetary Policy Committee of the CBN in September 2015 intervened by reducing the CRR from 31.0 per cent – since May 2015 – to 25.0 per cent, while retaining the monetary policy rate (MPR) at 13.0 per cent since January 2015. The CBN's action was carried out with a view to encouraging more lending to the economy, by increasing liquidity to banks. However, it remains unclear if such adjustments in the CRR in the past influenced commercial banks' loan advances to the real economy in the desired direction. This is particularly so given that reserve requirements are more or less perceived as a macro-prudential tool rather than a monetary policy instrument unlike the MPR, which serves as an anchor rate to all other interest rates that affect bank lending in the economy. Thus, providing a clear perspective on the impact of CRR adjustment on bank lending in Nigeria requires empirical investigation. The objective of this study, therefore, is to determine the impact of adjustment of cash reserve requirement in influencing bank lending in Nigeria with a view to drawing useful implications for monetary policy actions in enhancing credit delivery by the banking sector to the economy.

In doing this, we adopted the VAR methodology proposed by Sims (1980), and applied by many studies on the impact of CRR adjustment on banks' lending behaviour in various countries (see for instance Glocker and Towbin, 2012; Noss and Toffano, 2014), unlike previous related studies for Nigeria (Otu and Tule, 2002; Olokoyo, 2011). This study, however, differs from the past attempts by modifying the typical reduced-form VAR model proposed by Sims (1980) to link the two key transmission channels – interest rate and liquidity channels – through which reserve requirement impulses impact bank lending behaviour (see, Alper, et al., 2014). Furthermore, we decompose the analysis by estimating a five variable VAR model for each of the two channels to determine the most effective or dominant channel and the timing, as well as the best policy response needed to stimulate credit in the economy towards achieving sustainable economic growth.

The paper is structured into six sections. Following this introduction is section 2 which reviews the theoretical and empirical literature. Section 3 provides the stylised facts on reserve requirement policy and bank lending in Nigeria. Section 4 highlights the methodology, the results and empirical analysis. The summary and concluding remarks are provided in section 5.

II. Literature Review

II.1 Conceptual Issues

II.1.1 Tools of Monetary Management in Nigeria

Monetary management seeks to ensure the achievement of desired objectives of macroeconomic stability, balance of payments equilibrium, economic growth and a sound financial system. In Nigeria, the sole monetary authority is the Central Bank of Nigeria (CBN) and the CBN Act of 2007 mandates it to carry out certain functions on behalf of the government. These functions include: ensuring monetary and price stability; issuing the legal tender currency in Nigeria; maintaining external reserves to safeguard the international value of the legal tender currency; promoting a sound financial system; and acting as banker and provide economic and financial advice to the Federal Government

Monetary policy refers to a combination of instruments/measures designed to regulate the value, supply and cost of money in an economy, in consonance with the expected level of economic activity. For most economies, the objectives of monetary policy include price stability, maintenance of balance of payments equilibrium, promotion of employment as well as economic growth, and sustainable economic development. These objectives are necessary for the attainment of internal and external balance, and the promotion of long-run economic growth (Nnanna, 2001). The nature and direction of monetary policy is influenced by a number of considerations including; government economic policy, global economic conditions, state of the financial system, structure of the economy, as well as domestic economic performance. In other words, the decision of central banks to employ either monetary tightening or expansionary measures is largely based on the foregoing considerations. Also, the tools to be applied to tackle these issues would depend on the dynamics of the economy at any given time.

In the early 1970s to mid-1980s, it was customary for central banks, particularly in developing countries, to resort to the use of direct control measures which are not market-based but largely, determined by government regulations. In Nigeria for instance, the direct method of monetary policy lasted from 1959-1985. The direct monetary policy tools during that period included selective credit control, rationing, quota, interest rate pegging, foreign exchange control and cash reserve requirement. These measures were frequently reviewed based on the priorities of government. The objectives of direct control and associated measures during the control regime included: developing and maintaining a sound domestic currency; ensuring adequate supply of credit to the economy with minimal inflationary pressures; and achieving balance of payments equilibrium through credit rationing and foreign exchange control.

However, owing to frequent policy changes associated with direct control measures, which resulted in the failure to achieve the desired policy objectives, and the increasing need for a strong economy that is globally competitive, Nigeria had to employ indirect control measures as tool for economic management in 1986 under the Structural Adjustment Programme (SAP) whose main goal was to institutionalise a more efficient market system for the allocation of resources to foster economic growth and development. Thus, from 1986 to date, monetary policy has been based on indirect control or market-based. By this development, monetary policy was expected to play an

important role in the new economic management process and environment which was underpinned by greater financial and economic liberalisations.

II.1.2 Indirect Instruments of Monetary Policy

II.1.2.1 Reserves Requirements

Reserve requirement is one of the monetary management tools available to central banks to regulate and control the level of banking system liquidity with the overall objectives of sound financial system stability and ensuring that banks contribute maximally to the growth of the economy. To a large extent, it determines the available loanable capital to banks as it stipulates the amount of cash reserves that should be held by deposit money banks for their day to day activities. Excess over the stipulated cash reserve ratio are kept with the central bank. The adjustment of the reserve requirement by the monetary authority has implications for the growth of monetary aggregates and banks' capacity to advance credit to the economy. Reserve requirements protect banks against insolvency by limiting their risk capacities and ensuring that they have adequate funds to meet the needs of depositors. Reserve requirements also assist the monetary authority in achieving macroeconomic stability by ensuring that monetary growth is consistent with the absorptive capacity of the economy; and is a tool used by the central bank for manipulating money supply (Okamoto, 2011).

Reserve requirements are held by banks either as cash in vault or as non-interest bearing balances in the CBN. In some cases, reserves are kept in non-interest yielding instruments such as treasury bills. The opportunity cost of reserve requirements to the banking system is the foregone investment which those funds could have been invested pursuant to the profit motive of the banks. However, reserve requirements are generally not without a cost either in developing or developed economies. In recent times, the remuneration on banks' reserves has encouraged banks to build more reserves and promote the effectiveness of monetary policy. Feinman (1993) notes that higher reserve requirements could help smoothen the implementation of monetary policy and thereby, preventing volatility of bank reserves which could discourage banks from lending to the real economy.

The computation of reserve requirement varies across countries in terms of the base, form and composition. Some countries include liquid assets requirement to the mandatory vault cash and holdings with the central bank. Others differ on the sources of deposit (in terms of domestic or foreign) and whether the deposits are in local or foreign currency. Some countries also, exclude savings and time deposits, while others impose varying components of reserve ratios on demand, savings and time deposits. Imposition of reserve requirement "tax" by the monetary authorities lowers bank profitability. However, the payment of interest on reserves by the central banks can improve bank returns and this may in turn enhance the returns to depositors and shareholders. Interest payments on reserve often serves as an incentive to banks to keep their deposits with the central bank and to reduce liquidity overhang in the economy.

II.1.2.2 Open Market Operations (OMO)

Open Market Operations (OMO) is the major instrument of monetary policy used by the CBN. It involves the buying and selling of government securities in the open market in order to regulate the amount of money in the banking system. The central bank injects money into the banking system (by buying securities such as Treasury Bills from the public) to stimulate economic growth. Conversely, by selling securities, it withdraws excess liquidity in the system. OMO could be undertaken through outright transactions or repurchase transactions. While outright transactions involve the purchase and sale of securities without an obligation to resell or repurchase them at a later date, repurchase agreements are temporary, and are reversed after the contract.

OMO enables the central bank to influence the cost and availability of reserves which will produce the desired changes in bank credit and money supply, making it an important monetary policy tool. The effectiveness of the OMO, however, largely depends on the existence of well-developed and efficient financial markets that are sensitive to interest rate changes (CBN, 2011).

II.1.2.3 Discount Window Operations

Discount Window Operation is a facility which provides short-term (usually overnight) loans to banks against collaterals in form of government or other acceptable securities. The central bank lends to banks at the policy rate (the nominal anchor rate) to meet temporary shortages of liquidity resulting from internal or external disruptions. Thus, the discount window enables the central bank to perform its role of lender of last resort to the banks.

II.2 Theoretical Issues

The role of banks in the development of an economy is a well-established fact in the literature in both developed and developing economies. The traditional growth theories have also underscored the imperatives of capital in the economic growth process. Banks, therefore, being major providers of funds for capital development, are very crucial to the achievement of a strong and resilient economy. The concern for the effective performance of this role is one of the reasons banks are regulated by monetary authorities in order to ensure their soundness and safety at all times.

Okamoto (2011) identified two reasons why banks are regulated. First, regulators do so to ensure a financial system that can guarantee confidence to depositors and absorb sudden economic shocks without adverse impact on the economy. Second, regulators want a financial system that can efficiently intermediate for the overall growth of the economy by offering products that help to smoothen consumption and ensure the availability of investible funds for productive uses.

Several theories have tried to explain how bank capital requirements could influence bank lending, and possibly prevent financial crisis. Most of them assume market imperfections,

thus refuting the Modigliani-Miller theory which was based on the premise of perfect competition. The Modigliani-Miller theory, states that banks' lending will depend on banks' capital structure, lending advancements and capacities, as well as prevailing market conditions. This means that banks' lending behaviour is influenced by the capital base, risk capacities, loan repayments profile, as well as the prevailing market conditions which are usually determined by the interactions between the domestic and external economic environments. The CBN (2010) notes that the effects of monetary policy on bank lending would, therefore, depend on the capital adequacy requirements for banks. The requirements varied from time to time depending on prevailing situations. An increase in the reserve requirement is expected to limit bank lending. Also, if the shareholders' fund of the bank capital is small, banks may reduce their lending, otherwise they will not be able to meet the capital adequacy and liquidity ratio requirements.

To be specific, the amount of capital that is available for lending by banks is influenced by regulatory requirements on cash reserves ratio and liquidity ratio. The effects of these requirements on policy are transmitted into the economy through the credit channel of monetary policy transmission mechanism. From the bank lending channel perspective, banks issue liabilities (bank deposits) and hold assets (bank loans). It emphasises that since deposits represent the major source of funds for lending, an expansionary monetary policy increases bank reserves and deposits, and invariably increases the availability of bank loans. Similarly, a contractionary policy would result in a reduction in bank lending. The transmission process is given as follows:

***Bank Reserve Requirement*↑→ *Money Supply*↓→ *Bank Reserves/Deposits*↓ *Bank Loans*↓**

The converse holds when there is a decrease in reserve requirement. Bernanke and Blinder (1988) posit that there are three necessary conditions to be satisfied in order for the bank lending channel to effectively transmit monetary policy: the elasticity of substitution between bank loans and bonds for borrowers should be perfectly inelastic; the ability of the central bank to affect the supply of bank loans through reserve requirements; and the existence of imperfect price adjustment that prevents monetary shocks from being neutral.

The balance-sheet channel, on the other hand, shows how monetary policy affects the credit portfolio of financial intermediaries as well as other economic agents. A borrower with a stronger financial position pays a lower external finance premium, as the present value of an investment is more sensitive to a given interest rate change when the stream of payment is longer. Due to information asymmetry and bankruptcy laws, the balance sheet position has implications for banks' ability to secure external finance. Gambacorta and Mistrulli (2003) state that capital requirement remains one of the key determinants of bank lending in several ways. A contractionary monetary policy reduces funds available to banks, thereby inducing increases in market interest rates. Conversely, an easing monetary policy causes an increase of deposits and a reduction of market interest rates. In both cases, the two ways through which bank capital could influence the effects of changes in monetary policy on lending are through the bank lending and bank capital channels. Through the bank lending channel, a monetary tightening could impact on

bank lending through a decrease in reservable deposits which cannot be completely offset by issuing other forms of funding. On the other hand, the bank capital channel assumes that there is an imperfect market for bank equity, banks are subject to interest rate risk because their assets have a higher maturity with respect to liabilities, and regulatory capital requirements limit the supply of credit (Gambacorta and Mistruilli, 2003).

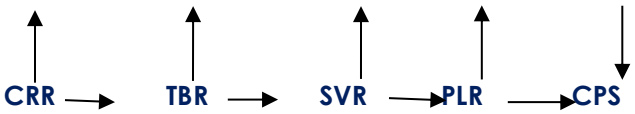
Bank capitalisation and reserve requirements have also been observed to propagate economic shocks. Specifically, the capitalisation of banks has been associated with risk taking behaviour as well as portfolio choices, implying that the degree of capitalisation determine their lending behaviour during economic downturns. Banks with lower capital bases are usually risk averse, thus, reduce lending. On the contrary, those that are well-capitalised are less risk averse, therefore, their lending behaviour remain unchanged or increase overtime. However, in the presence of solvency regulations, well-capitalised banks keep a higher level of capital because of their risky lending portfolio (Gambacorta and Mistruilli, 2003).

Despite the increasing reliance on reserve requirements as a policy tool, its effectiveness on bank lending has not been extensively researched. The exact transmission mechanism through which reserve requirements interact with bank lending behaviour still remains under-explored. However, one thing is certain - the degree of substitution between central bank credit and deposits as sources of bank funding remains an important parameter for the transmission mechanism of reserve requirement. If they are imperfect substitutes, then a rise in reserve requirements will not be fully replaced with central bank credit. This implies that both the demand for deposits and supply of loans will be affected (Gambacorta and Mistruilli, 2003).

Alper, et. al., (2014) and Kara (2014) identify three major transmission channels through which changes in reserve requirements affect bank lending behaviour have been identified in the literature; (i) the cost channel; (ii) the interest rate risk channel; and (iii) the liquidity channel. The cost channel occurs when an increase in reserve requirements affects financial intermediation through an implicit tax on the banking system. The final impact on deposit and loan rates, however, will depend on the degree of market competition. The interest rate risk channel, assumes that since the maturity of central bank credit is typically shorter than the maturity of deposits, a more reliance on central bank funding results to the interest rate risk. The liquidity channel works through a decline in bank liquidity and loan supply due to an increase in reserve requirements which may affect loan behaviour through a balance sheet adjustment to restore liquidity buffers.

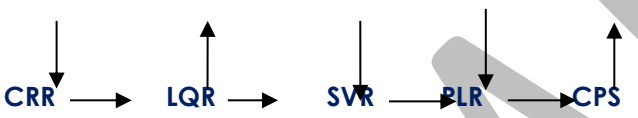
Alper, et. al., (2014) also note that the CRR could effect changes on bank behaviour though the interest rate or liquidity channels. The interest rate risk channel assumes that adjustment in CRR affects the opportunity cost of fund which is the return the reserve is expected to yield if it is invested in other alternative assets such as bond or foreign exchange market. In a developing economy like Nigeria where banks are active players in the bond market, free reserves are often invested in the bond market depending on the interest rate-risk relationship. This in turn directly affects deposit rate and lending rate as well as the lending behaviour of banks.

For instance, an upward adjustment in CRR increases the opportunity costs of fund or the interest rate risk, the savings rate and the lending rate, while it decreases the volume of loans as the economic agents are averse to higher interest rate and vice versa.



The Interest rate risk channel

On the other hand, in the liquidity channel, a decrease in CRR increases the liquid assets of banks, which also reduces the spread between deposit and savings rate. This phenomenon decreases the lending rate and directly increases the credit available for banks' lending and vice versa. The transmission process of the liquidity channel is shown below.



Ireland (2005) describes monetary transmission mechanism as how the policy-induced changes in the nominal stock or the short-term nominal interest rate impact real variables such as aggregate output and employment. In order to fully explain the transmission channels through which changes in reserve requirements affect bank lending behaviour, Alper, et. al., (2014) assume that central bank funding and bank deposits are perfect substitutes as loanable funds, and the central bank does not need to pay interest on reserves. The transmission mechanism is thus shown as follows;

Cost channel: Reserve Requirement ↑ Cost of deposit funding ↑ Deposit Rate↓ Deposits↓ Central Bank Funding ↑ Loan Rate (unchanged), Loans (unchanged).

However, if the central bank pays interest on bank reserves at market rates, the above channel would cease to hold because the increased cost of deposit funding would be offset by the higher interest payments on reserves. If bank reserves are fully remunerated, bank behaviour may still be affected by the reserves requirements through interest rate risk or liquidity channels (Alper, et. al., 2014).

II.3 Empirical Literature

Empirical findings on the efficacy of the CRR on bank lending behaviour differ. Okamoto (2011) used an autoregressive integrated moving average (ARIMA) model on data on the entire U.S. banking system covering the period 1971 to 2009. Two sets of regressions were considered; the first utilising lending volume as the dependent variable, and the second, interest rate as the dependent variable. The results of the first regression indicated that an

increase in the reserve requirement was associated with a decrease in lending volume, while the results from the second regression showed that an increase in the 30-year mortgage rate was associated with a decrease in bank credit.

There have also been studies on the effect of changes in regulatory capital requirements on bank lending in the UK. For instance, Bridges et. al., (2014) used panel regression and data from 1990 to 2011. The results showed that a 1.0 per cent increase in capital requirements leads to a reduction in loan growth by 2.0 per cent. Noss and Toffano (2014) using the vector autoregressive (VAR) methodology found that bank lending might be reduced by about 4.5 per cent when macro prudential capital requirements were increased by 1.0 per cent during an economic boom. Francis and Osborne (2009) estimated a long-run internal target risk-weighted capital ratio for each bank in the UK for the period 1996 to 2007. They found that banks with surpluses (deficits) of capital relative to the target tended to have higher (lower) growth in credit and other on- and off-balance sheet asset measures, and lower (higher) growth in regulatory capital and tier 1 capital. Specifically, a 1.0 per cent increase in capital requirements, reduces lending by 1.2 per cent.

Similarly, Aiyar, Calomiris and Wiedalek (2011) using UK data on bank-specific capital requirements from 1998 through 2007, applied a standard fixed effects panel data approach found evidence that regulatory capital requirements affects bank lending. Examining the interaction of monetary policy and capital requirement regulation, Aiyar, Calomiris and Wiedalek (2014) observed that when capital requirements were increased by 1.0 per cent, real lending reduced by 4.6 per cent and credit growth by about 6.5 - 7.2 per cent. The results further revealed that lending by large banks reacted significantly to changes in capital requirement but does not react to changes in monetary policy, while lending by small banks reacts to both. The conclusion of the study was that tightening of either capital requirements or monetary policy reduces the supply of lending.

Mesonnier and Monks (2014) used a monthly dataset of bank balance sheets to show the lending behaviour of euro area banks that were subjected to the European Banking Authority (EBA's) 2011/12 capital exercise which required large European banks to meet a higher Tier 1 capital ratio by end-June 2012. They found that banks that had to increase their capital by 1.0 per cent of risk-weighted assets tended to have annualised loan growth of between 1.2 and 1.6 percentage points, which was lower than that of banks in groups that did not have to increase their capital ratio. Furthermore, they also analyse the aggregate effects at the country level and discovered that banks that did not have to recapitalise did not substitute for more constrained lenders.

Cosimano and Hakura (2011) investigated the impact of the Basel III framework capital reserves requirements on bank lending rates and loan growth from 2001 to 2009. The estimates revealed that the high capital requirements resulted to higher lending rates. Specifically, an increase in equity-to-asset ratio of 1.3 per cent causes large banks to raise their lending rates by 16 basis points, and cause a decline in loan growth of about 1.3 per cent in the long-run. Furthermore, the response of banks' to the capital regulations vary considerably from one economy to another, depending on cross-country variations in the

tightness of capital constraints, banks' net cost of raising equity and the elasticity of loan demand with respect to changes in loan rates. Similarly, Brun, Fraisse and Thesmar (2015) investigating the French loan level data in their transition from Basel I to Basel II found that a 1.0 per cent decrease in capital requirement leads to a growth in loan of about 5.0 per cent. Furthermore, because the transition to Basel II resulted in an average reduction of 2.0 percentage points of capital requirements, the authors estimated that the new regulation led to an increase in the average loan size and aggregate corporate lending by 10.0 and 1.5 per cent, respectively.

Glocker and Towbin (2012) estimated a VAR model for the Brazilian economy and noted that discretionary increases in reserve requirements led to reduction in domestic credit, while very different effects were observed for other macroeconomic aggregates. The results further suggest that reserve requirements can complement interest rate policy in achieving financial stability, but cannot be its substitute with regards to ensuring price stability.

Tovar, Mercedes and Martin (2012) examined the role of reserve requirements and other macroprudential instruments on real private bank credit growth in five Latin American countries (Brazil, Chile, Colombia, Mexico and Peru). Using two complementary methodologies - an event analysis and a dynamic panel data vector autoregression (panel data VAR) and monthly data for the period 2004:M6—2011:M4. The empirical results showed that the instruments had moderate and transitory effects and were complementary monetary policy.

For Nigeria, Otu and Tule (2002) examined the effects of reserve requirement on the behaviour of banks to intermediate from the period 1992 to 2001. They employed a combination of basic accounting conventions, the multiplier approach to monetary management and regression analysis. The empirical results showed a positive relationship between private sector credit and reserve requirement, which contradicted apriori expectations. Specifically, a unit increase in CRR induces a 0.4 per cent increase in private sector credit. Olokoyo (2011) investigating the determinants of commercial bank lending applied an Error Correction Methodology (ECM) on the 89 commercial banks in the country from the period 1980 to 2005. As in the empirical results from the study by Otu and Tule (2002), the findings of the study were contrary to the general belief that increases in the CRR impact negatively on loans and advances as the regression coefficients showed that a 1.0 per cent increase in CRR causes a 0.12 per cent increase in bank lending.

III. Stylised Facts on Cash Reserve Requirements and Bank Lending In Nigeria

We present below the stylised facts on Cash Reserve Requirement (CRR) and bank lending behaviour in Nigeria:

III.1 Cash Reserves Requirements

Cash reserve requirement (CRR) is one of the monetary management tools used by the CBN to achieve the objectives of price and exchange rate stability as well as financial

system stability. CRR is complemented with other market-based instruments such as open market operations (OMO) and the discount widow to influence money multiplier, money supply and liquidity conditions. The essence is to ensure optimal liquidity that is consistent with the absorptive capacity of the economy in order to have non-inflationary growth that can guarantee price stability or higher output growth.

The adjustment of CRR by the CBN is usually underpinned by the prevailing economic conditions to be tackled. Some of the issues which CRR has been used to address are liquidity conditions in the banking system, inflationary pressure, credit conditions, and the state of the real sector, etc. The CRR for the banks is usually determined by the CBN through Monetary Policy Committee (MPC), which is responsible for monetary policy decisions. The prescribed reserves requirements usually vary with the monetary conditions. If there is excess liquidity in the system, the CRR may be reviewed upward and if there is liquidity shortage, it may be reviewed downward to release more liquidity into the economy. For instance, the MPC at its last meeting in September 2015 reduced the CRR to 25.0 per cent from 30.0 per cent, owing to the tight liquidity conditions caused by reduced foreign exchange inflow from crude oil export and the implementation of Treasury Single Account (TSA).

Reserves requirements have assisted the CBN to ensure a vibrant and efficient financial market by controlling the supply of reserves to the deposit money banks. By so doing, it helps to moderate and stabilise interest rates in the money market. This means that the cost of funds in the banking system is also influenced by variations in the cash reserve requirement. The examination of the CRR for private sector funds (PRSF) from Figure 1 indicates that the CRR exhibited three major patterns. The first period: January 2006–March 2009 showed that the CRR ranged from 5.0 per cent in 2006 to 2.0 per cent in March 2009. This episode coincided with the first four years of post-banking consolidation, which was characterised by excess liquidity. The second episode (April 2009–February 2011) coincided with the period of the banking crisis of 2009, when some Nigerian banks were overexposed to risk and had a lot of non-performing loans. Thus, throughout that period the CRR was kept at 1.0 per cent. The last episode (March 2011–August 2015) witnessed a progressive increase in the CRR from 2.0 per cent in March 2011 to 31.0 per cent as at August 2015, reflecting a tight monetary policy stance to curb excess liquidity challenges and ensure macroeconomic stability as well as financial systems stability.

Figure 2 shows the relationship between the CRR and bank lending from January 2006 and July 2015. It can be observed that the movement of CRR and bank lending has been both inverse (based on *a priori* expectations) and direct (contrary to expectation). From January 2007 to December 2010, the CRR and commercial bank lending showed the expected inverse relationship, as bank lending to private sector went up when the CRR was going down. This period coincided with the global financial crisis (GFC) when there was an urgent need to stimulate investments and boost growth. However, afterwards bank lending increased in spite of increase in the CRR. This suggests that other factors besides the CRR may have been responsible for increased lending to the private sector, thus necessitating empirical enquiry.

Figure 1: Trends in Cash Reserve Ratio (Private Sector Funds) (Jan. 2006- Jul. 2015)

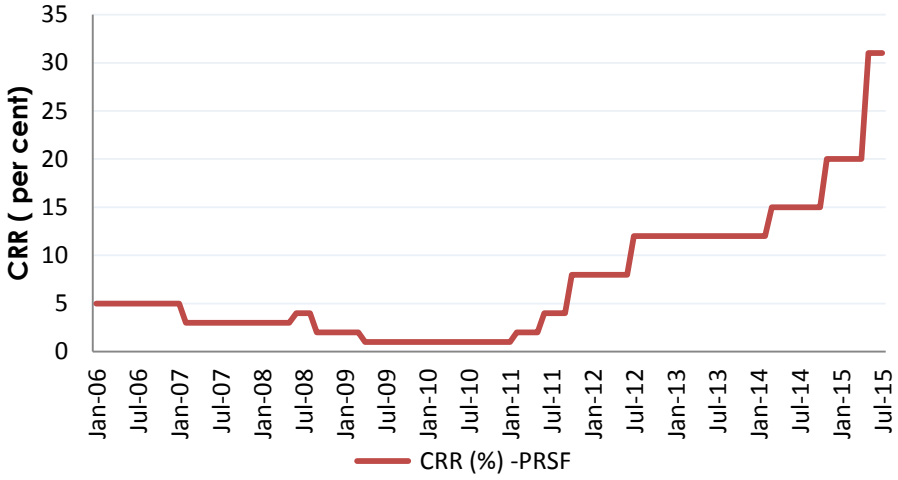


Figure 2: Trends in Private Sector Cash Reserve Ratio and Commercial Banks' Lending to Private Sector (Jan. 2006 -Jul. 2015)

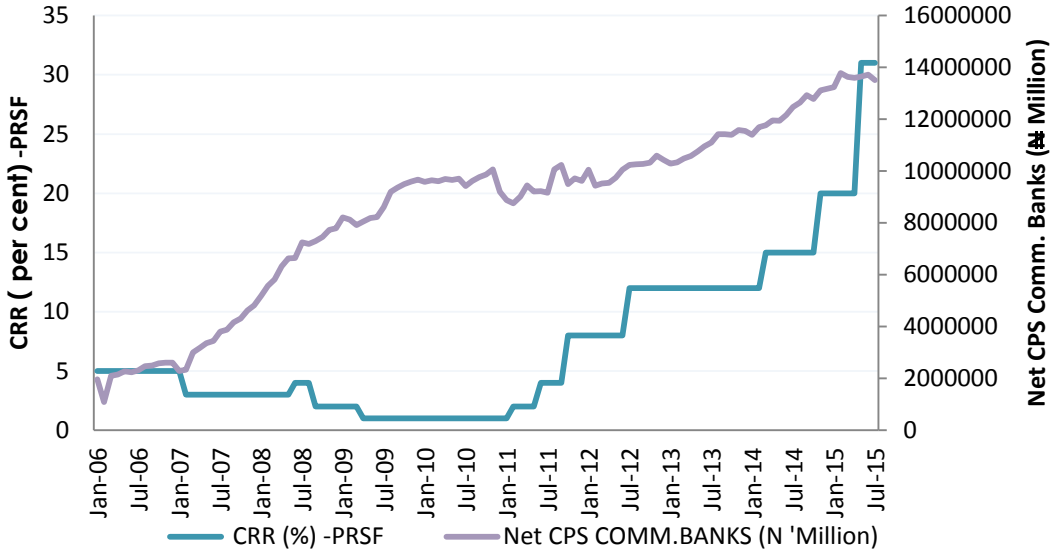
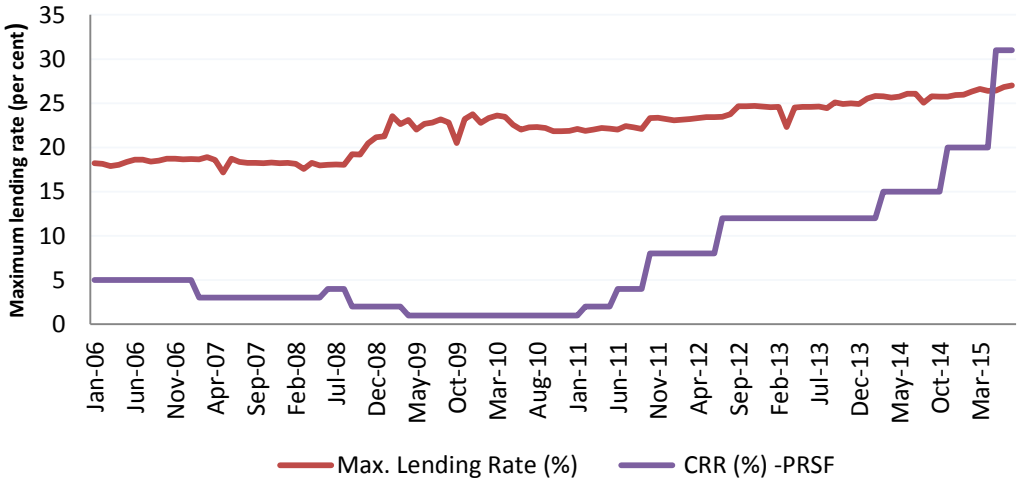


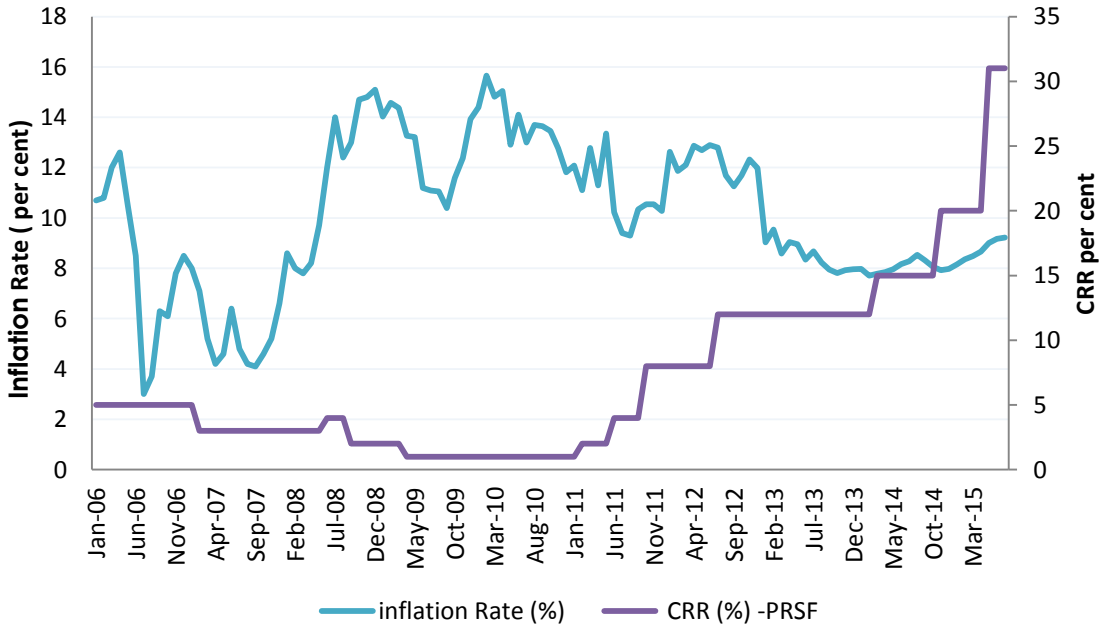
Figure 3 shows trends in the CRR and lending rate. Theoretically, an increase in the CRR is expected to lead to an upward pressure in interest rate, while a decrease in the CRR leads to a downward trend in lending rates because increase in banking sector liquidity would push down interest rate. These theoretical expectations were met between January 2006 and May 2008, and January 2012 and May 2015. But the trend between September 2008 and 2011 did not reflect the expectations. This was attributed to the effect of the post-global financial crisis era when the CRR was flat at 1.0 per cent to make the banks recover from the crisis, as well as forestall financial crisis arising from banks' insolvency and illiquidity.

Figure 3: Trends in Cash Reserve Ratio and Maximum Commercial Banks' Lending Rate (Jan. 2006-Jul. 2015)



A monetary tightening (increase in CRR) measure is expected to reduce liquidity and thereby, leading to a lower inflation rate. Figure 4 indicates that this expectation has been largely realised suggesting that the CRR adjustments also play a key role in the movement of inflation rate in Nigeria.

Figure 4: Trends in Cash Reserve Ratio and Inflation Rate (Jan. 2006 - Jul. 2015)



III.2 Evolution of Bank Lending in Nigeria

Lending is one of the functions performed by banks in Nigeria to stimulate economic growth, provide employment opportunities and reduce poverty. Prior to the SAP in 1986,

banks' lending behaviour was strictly regulated by the CBN on behalf of the Government. For instance, in 1982, there was a directive that the aggregate credit expansion be maintained between 30.0 and 40.0 per cent. Thus, the Banks were not allowed to expand loans and advances by more than 30.0 per cent while banks with loans and advances below ₦100.0 million at the end of December, 1981 may expand credit up to 40.0 percent (CBN, 1982). It was also customary for banks to lend to "Preferred Sectors" based on policy guidelines. In 1982, allocation to construction sector was raised from 10.0 percent in 1981 to 13.0 per cent. Also, allocation to the productive sector was increased from 56.0 per cent in 1981 to 59.0 per cent in 1982.

Banks' lending habit in the pre-SAP era was also influenced by the dichotomy between indigenous and foreign borrowings. Thus, banks were encouraged to grant more loans to nationals than foreigners to allow them to acquire shares in nationalised industries. From 1986, the banking sector was deregulated and banks were free to grant credit to their customers subject to meeting regulatory requirements. Since then the issue of lending to preferred sectors was abolished. Bank lending, therefore, became market driven. In recent times due to the challenges posed to the financial sector by the global financial crisis of 2007/2008 and post GFC policies, bank lending exposure to certain sectors were restricted globally. The Nigerian banking sector followed the trend and restricted banks' exposure to capital market and oil and gas sub-sectors among others.

Despite the deregulation of the banking sector, the CBN continues to influence bank lending behaviour in Nigeria through its various intervention programmes. The CBN in pursuance of its developmental objectives which are targeted at ensuring higher economic growth, increased welfare, employment generation and wealth creation has established various intervention schemes to encourage banks to lend to specified sectors such as power, small and medium enterprises (SMEs), aviation, and agriculture sectors among others. Some of the schemes include the well-known Agricultural Credit Guarantee Scheme (ACGS), Micro, Small and Medium Enterprises Development Fund (MSMEDF), SME Fund, Power and Aviation Fund. Banks' lending under the ACGS Fund for example has been guaranteed by the CBN on behalf of the Federal Government. In addition, interest rates charged by the banks are lower in all the schemes compared with the market interest rate. This has, however, led to apathy by many banks in fully taking up the funds for onward lending to the target beneficiaries, and points to the myriad of factors that may account for bank lending behaviour in Nigeria.

IV. Methodology

IV.1 Analytical Framework

In evaluating the impact of CRR adjustment on lending behaviour in Nigeria, we adapt a VAR model as proposed by Sims (1980) to underline the channels of transmission of reserve requirement impulses on bank lending behaviour in Nigeria. The choice of this technique is based on the fact that VAR model helps to sought out the contemporaneous effects of a policy change on other variables and also good for forecasting. The VAR methodology remains the major workhorse for estimating the effects of monetary and macro prudential

policy transmission mechanism on macroeconomic and financial variables (Bernanke and Blinder, 1988).
The VAR representation is specified as:

$$Y_t = aY_{t-1} + bX_t + v_t \quad (1)$$

Where Y_t is the vector of endogenous variables, X_t is the vector of exogenous variables and v_t is the residual vector. In addition, ***a*** is a matrix that includes all the coefficients describing the relationships among the endogenous variables, and ***b*** is a matrix that includes all the coefficients describing the relationships among the endogenous and exogenous variables.

Transforming equation (1) into a typical reduced-form VAR as proposed by Sims (1980) in a system of equations yields equation 2 below as:

$$Y_t = A(L)Y_{t-1} + \varepsilon_t \quad (2)$$

Where Y_t is the column vector of observations at time (t) on all variables and is known as the vector of endogenous variables. $A(L)$ is the matrix of coefficients to be estimated and the symbol ε_t represents the column vector of random disturbances values called innovations that may be contemporaneously correlated with each other and assumed to be non-autocorrelated over time.

Furthermore, equation (2) can be re-specified as:

$$Y_t = A_1Y_{t-1} + A_2Y_{t-2} + A_3Y_{t-3} + \cdots + A_kY_{t-p} + \varepsilon_t \quad (3)$$

Where each variable is regressed on its own lags, and the lags of the other variables in the model. This provides a better insight into the dynamics of the system which allows for a feedback among the endogenous variables in the model. Thus, this study applies this framework to examine the phenomenon of interest.

IV.2 The Basic Model Structure

As identified in the literature, there are two channels in which CRR adjustments affect lending behaviour. These are the interest rate and liquidity channels. To track and examine the transmission mechanism for each of the two channels the impulses of CRR adjustment is transmitted to the banking sector, equation 3 is transformed into two structural forms (equations 4 and 5) in a recursive pattern. The specification of the structure is to enhance the understanding of the transmission process and not for the application of structural VAR method. Equation 4 is the interest rate risk channel, while equation 5 is the liquidity channel through which CRR adjustment can influence lending behaviour. The theoretical linkages have been explained adequately in the literature. Nonetheless, the application of VAR is to help forecast the impact of CRR adjustment on bank lending behaviour. Furthermore,

the study assumes that credit to government does not respond to the changes in CRR, hence it was omitted in the specification.

IV.2.1 Interest Rate Risk Channel

The interest rate channel assumes that adjustment in CRR has implications on the opportunity cost of fund proxied by Treasury bill rate, savings/deposit rate, lending rate and credits to the private sector.

The modified model is represented below as:

$$\begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 & 0 \\ a_{41} & a_{42} & a_{43} & 1 & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & 1 \end{pmatrix} \begin{pmatrix} \mathrm{CRR} \\ TBR \\ \mathrm{DR} \\ PLR \\ CPS \end{pmatrix} = \mathrm{V(L)} \begin{pmatrix} CRR \\ TBR \\ DR \\ PLR \\ CPS \end{pmatrix} + \begin{pmatrix} \varepsilon\mathrm{crr} \\ \varepsilon_{Tbr} \\ \varepsilon_{DR} \\ \varepsilon_{PLR} \\ \varepsilon_{CPS} \end{pmatrix} \quad (4)$$

Where:

CRR – Cash Reserves Requirements
TBR – Treasury Bills Rate
DR – Deposit Rate
PLR – Prime Lending Rate
CPS – Credit to the Private Sector

IV.2.2 Liquidity Related Channel

The liquidity effect of CRR adjustment on lending behaviour affects the liquidity condition, savings rate, lending and overall credit to the private sector. For instance, a downward CRR adjustment would increase liquidity condition of banks, which lowers interest rate and increase lending to the private sector.

The modified model based on this channel is represented below as:

$$\begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 & 0 \\ a_{41} & a_{42} & a_{43} & 1 & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & 1 \end{pmatrix} \begin{pmatrix} \mathrm{CRR} \\ LR \\ \mathrm{DR} \\ PLR \\ CPS \end{pmatrix} = \mathrm{V(L)} \begin{pmatrix} CRR \\ LR \\ DR \\ PLR \\ CPS \end{pmatrix} + \begin{pmatrix} \varepsilon\mathrm{crr} \\ \varepsilon_{LR} \\ \varepsilon_{DR} \\ \varepsilon_{PLR} \\ \varepsilon_{CPS} \end{pmatrix} \quad (5)$$

IV.3 Estimation Technique and Procedure

In evaluating the transmission channel and impact of CRR adjustment on the selected variables, we conduct our analysis in two stages. First, we estimated the VAR model and derived the impulse response function and variance decompositions. Second, we carried

out in-sample and out-sample forecasts as well as simulation of key policy variables. The idea is to determine the response of some monetary policy rates particularly lending rate to changes in CRR.

To ensure that the variables are devoid of measurement error, the data were transformed to keep them in the same magnitude. The data were also subjected to diagnostic checks such as the unit root test to ensure that the inferences drawn from the results are not misleading, as well as the VAR stability and lag length selection criteria to determine the appropriate lag for the VAR equations.

IV.4 Description and Sources of Data

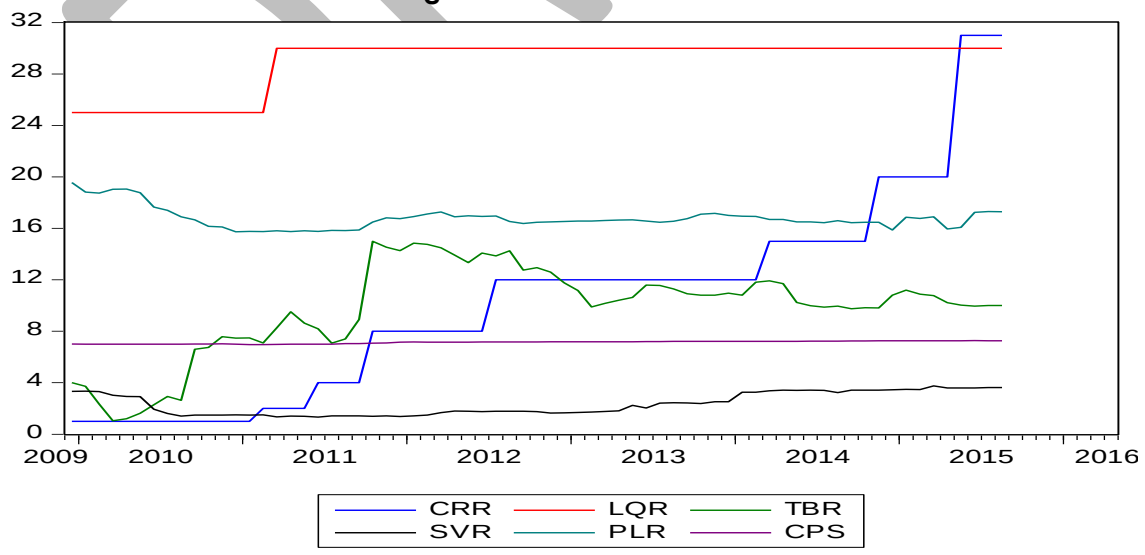
Data for this study includes cash reserve requirement, liquidity, savings rate, treasury bill rate, lending rate and credit to private sector. They were obtained from the Central Bank of Nigeria statistical database. Monthly data of the variables spanning 2009:12 to 2015:08 were used in the estimation of the models. Specifically, the lending rate is used in the equation as the loan rate, while the treasury bill rate is used to capture the opportunity cost of keeping CRR. On the other hand, credit to the private sector measures the value of loans administered to the private sector.

V. Empirical Analysis

V.1 Diagnostic Tests Results

The graphical plot which shows the trend and pattern of all the variables is shown in figure 1. Again, Table 4.1 indicates that all the variables are stationary in their first difference at 5.0 per cent level of significance, since the critical value for both the statistics (Augmented Dickey-Fuller and the Phillips-Peron) tests applied to evaluate the stochastic behaviour of the model.

Figure 4.1 Plot of Variables



In other words, this indicates that the variables are integrated of the same order (1). The optimal lag lengths were determine based on the HQ and SIC criteria. The lag selection criteria tests indicate that lag one is the appropriate lag for the models based on chosen criteria. In addition, root mean stability test was conducted to determine the appropriateness of the models. These tests confirmed the stability of the model and justify the choice of the model to forecast the future path of the endogenous variables in the equations. The results of the stability test are presented in the appendix.

Table 4.1: Unit Root Test Statistics

	ADF test statistics	Critical value	Phillips-Perron test statistics	Critical value
CRR	-8.6232	-3.4708	-8.6232	-3.4708
TBR	-7.1746	-3.4783	-7.1126	-3.4783
LQR	-8.2586	-3.4783	-8.2606	-3.4783
SVR	-8.1066	-3.4783	-8.1462	-3.4783
PLR	-8.0236	-3.4783	-8.0240	-3.4783
CPS	-6.3387	-3.4783	-6.3236	-3.4783

All variables are stationary after the first difference implying that the variables are integrated of order 1.

V.2 Analysis of Results

V.2.1 Results of Impulse Response function of key variables and Variance Decomposition

The results of the impulse response function and forecast error variance decomposition are presented in Figure 4.2 and 4.3, respectively. It indicated that the responses of the variables to CRR shock were consistent with theory. Specifically, a one standard deviation shock to the innovation in CRR would bring about an increase in the variables. Figure 4.2 shows the responses of Treasury bill rate, saving rate, lending rate and credit to the private sector to a one-standard deviation error shock in cash reserve requirement. From the interest rate risk channel, it is evident that in response to a positive innovation in CRR, the opportunity cost of fund would positively increase in the first month but decline in the second month and then decays off in the fourth month.

Thus, an increase in CRR makes the opportunity cost of investing in alternative assets very high in the immediate period but quickly fizzles out. Similarly, an innovation shock in CRR produces a correspondent impact on lending rate. This result is intuitive as it is consistent with economic theory. In other words, tightening CRR increases the lending rate as the cost of credit is priced higher, while credit availability reduces. However, the impact on credit to the private sector is counter-intuitive even though the impact of CRR is very small over the period. This may be as a result of the inertias in the economy indicating that there are other reasons why deposit money banks do not lend to their customers even with a loosed CRR.

Figure 4.2 Response of TBR, PLR and CPS to shock in CRR (Interest Rate Risk)

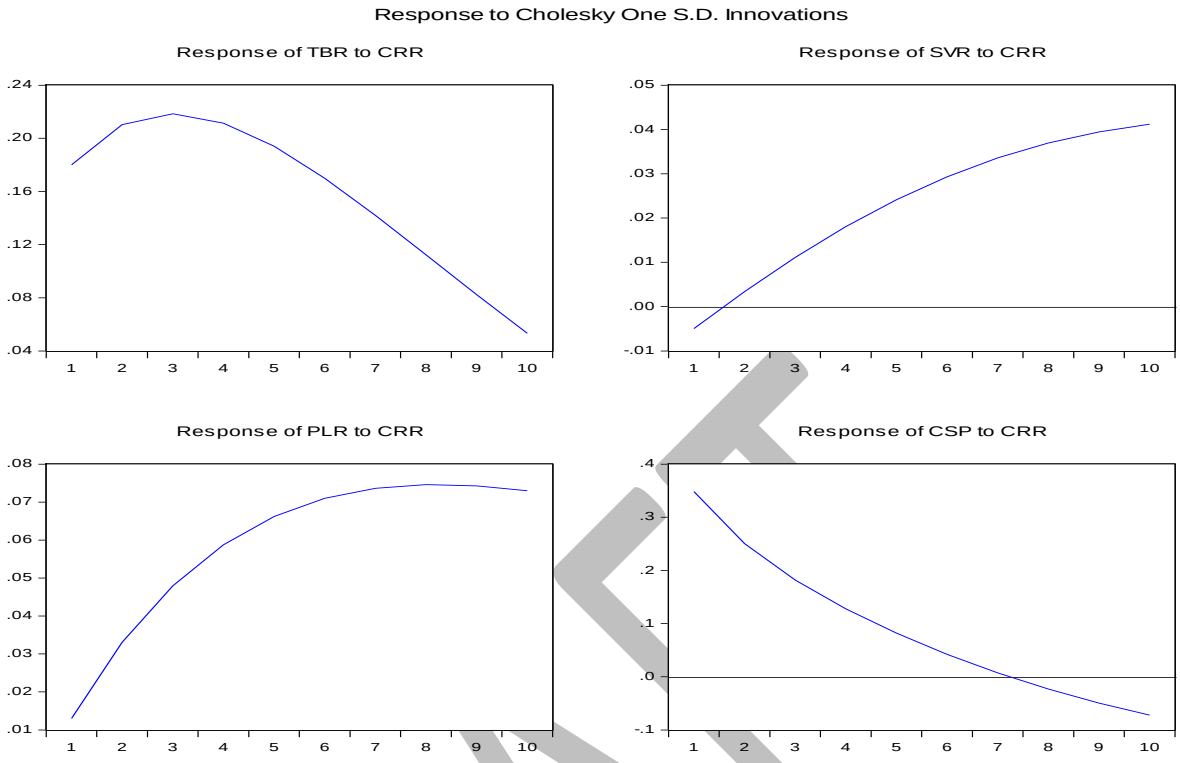


Figure 4.3 Response of LQR, PLR and CPS to shock in CRR (Liquidity Channel)

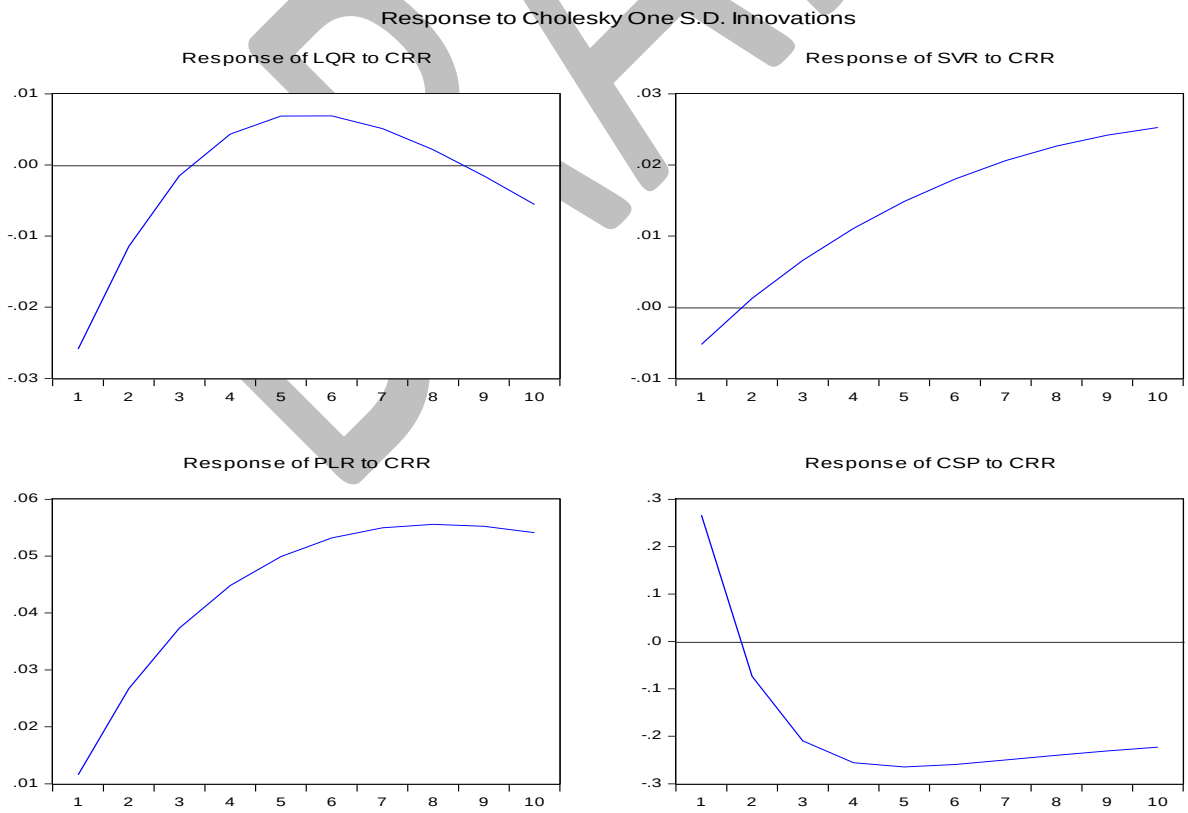


Figure 4.3 plots the responses of liquidity, deposit and lending rates and credit to the private sector to a one standard deviation shocks to the cash reserve ratio (CRR). The IRFs validate the potency of the instrument in freeing credit to the economy. A one standard deviation shock to CRR decreases liquidity. The magnitude of response increased progressively until the 10th month period. The decline in liquidity also caused deposit rate and prime lending rate to rise correspondingly to the 10th month period as they did not die off throughout the horizon. In the same vein, one standard deviation shock to CRR decreases the credit to the private sector precipitously before dying off in the third month and negatively downward throughout the 10th month horizon. Intuitively, a reduction in the CRR would produce similar opposite effect on lending behaviour of Banks in Nigeria. This justifies the use of the instrument as a tightening measure even though the magnitude of the impact is relative.

V.2.2 Forecast Error Variance Decomposition

The variance decomposition helps to identify the share of variation in each of the endogenous variables due to shocks on the control variable. The result of the interest rate risk channel shows that the shocks to CRR do not have significant impact on credits to the private sector except Treasury bill rate and lending rate. This supports the results of the impulse response function. On the other channel, the result showed that variation in CRR is influenced significantly by its own perturbation and saving rate in the first month. By the fourth month, the influence of credit to private sector would have increased marginally which also reduces the influence of CRR own shock. The implication of this result is that adjustment in CRR has more impact through the liquidity channel than the interest rate channel in Nigeria. Therefore, the CRR is a potent tool for managing liquidity and the likelihood of influencing bank lending behaviour in Nigeria. This is in consonance with the observed trend under the stylised facts. However, the marginal effect of the CRR on bank lending is an indication that lending considerations are not based purely on CRR adjustments. Other factors that influenced banking lending behaviour in Nigeria include the structure of the economy, return on investment and alternative investment opportunities and repayment profile of the bank customer.

V.3 Policy Simulation Analysis

We conducted simulation analysis on the channels based on the selected variables. The results are presented in Table 4.2 and 4.3. The simulation was based on the baseline and 2 scenarios each ie if CRR remain unchanged and if the authority reduces it to 25.0 and 20.0 per cent, what would be the impacts on other key variables. The evidences provided by the simulation and forecast results are very striking in both channels of the transmission of impulses through the CRR adjustments. Our findings showed that under the interest rate risk channel, if the policy variables CRR remained unchanged at 31.0 per cent over the forecast period, key rates such as the treasury bill rate, would increase from its current rate of 10.0 to 10.3 per cent by end-December 2015, while the lending rate will increase slightly to 17.7 per cent from the current 17.29 per cent.

However, credits to the private sector would increase from its current level to 3.6 per cent by end-December 2015. Similarly, a reduction in CRR to 25.0 per cent would cause lending rate to decline slightly to reach 17.4 per cent by the end of December 2015, while credit to private sector will hover around 3.0 per cent lower than the level if CRR had been unchanged. Intuitively, this reduction would reduce the price of bond slightly in the immediate to near term period as the decrease in CRR would leave banks with more funds to invest in the bond market as well as extend credits to the private sector. A further reduction in CRR to 20.0 per cent would reduce the price of bond and reduce the lending rate without significant impact on the credits to the private sector. Thus, it is evident that the result of the interest rate risk channel is counter-intuitive indicating that there are other factors that influence the behaviour of deposit money banks such as the profit motive relative to their risk profiles.

Scenario Analysis

On the liquidity channel, the policy simulation result is also counter-intuitive as the impact of CRR adjustment on credit to the private sector is significantly weak. Evidently, if CRR remained unchanged or adjusted by 25.0 or 20.0 per cent, the impact on credit to the private sector is small. However, there is modest reduction in lending rate due to the downward adjustment on CRR from 31 to 25.0 and 20.0 per cent. The result indicates that a reduction of CRR to 25.0 and 20.0 per cent would keep the lending rate around 17.4 and 17.2 per cent, respectively. Nonetheless, credit to the private sector is estimated around 2.31 if CRR is adjusted to 25 per cent but would increase slightly to 2.9 per cent by end December, 2015 if CRR is reduced further to 20 per cent over the same period.

The general implication of this result is that CRR adjustments have little or no impact on lending behaviour in Nigeria. Given the oligopolistic nature of our banks, the incentive to lend would be to reduce the other incentives such as the irrational gains in the bond and foreign exchange market that the banks play active role in. Again, the risk sharing project should be consolidated to reduce the risk that banks are exposed to. The intuition here is that the monetary authority would need to assess the operational modalities of banks and determine why it is difficult for them to lend to the private sector to spur growth.

Table 4.2: Baseline and Scenario Analysis of the Interest Rate Risk Channel

	Baseline (31%)			Reduce CRR to 25%			Reduce CRR to 20%		
	TBR	PLR	CPS	TBR	PLR	CPS	TBR	PLR	CPS
2015M09	10.15	17.40	3.46	9.87	17.32	3.05	9.64	17.26	2.71
2015M10	10.26	17.50	3.67	9.76	17.35	3.10	9.35	17.23	2.63
2915M11	10.31	17.58	3.67	9.66	17.37	3.07	9.12	17.20	2.57
2015M12	10.31	17.65	3.57	9.56	17.39	3.00	8.94	17.18	2.52
2016M01	10.28	17.71	3.44	9.48	17.41	2.92	8.88	17.17	2.49
2016M02	10.21	17.76	3.29	9.39	17.43	2.85	8.71	17.16	2.48
2016M03	10.13	17.80	3.15	9.32	17.44	2.78	8.64	17.15	2.27
2016M04	10.04	17.84	3.00	9.25	17.46	2.71	8.59	17.14	2.47

Table 4.3: Baseline and Scenario Analysis of the Liquidity Channel

	Baseline (31%)			Reduce CRR to 25%			Reduce CRR to 20%		
	LQR	PLR	CPS	LQR	PLR	CPS	LQR	PLR	CPS
2015M09	29.95	17.37	2.39	29.91	17.31	2.76	29.88	17.26	3.07
2015M10	29.88	17.44	2.08	29.83	17.33	2.63	29.78	17.23	3.09
2015M11	29.81	17.49	1.82	29.75	17.34	2.47	29.69	17.21	3.02
2015M12	29.74	17.54	1.59	29.68	17.35	2.31	29.63	17.19	2.92
2016M01	29.66	17.58	1.37	29.61	17.35	2.16	29.57	17.17	2.82
2016M02	29.59	17.61	1.17	29.55	17.36	2.02	29.53	17.15	2.74
2016M03	29.52	17.64	0.98	29.50	17.36	1.90	29.49	17.13	2.67
2016M04	29.45	17.66	0.80	29.46	17.36	1.79	29.46	17.12	2.62

VI. Summary and Conclusion

The study has examined the relationship between the CRR adjustments and banks' lending behaviour in Nigeria and found that there is a marginal effect on lending behaviour both from the anecdotal evidence and empirical analysis. The results of the study also showed that the CRR adjustments are more effective in controlling liquidity than lending. This may be explained by the fact that banks' lending is not strictly based on CRR adjustments in Nigeria. Other factors taken into consideration include profit motive, risk profile of the customers, prevailing economic situations, returns on other investment alternatives, etc.

The outcome of this study validates previous studies such as Otu and Tule (2002) and Okamoto (2011) which revealed that CRR is more effective in managing liquidity conditions and more of a macro prudential tool for ensuring a sound financial system.

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