

# IMPACT OF FINANCIAL SECTOR REFORMS ON AGRICULTURAL GROWTH IN NIGERIA: A VECTOR AUTOREGRESSIVE (VAR) APPROACH

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## Abstract:

*The study assessed the impact of financial sector reforms on agricultural growth in Nigeria. Secondary data were collected from Central Bank of Nigeria covering the period from 1970-2009 and analyzed using long-term time-series techniques and the vector error correction model (VECM) approach. The result revealed that financial sector reforms (LNFSRGDP) in the baseline and sensitivity model (LNPSC) significantly impact on agricultural growth both in the long and short-run. However, the impact of financial sector reforms shock (proxied by LNPSC) on agricultural output growth was lower by 0.60 percent when compared with 78.85 percent (proxy by LNFSRGDP) in the baseline model. This implied that financial sector reforms play a significant role in the growth of the agricultural sector by increasing its production level and independently generate positive investments in the sector than in the sensitivity result. It is therefore recommended that government should adopt strong macroeconomic policies targeted to kick-start meaningful growth in the agricultural and financial sectors as well as provide the enabling environment for farming as a business through concessionary interest rates, tax free and import duty concessions. These financial and fiscal incentives when provided would encourage further output growth in the agricultural sector of the country.*

**Key Words:** Agricultural Growth. Financial Sector Reforms. Vector Autoregressive Approach.

## Introduction

The issue of financial sector reforms has taken the center stage in the world's economy. Both developed and developing countries have tried to bring about reforms in their financial sectors in order to impact on the growth of either the entire economy or a sub-sector of the economy such as agriculture. Financial sector reforms constitute that aspect of economic reforms which focuses mainly on restructuring the financial institutions (regulators and operators) via institutional and policy reforms (Balogun, 2007). It has also been described as deliberate measures and policies made by the relevant authorities to bring the needed changes in the financial institutions over a period of time (Akpaeti, 2012). These changes are expected to ultimately result in economic growth. Economic growth is defined in economic literature as the incremental outcome of

productive activities, which can be assessed by observing the behavior of real Gross Domestic Product (GDP) or Gross National Product (GNP) per capita, year by year (Eyo, 2005).

The financial system has been acknowledged to play an important role in economic growth and development. Several theoretical and empirical studies at the international, national and provincial levels demonstrate that the financial sector could be a catalyst of economic growth if it is developed and healthy (Chen & Feng, 2000; Chow & Li, 2002, Daramola, 2004; Akpaeti, Bassey, & Ibok, 2014). Marjit (2004) opines that economic growth is significantly related to growth in agriculture. This confirmed the works of Johnston and Mellor (1961), who stated that agriculture has important linkages and interrelate with the rest of the economy. This interaction is highly vulnerable to changes in other sector especially macroeconomic policies not specially targeted at agriculture (Oyejide, 1986). World Bank (1989) also reported that in most other developing countries where agriculture is a large sector of the economy, no other sector of the economy is large enough to serve as an engine of economic growth in the next decade. This is because a large proportion of the Gross Domestic Product (GDP) comes from the agricultural sector.

In Sub-Saharan Africa (SSA), the international recessions, debt crises and political instability adversely affected savings and investment ratio in the region. This was occasioned by a decline in the domestic resource mobilization and narrow tax base, which further depressed investment and economic growth (Kasekende & Atingi-Ego, 2003). The unfavourable conditions in SSA relating to the deterioration in economic performance alongside financial repression in the 1970s gave rise to the adoption of structural adjustment programme under the auspices of the Washington Consensus (World Bank, 2007).

In Nigeria, before the comprehensive financial sector reforms of 1987, the process of industrialization and agricultural modernization that was needed to move the country into an enviable position of development by the existing financial institutions was not good enough to help the process. This was because of certain limiting factors such as foreign owned financial institutions, poor access and insufficient loan facilities by local farmers and entrepreneurs due to high interest rates, reluctance of granting long-term funds to farmers by creditors because of the

risky nature of the agricultural sector; as well as investing in new and unfamiliar technologies. (Ikhide, 1996 & Akpaeti, 2013). These situations coupled with repression in the financial sector occasioned by excruciating external debt burden, falling terms of trade in the international market, slow growth of output, high rate of unemployment posed serious concern to the government who needed to channel cheap credit towards the sectors in the economy that were believed to be at the forefront of development by the Central Bank of Nigeria. These scenarios caused a shift in the economic development paradigm from government-led development (public driven economy) to private sector-led development (Adegbite, 2005). Thus, were compelled to use the financial sector to finance investment projects for the purposes of allocating resources to projects with high social returns, distribution of incomes and to revamp high economic growth. This resulted to financial sector reforms as a subset of the Structural Adjustment Programme in August, 1987 with interest rates being deregulated (Ikhide, 1996; Akpaeti, 2013).

Elements that constitute the financial sector reforms were monetary policy reforms, foreign exchange reforms, financial structure reforms, capital market reforms, liberalization of capital movement reforms, and banking reforms (recapitalization and consolidation). The key objective of the financial sector reforms was to create strong financial institutions that would take advantage of the benefits of increase in size, improve the efficiency and raise the diversity of the financial system of the economy. This objective was to be attained through financial liberalization, which could be viewed as the process of moving towards market determined interest rates, as well as market-determined prices on all classes of financial products, a banking system characterized by symmetric entry and exit conditions to all participants, increasing internationalization or the opening up of domestic markets to international competition, and limited barrier to the introduction of new products. The major policy variables adopted during this period were interest rate and exchange rate (CBN, 2009).

In spite of several reform measures such as deregulation of interest rates, removal of sectoral credit allocation, exchange rate, establishment of the Nigeria Deposit Insurance Cooperation (NDIC) and introduction of monetary policy instruments (2005) in the financial system, there is still a knowledge gap regarding financial sector reforms and agricultural growth because research effort in this regard have been minimal, when compared to efforts the other components of the

economic reforms such as trade liberalization and exchange rate reforms. Even where research is available, emphasis has tended to be placed on the institutional aspects of the reform that is banking sub-sector (Soyibo & Adekanye, 1992; Ojo, 1993; Ikhide & Alawode, 1994; Balogun, 2007). Mentions are only on the potential effects of the reforms on agriculture with no empirical evidence with efforts geared towards the investigation of current account and government deficits as well as their implication for saving and growth imbalances. Apart from this, many similar studies have failed to or not sufficiently document empirically the effect of reforms on agricultural growth. This paper attempts to fill in this gap.

Using long-term time-series data and the vector autoregressive (VAR) method of analysis, this study attempts to empirically examine the effect of financial sector reforms on the long-term agricultural growth in Nigeria. In addition to the stated objectives, it builds on the existing literature in two important ways. First, financial sector GDP or RGDP (value added) is used as a measure of financial sector reforms. This is a major departure from the commonly used bank related measures such as: monetary aggregates like M2, liquid liabilities of the financial system, or bank credit to the private sector which are regarded as poor indicators of financial sector reforms (Levine, Loayza & Beck, 2000; Arestis & Luintel, 2001; Liang & Teng, 2006) as compared to financial sector Gross Domestic Product (GDP) or Real Gross Domestic Product (RGDP) which is by far a better indicator of financial sector reforms (Watchel, 2000; Ghirmay, 2009) in a number of ways; one of which is that, it represents a broader measure of financial reforms. Consequently, unlike the other measures, it does not underestimate the level of financial sector in Nigeria's economy, where significant financial development, Investment, Productivity and economic growth or innovation occurs in the real sector. Second, it uses a Granger causality testing procedure to conduct causality analysis. It is against this backdrop that it becomes necessary to assess the impact of financial sector reforms on agricultural growth in Nigeria. The specific objective is to examine the effect of financial sector reforms on agricultural output growth in Nigeria.

## **Literature Review**

The importance of the financial system to economic development is not a clear-cut issue. Researchers like Robinson (1952) are of the view that economic development creates demand for certain financial instruments while others like Hicks (1969) holds a contrary view and argues that the financial system plays a crucial role in the mobilization of capital for industrialization. Thus, the financial system only responds to the demand created as a result of economic development. It is however known that countries with better developed financial systems, that is financial markets and institutions with most effective way of channeling society's savings to its most productive use, tend to experience faster economic growth compared to those with less developed financial systems (Beck, Levine, & Loayza, 2000). This is because financial sector development helps economic growth through more efficient resource allocation and productivity growth rather than through the scale of investment or saving mobilization. In addition, the availability of finance helps to foster economic development by widening access to external finance and helping those industries and firms to rely mostly on financial resources (Demirguc-Kunt & Maksimovic, 1998; Rajan & Zingales, 1995). It also helps to improve resource allocation and increases the efficiency with which investment funds are reallocated across industries as demand changes. Financial development also plays an important role in dampening the impact of external shocks on the domestic economy.

Haslag and Koo (1999) opined that financial repression and economic growth are related. There is also a relationship between growth and gross real return on household assets. Assuming an economy where household preferences exhibit a constant elasticity of inter-temporal substitution, the rate of per-capita output growth is positively related to the gross real return on a household's assets. As such the argument focuses on the negative effect of repression on the growth rate of per-capita output. Aizenman (2005) opines that the clamour for developing countries to embark on capital and financial market liberalization is born out of the desire to achieve economic growth.

According to Asamoah (2008), the financial sector reforms can affect economic growth by altering the saving rates. In this case, the sign of the relationship is not obvious, because financial sector development may also reduce savings and thereby growth. It is observed that the real rate of interest exerts a positive influence on the ratio of savings to the Gross National

Product (GNP) while the main function of the financial markets is to channel funds from savers to investors. Households and firms save their money in banks for the future. These banks lend those funds to investors. However, savers consider the interest rate or what they will gain from saving their money in the bank before they make a decision to save. Lower interest rate discourages savers and hence reduces funds available for investors. On the contrary, if there are many financial institutions competing for savings, the interest rate will be high for savings, savers will save more, making more capital available for investors.

Several theoretical perspectives and early studies of Schumpeter (1911), McKinnon (1973), Shaw (1973), Pagano (1993), Greenwood and Jovanovic (1990) and Arestis and Demetriades (1997) among others, show the relationship between financial sector and economic growth, although there is no consensus over the direction of causality. Various aspects of this relationship have been analyzed extensively in both theoretical and empirical studies for a single country, cross-nations, industry and firms level through cross-sectional, time-series and dynamic panel techniques. Goldsmith (1969) documented a positive correlation between economic and financial development in a sample of 35 countries and attributed the problems in the field of finance to the effect that financial structure and development have on economic growth. Quite a number of empirical studies have been carried out to examine the effect of financial reforms on economic growth. The results confirm that there is a positive correlation between the two. However, Caprio and Kliengebiel (1995) reported that many banking systems witnessed problems subsequent to liberalization. For instance, Chile experienced some banking problems right after the financial sector was regulated. Thus, empirical works of King and Levine (1993) and Levine, Loayza and Beck, (2000) find a positive effect of financial development on economic growth. On the other hand, literature in financial sector points to a destabilizing effect of financial liberalization. Only in South Korea was financial reform adjudged to be a success. Others have also examined the link between economic growth and how financial sector development broadly supports the view that both intermediaries as well as markets play a key role in supporting high economic growth. Moreover, numerous studies have found that better developed financial systems ease the financing constraint faced by enterprises, particularly small firms. Some studies have increasingly found financial development to have a causal effect in stimulating economic and productivity growth (Moore, Green, & Murinde, 2006; Das & Ghosh, 2006; Limi, 2004; Spiegel

191 & Yamori, 2003; Honda, 2003). For example, Moore, Green, & Murinde (2006) applied  
192 stochastic simulation methods to a system-wide flow of funds model for India for 1951-1994 to  
193 examine two issues. The first concerned was the impact of financial reforms on interest rates and  
194 loan-able funds. The second was to assess the robustness of policy if there was uncertainty about  
195 the true model. The results of their studies showed considerable variations in policy risk  
196 depending on the policy instrument and the policy regime. Interest rate risks were found to be  
197 greater in the controlled policy regime, while quantity risks were greater in the liberalized policy  
198 regime. The results of their studies also revealed that outcomes depended much on controls on  
199 intermediaries: more heavily controlled banks responded differently from other less heavily  
200 controlled financial intermediaries.

201  
202 Working with large cross-section of countries (developed and developing) and using the method  
203 of pure cross-country regression, or dynamic panel data methods such as the generalized  
204 methods of moments (GMM), several studies have examined the channels through which  
205 financial development affects economic growth (De Gregorio & Guidotti, 1995; Levine &  
206 Zervos, 1998; Beck *et al.*, 2000, and Benhabib & Spiegel, 2000, among others). However, many  
207 criticisms have been expressed against these studies with respect to the data and estimation  
208 methods used. The predominant is cross-country/multi-country panel regression estimates “mask  
209 important cross country differences” (Darlauf, 2001). That is, the slope coefficient is taken to be  
210 identical across the countries included in the panel, which implies that financial development  
211 generates equivalent investment and productivity increases across countries. However,  
212 heterogeneity across countries in terms of their institutional and financial structures which plays  
213 a crucial role in determining the finance-growth relationship has been documented in the  
214 literature (Edwards & Fisher, 1994; La Porta, Lopez-de-Silanes, Shleifer & Vishny, 1997;  
215 Shleifer & Vishny, 1998; Stulz, 2001). For example, as alluded to earlier, there is a rich diversity  
216 of opinion in the existing literature on the relationship between the financial structure (that is, the  
217 degree to which the financial system is bank or market-based) and long-term economic growth  
218 (Levine, 2002).

219  
220 All of these raise the possibility that the relationship between financial development and  
221 economic growth is country-specific, hence, the cross-country/multi-country panel estimates

may not correspond to a country specific estimate. Consequently, generalizations based on cross-country or multi-country panels may provide incorrect inference for several countries included in the panel; thereby, seriously impairing their policy significance. The shortcomings of the cross-country/panel estimators have prompted a number of researchers to rely on time-series methods to examine the finance-growth nexus based on the data of individual countries (Neusser & Kugler 1998; Rousseau & Wachtel, 1998; Arestis & Luintel, 2001). As argued by Arestis and Luintel (2001) ‘time series methods can provide useful insights into differences of this [financial development and economic growth] relationship across countries and may illuminate important details that are hidden in averaged-out results’.

## Materials and Methods

**Data Collection:** Secondary data were utilized for the study. It covers a period of 1970-2009 and was sourced from the Central Bank of Nigeria (CBN), Statistical Bulletin, Annual Report and Statements of Account of Central Bank of Nigeria (CBN), Federal Ministry of Agriculture and Natural Resources, National Bureau of Statistics (NBS), National Population Commission and Food and Agriculture Organization (FAO).

## Analytical Techniques

The study made use of an econometric model adopted by Akpaeti (2013) to express: (i) Agricultural investments as dependent on financial sector reforms (ii) Agricultural growth as dependent on financial sector reforms. The relationships were specified as follows:

$$AGINV = f(\text{FSRGDP}) \quad 1$$

$$AGR\text{GDP}1 = f(\text{FSRGDP}) \quad 2$$

Where:

*AGRINV* = Agricultural Investments (represented by Foreign Investment plus Domestic Investment. The Foreign Investment was proxied for Foreign Private Investment (FPI) in the agricultural sector, while Domestic Investment was proxied for Credit to agriculture).

*AGR\text{GDP}1* = Agricultural Growth (proxy for Growth Rate of Agricultural Sector Real Gross Domestic Product).

*LNFSRGDP* = log of Financial Sector Real Gross Domestic Product

From economic theory, other policy variables such as savings, income, output, interest rate and exchange rate also affect agricultural investments while agricultural investment, labour in agriculture, exchange rate and interest rate also affect agricultural growth. Therefore, we have:

$$LNAGINV = f(LNFSRGDP, LNSAV, LNAGRGDP1, LNPCI, LNER, LNIR) \quad 3$$

$$LNAGRGDP1 = f(LNFSRGDP, LNAGINV, LNLFA, LNER, LNIR) \quad 4$$

$LNSAV$  = Log of Total Savings

$LNPCI$  = Log of Per Capita Income

$LNLFA$  = Log of Labour Force in Agriculture

$LNER$  = log of Exchange Rate

$LNIR$  = log of Interest Rate

( $AGINV, AGRGDP1, FSRGDP$ ) are as defined in equations 1 and 2.

Given the various theories on the relationship between financial sector reforms and economic growth, various variables of interest such as ( $LNAGINV, LNAGRGDP1, LNFSRGDP, LNSAV, LNPCI, LNLFA, LNER, LNIR$ ) were jointly determined. The empirical investigation into the relationships among these variables was carried out in a vector autoregressive (VAR) model and Granger causality test. A unique advantage of the VAR technique of analysis is that it treats all variables as potentially endogenous and also facilitates investigation of the related concept of causality in the Granger's sense of it (Granger, 1969). Causality in Granger's sense is inferred when values of a variable say  $X_t$  have explanatory power in a regression of  $Y_t$  on lagged values of  $Y_t$  and  $X_t$ . The vector autoregression (VAR) model has become one of the leading approaches employed in the analysis of dynamic economic relationships (Barsky & Kilian, 2004; Killian, 2009; Ozlale & Pekkurnaz, 2010; Chuku, Effiong, & Sam, 2011; Akpaeti, 2013) like the ones specified in equations 3 and 4 respectively. This study follows suit by specifying a VAR model that examined the short and long-run relationship of the impact of financial sector reforms on agricultural investment and growth in Nigeria.

The VAR representation of the model with lag order  $k$  is thus:

$$Y_t = C_0 + \sum_{i=1}^k A_i Y_{t-i} + \mu_t \quad 5$$

281 Where:

282  $Y_t = (LNAGINV, LNAGR GDP1, LNFSRGDP, LNSAV, LNPCI, LNLFA, LNER, LNIR)$  is a 8X1  
283 vector of endogenous variables or Integrated Variables 6

284  $C_0 = (C_1, C_2 \dots C_n)$  the C intercept vector of the VAR model.

285  $A_i =$  matrix coefficients estimated of autoregressive coefficient

286 vector  $Y_{t-i}$ , for  $i = 1, 2 \dots k$ . Thus,  $A_i$  is 8 x 8 coefficient matrices.

287  $\mu_t = (\mu_{1t}, \mu_{2t}, \dots \mu_{nt})$  vector of independent and identically distributed error terms (I.I.D).

288  $k =$  the number of lagged terms.

289 The VAR estimations are very sensitive to structure of lag variables and sufficient lag length  
290 does help to reflect the long term impact of variables on others. However, including longer lag  
291 lengths will lead to multicollinearity problems and will increase the degrees of freedom (DOF)  
292 (Wooldridge, 2006). From equation (6), it was expanded as follows:

$$\begin{aligned} 293 \Delta LNAGINV &= \varphi_0 + \varphi_1 \sum_{i=1}^k \Delta LNAGR GDP1_{q,t-i} + \varphi_2 \sum_{i=1}^k \Delta LNFSRGDP_{q,t-i} + \\ 294 \varphi_3 \sum_{i=1}^k \Delta LNSAV_{q,t-i} + \varphi_4 \sum_{i=1}^k \Delta LNPCI_{q,t-i} + \varphi_5 \sum_{i=1}^k \Delta LNLFA_{q,t-i} + \\ 295 \varphi_6 \sum_{i=1}^k \Delta LNER_{q,t-i} + \varphi_7 \sum_{i=1}^k \Delta LNIR_{q,t-i} + \\ 296 \mu_{1t} \end{aligned} \quad 7$$

$\Delta LNAGR GDP1$

$$\begin{aligned} 298 &= \theta_0 + \theta_1 \sum_{i=1}^k \Delta LNAGINV_{q,t-i} + \theta_2 \sum_{i=1}^k \Delta LNFSRGDP_{q,t-i} + \theta_3 \sum_{i=1}^k \Delta LNSAV_{q,t-i} + \\ 299 \theta_4 \sum_{i=1}^k \Delta LNPCI_{q,t-i} + \theta_5 \sum_{i=1}^k \Delta LNLFA_{q,t-i} + \theta_6 \sum_{i=1}^k \Delta LNER_{q,t-i} + \theta_7 \sum_{i=1}^k \Delta LNIR_{q,t-i} + \\ 300 \mu_{2t} \end{aligned} \quad 8$$

$$\begin{aligned} 301 \Delta LNFSRGDP &= \\ 302 \lambda_0 + \lambda_1 \sum_{i=1}^k \Delta LNAGINV_{q,t-i} + \lambda_2 \sum_{i=1}^k \Delta LNAGR GDP1_{q,t-i} + \lambda_3 \sum_{i=1}^k \Delta LNSAV_{q,t-i} + \\ 303 \lambda_4 \sum_{i=1}^k \Delta LNPCI_{q,t-i} + \lambda_5 \sum_{i=1}^k \Delta LNLFA_{q,t-i} + \lambda_6 \sum_{i=1}^k \Delta LNER_{q,t-i} + \lambda_7 \sum_{i=1}^k \Delta LNIR_{q,t-i} + \\ 304 \mu_{3t} \end{aligned} \quad 9$$

$$\begin{aligned} 305 \Delta LNSAV &= \\ 306 \beta_0 + \beta_1 \sum_{i=1}^k \Delta LNAGINV_{q,t-i} + \beta_2 \sum_{i=1}^k \Delta LNAGR GDP1_{q,t-i} + \beta_3 \sum_{i=1}^k \Delta LNFSRGDP_{q,t-i} + \\ 307 \beta_4 \sum_{i=1}^k \Delta LNPCI_{q,t-i} + \beta_5 \sum_{i=1}^k \Delta LNLFA_{q,t-i} + \beta_6 \sum_{i=1}^k \Delta LNER_{q,t-i} + \beta_7 \sum_{i=1}^k \Delta LNIR_{q,t-i} + \\ 308 \mu_{4t} \end{aligned} \quad 10$$

$$\begin{aligned} \Delta \text{LNPCI} &= \\ \gamma_0 + \gamma_1 \sum_{i=1}^k \Delta \text{LNAGINV}_{q,t-i} + \gamma_2 \sum_{i=1}^k \Delta \text{LNAGR GDP1}_{q,t-i} + \gamma_3 \sum_{i=1}^k \Delta \text{LNFSRGDP}_{q,t-i} + \\ \gamma_4 \sum_{i=1}^k \Delta \text{LNSAV}_{q,t-i} + \gamma_5 \sum_{i=1}^k \Delta \text{LNLFA}_{q,t-i} + \gamma_6 \sum_{i=1}^k \Delta \text{LNER}_{q,t-i} + \gamma_7 \sum_{i=1}^k \Delta \text{LNIR}_{q,t-i} + \\ \mu_{5t} & \quad \quad \quad 11 \end{aligned}$$

$$\begin{aligned} \Delta \text{LNLFA} &= \\ \psi_0 + \psi_1 \sum_{i=1}^k \Delta \text{LNAGINV}_{q,t-i} + \psi_2 \sum_{i=1}^k \Delta \text{LNAGR GDP1}_{q,t-i} + \psi_3 \sum_{i=1}^k \Delta \text{LNFSRGDP}_{q,t-i} + \\ \psi_4 \sum_{i=1}^k \Delta \text{LNSAV}_{q,t-i} + \psi_5 \sum_{i=1}^k \Delta \text{LNPCI}_{q,t-i} + \psi_6 \sum_{i=1}^k \Delta \text{LNER}_{q,t-i} + \psi_7 \sum_{i=1}^k \Delta \text{LNIR}_{q,t-i} + \\ \mu_{6t} & \quad \quad \quad 12 \end{aligned}$$

$$\begin{aligned} \Delta \text{LNER} &= \\ \sigma_0 + \sigma_1 \sum_{i=1}^k \Delta \text{LNAGINV}_{q,t-i} + \sigma_2 \sum_{i=1}^k \Delta \text{LNAGR GDP1}_{q,t-i} + \sigma_3 \sum_{i=1}^k \Delta \text{LNFSRGDP}_{q,t-i} + \\ \sigma_4 \sum_{i=1}^k \Delta \text{LNSAV}_{q,t-i} + \sigma_5 \sum_{i=1}^k \Delta \text{LNPCI}_{q,t-i} + \sigma_6 \sum_{i=1}^k \Delta \text{LNLFA}_{q,t-i} + \sigma_7 \sum_{i=1}^k \Delta \text{LNIR}_{q,t-i} + \\ \mu_{7t} & \quad \quad \quad 13 \end{aligned}$$

$$\begin{aligned} \Delta \text{LNIR} &= \\ \phi_0 + \phi_1 \sum_{i=1}^k \Delta \text{LNAGINV}_{q,t-i} + \phi_2 \sum_{i=1}^k \Delta \text{LNAGR GDP1}_{q,t-i} + \phi_3 \sum_{i=1}^k \Delta \text{LNFSRGDP}_{q,t-i} + \\ \phi_4 \sum_{i=1}^k \Delta \text{LNSAV}_{q,t-i} + \phi_5 \sum_{i=1}^k \Delta \text{LNPCI}_{q,t-i} + \phi_6 \sum_{i=1}^k \Delta \text{LNLFA}_{q,t-i} + \\ \phi_7 \sum_{i=1}^k \Delta \text{LNER}_{q,t-i} + \\ \mu_{8t} & \quad \quad \quad 14 \end{aligned}$$

326

327 While it is easier measuring other variables described above, it is also of valued importance to  
 328 note that measuring financial sector reforms often poses a challenge to researchers in their effort  
 329 to assess the impact of financial intermediation on real economic activity. The reason is because  
 330 commonly used bank measures such as the ratio of monetary aggregates (like M2) to GDP, the  
 331 ratio of liquidity liabilities to GDP and the ratio of bank credit to the private sector to GDP are  
 332 considered as poor indicators of financial sector reforms (Levine, Loayza & Beck, 2000; Arestis  
 333 & Luintel, 2001; Liang & Teng, 2006 and Ghirmay, 2009). As such, financial sector RGDP or  
 334 GDP is regarded by far a better measure of financial sector reforms in that: (i) it represents a  
 335 broader measure of financial reforms. (ii) it reflects all the activities of a financial system; that is,  
 336 all financial transactions “involving the creation, liquidation, or change in ownership of financial  
 337 assets and/or facilitating financial transactions”.(iii) does not vary from structural changes within  
 338 the financial sector.(iv) it does not underestimate the level of financial sector in Nigeria’s  
 339 economy, where a significant financial development, Investment, Productivity and economic  
 340 growth or innovation occurs in the real sector. Based on the above assertions, financial sector  
 341 RGDP (Real Gross Domestic Product) was utilized as indicator for financial sector reforms.

342

The *apriori* expectations for vector autoregressive models are suited to track and identify structural shocks within a system of equations, with respect to underlying economic theory. The focus of this study is on the relationship between the impacts of financial sector reforms on agricultural investment and growth in Nigeria's economy, thus, we concentrate on the expected theoretical relationships that should hold in equation (9). The parameter for  $\lambda_1$  is expected to be positively related. Financial constraint is one of the problems in agricultural production; an efficient financial sector should ensure the channeling of funds to agricultural sector. Thus, as the financial sector becomes more efficient, more saving will be mobilized and this provides an opportunity for funds to be extended to provide investment opportunities in the agricultural sub-sector.

The parameter for  $\lambda_2$  is expected to have a direct positive influence on income, interest rate, financial sector gross domestic product, financial sector reform and agricultural output growth. This implies that investment from the financial sector would greatly enhance agricultural output growth. The parameter for  $\lambda_3$  is expected to be positively related. Generally, financial sector reform is expected to have a positive impact on saving mobilization in the economy. However, depending on the measure of the financial sector reform, a priori sign could be negative. The parameter  $\lambda_4$  is expected to have a positive sign. Per capita income is very crucial for economic growth and it may increase savings, which may in turn help in boosting the financial system. The parameter  $\lambda_5$  is expected to be positively related. The positive sign is to reflect the quality of manpower being produced by the agricultural sector of the economy.

The parameter  $\lambda_6$  is expected to have a positive sign. This is because a lower interest rate will induce private economic agents to undertake investment activities at the lower levels of interest rate. However, in an environment characterized by severe financial repression as being the case in developing countries over the years, investment funds may not be readily available to potential investors (Afangideh, 2009). In this case, the only way to induce people to mobilize investment funds through saving is high interest rate. This implies that the higher the financial intermediaries, the more the availability of investment funds through savings and hence the high level of investment in agriculture. This is the premise of the argument of Mckinnon-Shaw hypothesis which postulated a positive relationship between financial liberalization and the real interest rate. The parameter  $\lambda_7$  is expected to have a negative sign since the exchange rate is negatively related to the agricultural production. At a favourable exchange rate, more agricultural

outputs would be produced. Also, with good macroeconomic policies that enhance favourable exchange rates, agricultural funds can be widely available at low interest rate.

According to Wooldridge (2006), VAR technique would be invalid if variables are not stationary at level, in such situation, a cointegration and vector error correction (VECM) techniques are carried out to investigate the relationship among non-stationary variables. Hence, it became necessary to conduct preliminary diagnostics on the time series properties of the variables before further evaluation. In order to ascertain the pattern of integration of the variables, a unit-root test was conducted using two specifications of the augmented Dickey-Fuller (ADF) test: (i) intercept (ii) trend and intercept. The latter was used for confirmation tests. The essence of the test was to determine stationarity in trend of the variable and to show the order of integration at which they become stationary if it reveals a non-stationary trend.

The hypothesis for the unit root test is:

$$H_0: \rho = 1$$

$$H_1: \rho < 1$$

To ensure the authenticity of the results obtained (Maddala, 2002), cointegration test was carried out. This was done using the Johansen approach of testing the number of cointegrating vectors: the Trace and the Maximum Eigenvalue statistics. The null hypothesis for the trace test was that there are at most  $r$  cointegrating vectors, while for the Max Eigenvalue test, the null of  $r = 0$  was tested against the alternative that  $r = 1$ ;  $r = 1$  was tested against the alternative that  $r = 2$  and so on. The optimal lag length for the cointegration test was selected using the Schwarz Information Criterion (SIC).

After estimating the cointegrated VAR, innovation accounting was conducted to determine the dynamic responses of the variables to one-standard deviation shocks in other variables in the system. This was done by generating the impulse response functions from the system. Impulse Response Functions (IRF), trace the responsiveness of the dependent variable in the VAR (VECM) to a unit shock in the error terms. For each variable from each equation, a unit shock was applied in the error term and the effects upon the VAR (VECM) to a unit shock in error terms are observed over a period of time. If there are  $K$  endogenous variables in the model, then a total of  $K^2$  impulse responses can be generated. In this study, the analysis was confined to the

responses of AGRINV, AGRGDP, FSRGDP, SAV, PCI, LA, IR and ER to the shocks in FSRGDP.

To further to obtain information concerning the relative importance of each innovation towards explaining the behaviour of the endogenous variables, variance decomposition analysis (VDC) was conducted. The generalized forecast error variance decomposition technique attributed to Koop, Pesaran and Potter (1996) and Pesaran & Shin (1998) was used. This technique has the advantage that its results are not sensitive to the ordering of the variables in the VAR (VECM).

To examine the short-run impacts of financial sector reforms on agricultural investments and growth in Nigeria, the Granger-casualty test developed by Granger (1969) was adopted. This test seeks to ascertain whether or not the inclusion of past values of a variable say  $Y_{t-p}$  do or do not help in the prediction of present values of another variable  $X$ . If  $X$  is better predicted by including past values of  $Y$ , than by not including them, then  $Y$  is said to Granger-cause  $X$  (Gujarati, 2003). Several alternative methods of testing for Causality in Cointegrated VAR have emerged in the literature. The popular approach has been to re-parameterize the model into the equivalent vector error correction model (VECM) and to conduct Causality tests following either the residual-based Engle-Granger two-stage method or the Johansen-Type Error.

Finally, to ensure that the conclusions arrived at from the baseline models (equations 7 to 14) are not spurious or outcomes of chance, sensitivity analysis and robustness checks on the results was carried out. This was done by replacing a variable in the baseline model. The basic difference between the models used for sensitivity analysis and the baseline model was the introduction of Private Sector Credit (PSC) as a measure (or proxy) for Financial Sector Reforms in sensitivity analysis and robustness analysis while Financial Sector Gross Domestic Product (FSGDP) was used as a proxy for Financial Sector Reforms in the baseline equation.

The reduced form representation of the VAR is thus:

$$X_t = C_0 + \sum_{i=1}^k \delta_i X_{t-i} + \mu_t \quad 15$$

Where:

428  $X_t = (LNAGINV, LNAGR GDP1, LNPSC, LNSAV, LNPCI, LNLFA, LNER, LNIR)$  is a  $8 \times 1$  vector  
 429 of five endogenous variables, while  $X_{t-i}$  is the corresponding lag term for each of the  
 430 variables.  $A_i$  is the  $8 \times 8$  matrix of autoregressive coefficient vector  $X_{t-i}$ , for  $i = 1, 2, \dots, k$ .  
 431  $C_0 = (C_1, C_2 \dots C_n)$  is the  $C$  intercept vector of the VAR model.  
 432  $\mu_t = (\mu_{1t}, \mu_{2t}, \dots \mu_{nt})$  is the  $8 \times 1$  vector of independent and identically distributed error terms  
 433 (I.I.D).  
 434  $K$  = the number of lagged terms.  
 435 LNPSC = Log of Private Sector Credit to Agriculture  
 436  $(LNAGINV, LNAGR GDP1, LNSAV, LNPCI, LNLFA, LNER, LNIR)$  = are as earlier defined.

437

### 438 **Effect of Financial Sector Reforms on Agricultural Output**

439 The result of the Augmented Dicker-Fuller (ADF) unit root test is presented in Table 1. Schwarz  
 440 Information Criterion (SIC) was used for the selection of the optimal lag length to a maximum of  
 441 9. The results revealed that variables used in the analysis possessed unit-roots at one percent  
 442 level of significance and was stationary only after transformation at the first differences for both  
 443 intercept and when trend specification was included. Only the agricultural output growth variable  
 444 was stationary at level, that is,  $I(0)$ . With the above result, the unit-root test results gave a useful  
 445 clue on how to arrange the variables into the vector error correction model (VECM) analysis.  
 446 Thus, agricultural investments (LNAGINV), financial sector reforms (LNFSRGDP), total  
 447 savings (LNSAV), per capita income (LNPCI), the labour force in agriculture (LNLFA),  
 448 exchange rate (LNER) and interest rate (LNIR) were fed into the model at their first-differences,  
 449 while agricultural growth (LNAGR GDP1) enters at its level.

**Table 1 Result of ADF Unit root test**

|          | Levels       |              | 1 <sup>st</sup> Difference |              |             |
|----------|--------------|--------------|----------------------------|--------------|-------------|
| Variable | Intercept    | Trend        | Intercept                  | Trend        | Conclusion  |
|          | + Intercept  |              | + Intercept                |              |             |
| LNAGINV  | -1.701[0]    | -1.157[0]    | -5.890[0]***               | -6.161[0]*** | <i>I(1)</i> |
| LNAGRDP1 | -6.039[0]*** | -5.972[0]*** | _____                      | _____        | <i>I(0)</i> |
| LNFSRGDP | -2.819[0]    | -2.392[0]    | -5.935[0]***               | -4.157[0]*** | <i>I(1)</i> |
| LNSAV    | 1.130[0]     | -0.771[0]    | -4.661[0]***               | -4.735[0]*** | <i>I(1)</i> |
| LNPCI    | -2.492[0]    | -1.962[0]    | -5.702[0]***               | -6.046[0]*** | <i>I(1)</i> |
| LNLFA    | 0.613[0]     | -1.371[0]    | -5.650[0]***               | -5.856[0]*** | <i>I(1)</i> |
| LNER     | 0.125[0]     | -2.163[0]    | -5.023[0]***               | -4.995[0]*** | <i>I(1)</i> |
| LNIR     | -2.189[0]    | -2.929[0]    | -9.239[0]***               | -9.162[0]*** | <i>I(1)</i> |

Source: computed by Author. Notes: \*\*\* indicates significance at 1% level. The values in bracket [ ] for the ADF test shows the optimal lag length selected by the SIC within a maximum lag of 9. Variables are in log forms.

With the fact that almost all the variables were stationary at the first differencing, it was necessary to carry out another test to assess if the non-stationary variables were co-integrated. In essence, the hypotheses were tested to affirm the rank of the cointegrating relationships that existed among the variables. Tables 2 and 3 show the results of Johansen cointegration tests indicating the presence of two (Trace) and one (Maximum Eigenvalue) cointegrating vectors respectively. This indicates that there were evidence of the existence of a long-run relationship among financial sector reforms, agricultural investment, output growth and other policy variables in Nigeria. Therefore, applying the vector error correction model (VECM) would enable us to track the long-run relationship between the variables and tie it to deviation that may occur in the short-run (Lorde, Jackson & Thomas, 2009).

465 **Table 2 Johansen Cointegration Trace Test**

| Null Hypothesis | Alternative Hypothesis | Test Statistic | Critical Value |
|-----------------|------------------------|----------------|----------------|
|                 |                        |                | 0.05           |
| r = 0           | r = < 1                | 198.682        | 159.530***     |
| r = 1           | r = < 2                | 134.750        | 125.615**      |
| r = 2           | r = < 3                | 91.215         | 95.754         |
| r = 3           | r = < 4                | 62.088         | 69.819         |
| r = 4           | r = < 5                | 38.263         | 47.856         |
| r = 5           | r = < 6                | 23.603         | 29.797         |
| r = 6           | r = < 7                | 10.765         | 15.494         |
| r = 7           | r = < 8                | 1.447          | 3.842          |

466 Source: Computed by Author. Notes: r indicates the number of co-integrating vector. \*\*\* is the  
 467 significance level at 1%. P-values are obtained using response surfaces in Mackinnon *et al.*,  
 468 (1999).

469 **Table 3 Johansen Cointegration Maximum Eigenvalue Test**

| Null Hypothesis | Alternative Hypothesis | Test Statistic | Critical Value |
|-----------------|------------------------|----------------|----------------|
|                 |                        |                | 0.05           |
| r = 0           | r = 1                  | 63.932         | 52.363***      |
| r = 1           | r = 2                  | 43.535         | 46.231         |
| r = 2           | r = 3                  | 29.128         | 40.078         |
| r = 3           | r = 4                  | 23.825         | 33.877         |
| r = 4           | r = 5                  | 14.659         | 27.584         |
| r = 5           | r = 6                  | 12.839         | 21.132         |
| r = 6           | r = 7                  | 9.318          | 14.265         |
| r = 7           | r = 8                  | 1.447          | 3.842          |

470 Source: Computed by Author. Notes: r indicates the number of co-integrating vector. \*\*\* is the  
 471 significance level at 1%. P-values are obtained using response surfaces in Mackinnon *et al.*,  
 472 (1999).

Going by the Johansen cointegration results, a VECM (2) with at least two cointegrating vectors was carried out to ascertain that the estimated VECM was not false, the residual auto correlation and correlogram tests were also conducted. The results revealed that the residuals of the estimated VECM were appropriately uncorrelated, implying that the estimated VECM was correctly specified or unbiased and the parameters estimated were consistent. This was because the spikes from the correlograms revealed the relative correlation of the error terms in the VECM equations and the closer the spikes are to the zero line, the more uncorrelated the error terms. The coefficients from the estimated VECM were not of primary interest in this empirical work. Instead, focused was on the impulse response function (IRFs) and variance decomposition (VDC) generated from the VECM.

The impulse response functions traced out the responsiveness of the dependent variable in the VECM to shocks on each of the variables using the Cholesky one standard deviation innovations (Choleskey one Standard deviations examine the dynamic interactions among variables). This implies that impulse responses showed the path of LNAGRDP1 (agricultural growth) when there were innovations in the financial policy variables. For each equation, a unit shock was applied to the error, and the effects upon the VECM system over 30 periods were examined. The VECM system has eight variables, thus a total of 64 impulses could be generated. But the primary objective was to examine the impact of financial sector reforms shocks on the other seven macroeconomic or endogenous variables. Thus, only the responsiveness of the financial sector reforms on the macroeconomic variables (LNAGINV, LNAGRDP1, LNSAV, LNPCI, LNLFA, LNER and LNIR) was traced out.

Figure 1, presented seven panels of impulse response graphs indicating how innovations in financial sector reforms variable affected agricultural investments; growth and other policy variables in Nigeria over a period of 30 periods. Each panel illustrated the response of the policy variables to a one standard deviation innovation (corresponding to a positive shock) in the policy variable. A value of zero means that financial sector reforms shock has no effect on the financial policy variables and the variables continued on the same path it would have followed had there been no financial sector reforms shock. A positive or negative value indicated that the shock

caused the variable to be above or below its ‘natural’ path as the case may be. The solid lines depict the estimated effects of the shock.

Panels A, B, C and G displayed the impulse responses of agricultural investments, agricultural growth, total savings and interest rate respectively to the one time shock in the financial sector reforms as presented in Figure 1. These four financial policy variables fell below equilibrium with a negative response in an undulating but significant manner before stabilizing over the period reviewed to the positive shock in the financial sector reforms. This implies that there is a negative response among agricultural investments, savings and interest rate to the positive shock in financial sector reforms in Nigeria financial system. This would initially retard growth in agricultural sector as shown in panel B in the first two periods. However, in the long-run, it settles at a period below equilibrium level. That is, it leads to a long-run disequilibrium solution since the impulse response function does not return to the zero line. This is in line with the economic postulation that the higher the interest rate, the higher the savings and the greater the investment opportunities and vice versa. However, this was not consistent with our *apriori* expectations since economic agents are expected to adjust their spending and investment habits moderately and gradually in response to the increased supply of funds rather than immediately. The result correlated with that of Hasan, Akhan & Ali (1996) which reveals that low interest ceiling is seen to have restricted the real flow of loan-able funds, which depressed the quality of productive investment during financial sector reforms while Mckinnon (1973) and Shaw (1973) believe that when financial system is repressed by low level of savings rather than by the lack of investment opportunities, economic growth is severely hindered. Notwithstanding, investment is negatively linked to the effective real rate of interest on loans, but positively linked to the growth rate of the economy. They also opined that savings in many developing countries were barely sufficient to maintain the existing capital stock hence, could not permit enough investment to sustain economic growth.

The negative but significant effect of the financial sector reforms shock on these monetary variables displayed in Figure 1 was not consistent with theoretical expectations and this confirms the weak and unstable nature of credit markets in the Nigeria economy but agree with Asamoah (2008) who stated that the financial sector reforms can affect economic growth by altering the saving rates. In this case, the sign of the relationship was not obvious, because financial sector

development may also reduce savings and thereby growth while Fry (1998) affirms that the use of interest rate ceilings in a repressed system, distorts the economy in four critical ways: (i) Current consumption is favoured compared to future consumption (ii) financial institutions are favoured instead of lending via deposits and engage potential investors in relatively low-yielding investments (iii) the low level of interest rates would cause borrowers to favour capital-intensive projects (iv) the pool of potential borrowers is dominated by entrepreneurs who possess low-yielding projects.

Panel D indicated that per-capita income was consistently falling below equilibrium over the time period, though exhibited rising trend at the beginning of the period. This is plausible because of the argument that focuses on the negative effect of repression on the rate of per-capita income contrary to the McKinnon-Shaw premise. Financial researchers argued that the increase in the real interest rate may not necessarily lead to improved private savings. In very poor countries for instance, the level of income would be so low that households spend a very high proportion of their earnings on basic needs. In such a case, even with high real interest rates, the very little proportion of income would be saved. This implies that McKinnon-Shaw's proposition would therefore be more relevant in rich countries. In Panel E, labour force in agriculture increased consistently in a positive manner over time. This implies that labour force is skewed to the shock in the reform with a positive future expectation. This is consistent with theoretical postulation reflecting the quality of manpower being produced by the agricultural sector of the economy. Panel F revealed that exchange rate responded positively after a period of the thirty years. This shows that financial sector reforms have a positive impact on monetary policy (exchange rate) in Nigeria. This is contrary to the negative theoretical postulation considering the seasonal nature of agricultural production in a country with an open economy having many trading partners.

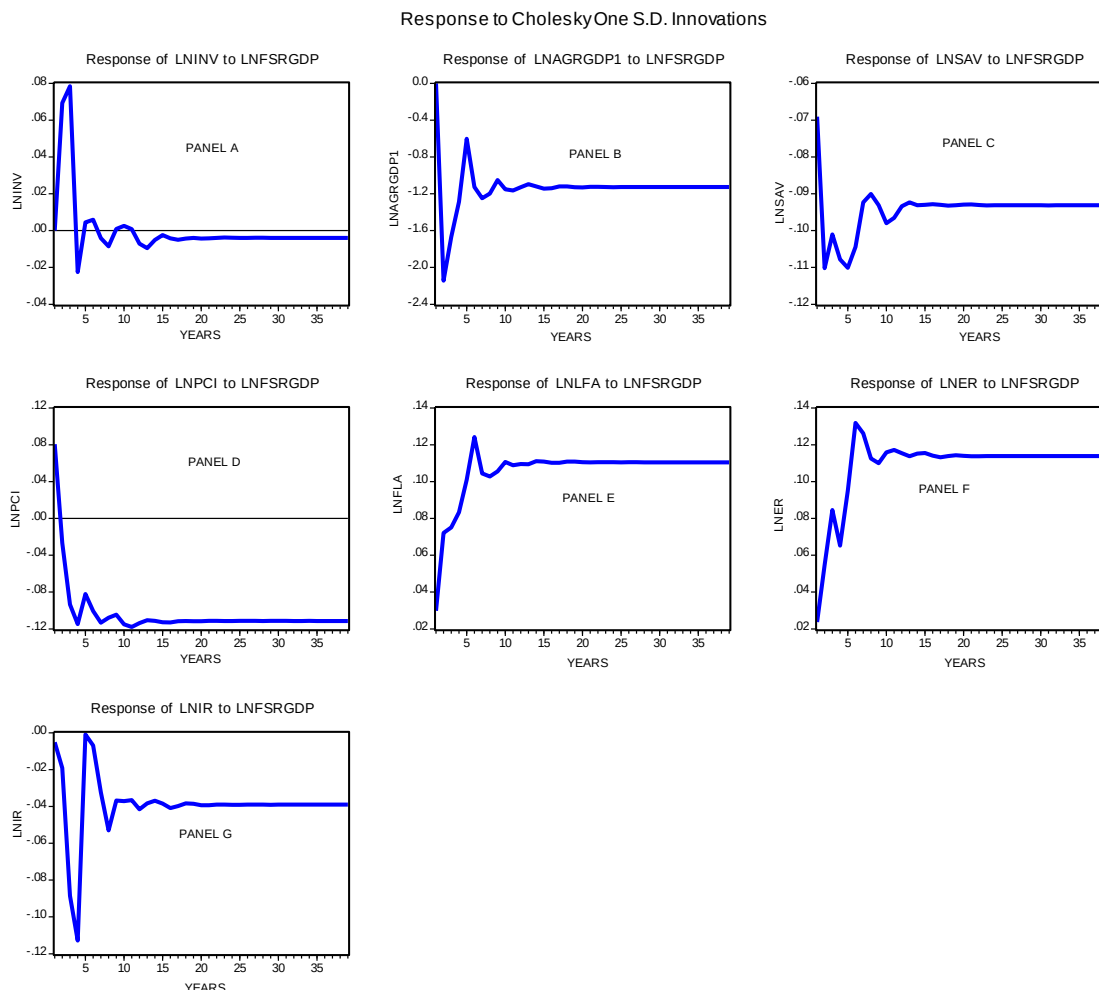


Figure 1: Response of LNAGINV, LNAGRDP1, LNSAV, LNPCI, LNLFA, LNER, and LNIR to LNFSRGDP shock in choleskey one standard deviation (Choleskey one Standard deviations examine the dynamic interactions among variables).

The Variance Decomposition Analysis (VDC) provides a means of analysis to determine the relative importance of the dependent variable in explaining the variations in the explanatory variables. The result of variance decomposition over a 30-year time period is displayed in Table 4. The values in the table confirmed the results obtained from the Impulse response analysis (IRFs). On the average, 3.84 percent of most of the variation in the forecast error for financial sector reforms was explained by the shocks to itself. Agricultural growth shock had a value of 78.84 percent of the variation in financial sector reforms over the 30-year period while the impact of financial sector reforms shock on agricultural investments was 0.34 percent over the 30 year period.

The influence of the shocks on total savings was marginal at the onset with values less than one percent up to the fifteen periods but later increased to 1.37 percent over the thirtieth year period. The average contributions of LNPCI, LNLFA, LNER and LNIR were 2.49 percent, 10.53 percent, 5.19 percent and 0.08 percent respectively. The higher contributions of agricultural growth to the shocks in financial sector reforms indicate that financial sector reforms significantly affected agricultural output more than other monetary variables which were mild and persistent. This correlated with the empirical works of King and Levine (1993) and Levine *et al.*, (2000) which confirms that financial development has a positive effect on economic growth. The implication of this is that policy makers will be faced with less uncertainty in planning for the long-term.

**Table 4 Variance Decomposition of FSRGDP**

| Period | S.E   | LNINV  | LNAGRDP1 | LNFSRGDP | LNSAV | LNPCI | LNLFA  | LNER  | LNIR   |
|--------|-------|--------|----------|----------|-------|-------|--------|-------|--------|
| 1      | 0.396 | 88.336 | 10.223   | 0.000    | 0.000 | 0.000 | 0.000  | 0.000 | 0.000  |
| 5      | 0.725 | 0.582  | 81.492   | 5.078    | 0.300 | 0.702 | 6.676  | 5.108 | 0.062  |
| 10     | 0.946 | 0.426  | 79.893   | 4.080    | 0.599 | 1.821 | 9.341  | 3.763 | 0.077  |
| 15     | 1.124 | 0.341  | 78.846   | 3.838    | 0.951 | 2.493 | 10.530 | 2.917 | 0.083  |
| 20     | 1.279 | 0.286  | 78.328   | 3.688    | 1.163 | 2.839 | 11.169 | 2.443 | 0.0869 |
| 25     | 1.417 | 0.251  | 78.022   | 3.585    | 1.289 | 3.047 | 11.567 | 2.151 | 0.089  |
| 30     | 1.542 | 0.226  | 77.812   | 3.515    | 1.374 | 3.189 | 11.841 | 1.952 | 0.091  |

Source: Computed by Author. Note: S.E (Standard Error), LNINV (log of Agric. Investment), LNAGRDP1 (log of Agric. Growth), LNFSRGDP (Log of Financial Sector RGDP), LNSAV (log of total savings), LNPCI (Log of Per Capita Income), LNLFA (Log of Labour Force in Agric.), LNER (Log of Exchange Rate) and LNIR (log of Interest Rate).

However, comparing the VDC analysis for agricultural output growth in Tables 5 revealed that agricultural output shocks on financial sector reforms was lower with an average contribution of 33.35 percent respectively than the shocks of financial sector reforms on agricultural output with an average of 78.84 percent as shown in Table 4. This implies that an increase in the financial

sector through effective reforms would enhance growth in the agriculture sector of the country. On the other hand, agricultural output shocks on other policy variables showed a positive impact indicating a positive interaction among variables. The low values recorded in interest rates are good signals to the agricultural investments which would consequently impact positively on output growth in agriculture as it would attract investors to come and invest into the sector.

**Table 5 Variance Decomposition of LNAGRDP1**

| Period | S.E   | LNINV  | LNAGRDP1 | LNFSRGDP | LNSAV | LNPCI | LNLFA  | LNER  | LNIR   |
|--------|-------|--------|----------|----------|-------|-------|--------|-------|--------|
| 1      | 0.396 | 88.336 | 10.223   | 0.000    | 0.000 | 0.000 | 0.000  | 0.000 | 0.000  |
| 5      | 0.725 | 0.582  | 81.492   | 5.078    | 0.300 | 0.702 | 6.676  | 5.108 | 0.062  |
| 10     | 0.946 | 0.426  | 79.893   | 4.080    | 0.599 | 1.821 | 9.341  | 3.763 | 0.077  |
| 15     | 1.124 | 0.341  | 78.846   | 3.838    | 0.951 | 2.493 | 10.530 | 2.917 | 0.083  |
| 20     | 1.279 | 0.286  | 78.328   | 3.688    | 1.163 | 2.839 | 11.169 | 2.443 | 0.0869 |
| 25     | 1.417 | 0.251  | 78.022   | 3.585    | 1.289 | 3.047 | 11.567 | 2.151 | 0.089  |
| 30     | 1.542 | 0.226  | 77.812   | 3.515    | 1.374 | 3.189 | 11.841 | 1.952 | 0.091  |

Source: Computed by Author. Note: S.E (Standard Error), LNINV (log of Agric. Investment), LNAGRDP1 (log of Agric. Growth), LNFSRGDP (Log of Financial Sector RGDP), LNSAV (log of total savings), LNPCI (Log of Per Capita Income), LNLFA (Log of Labour Force in Agric.), LNER (Log of Exchange Rate) and LNIR (log of Interest Rate).

To examine if a significant short-run relationship existed between financial sector reforms and the macroeconomic variables used in the study, an error correction modeling (ECM) analysis was employed as presented in Table 6. The parsimonious estimate showed that  $R^2$  value of 0.97 indicates the variables explained about 97 percent of agricultural output growth. F-statistic of 31.62 ( $P < 0.01$ ) reveals that they are jointly significant and the Durbin Watson Statistic value of 2.05 implies that the model does not suffer from autocorrelation problem but has a very good fit. For significance variables, it was found out that financial sector reforms (LNFSRGDP), past value of financial sector reforms (proxy by LNFSRGDP), per capital income

(LNPCI), labour force in agriculture (LNLFA) and interest rate (LNIR) were the significant determinants of agricultural output growth in Nigeria for the period of analysis. This result implies that the past financial sector reforms, per capital income, labour force in agriculture and interest rate significantly increases the current financial sector reforms, per capital income, labour force in agriculture and interest rate. Further result shows that the coefficients of other three variables (savings, exchange rate and agricultural investments) were not significantly different from zero. This suggests that past financial sector reforms, per capital income, labour force in agriculture and interest rate positively determine the current flow of financial sector reforms, per capital income, labour force in agriculture and interest rate in Nigeria while the previous savings, exchange rate and agricultural investments do not significantly affect the present savings, exchange rate and agricultural investments in Nigeria. As such, an increase in the previous volume of financial sector reforms, per capital income, labour force in agriculture and interest rate would result in an increase in the present level of financial sector reforms, per capital income, labour force in agriculture and interest rate to agricultural output in Nigeria. The result further reveals that the coefficient of the error correction term which measures the speed of adjustment towards long-run equilibrium was both correctly signed (negative) and statistically significant at 1% percent which shows a yearly correction of about 75% of the error with a different adjustable speeds to long-run equilibrium. Thus, correcting any deviations from the long-run equilibrium. The implication of this is that financial sector reforms had an impact on agricultural growth in the short-run.

**Table 6 Vector Error Correction Model for Short-run Impact**

| Variable        | Coefficient | Std. Error | t-Statistic | Prob.  |
|-----------------|-------------|------------|-------------|--------|
| C               | -1.695538   | 0.842285   | -2.013022   | 0.0613 |
| D(LNAGRDP1(-2)) | 0.160707    | 0.099081   | 1.621968    | 0.1243 |
| D(LNFSRGDP)     | 9.746098    | 1.774025   | 5.493778    | 0.0000 |
| D(LNFSRGDP(-2)) | -5.517377   | 1.671753   | -3.300354   | 0.0045 |
| D(LNSAV)        | 3.561411    | 2.476003   | 1.438371    | 0.1696 |
| D(LNSAV(-1))    | 1.763468    | 2.343236   | 0.752578    | 0.4626 |
| D(LNPCI)        | 2.854077    | 1.655964   | 1.723514    | 0.1041 |
| D(LNPCI(-1))    | -5.845329   | 1.326259   | -4.407382   | 0.0004 |
| D(LNPCI(-2))    | 1.599045    | 1.586716   | 1.007770    | 0.3286 |
| D(LNLFA)        | 2.912682    | 1.724201   | 1.689294    | 0.1106 |
| D(LNLFA(-2))    | -2.028902   | 1.127346   | -1.799715   | 0.0908 |
| D(LNER)         | -1.863357   | 1.486112   | -1.253846   | 0.2279 |
| D(LNER(-1))     | -1.678422   | 1.090944   | -1.538505   | 0.1435 |
| D(LNIR)         | -1.206719   | 1.174977   | -1.027015   | 0.3197 |

|                    |           |                       |           |        |
|--------------------|-----------|-----------------------|-----------|--------|
| D(LNIR(-1))        | -1.982491 | 1.023264              | -1.937418 | 0.0706 |
| D(LNIR(-2))        | -0.642033 | 0.764057              | -0.840295 | 0.4131 |
| D(LNINV)           | 0.828225  | 0.687123              | 1.205352  | 0.2456 |
| D(LNINV(-1))       | 1.108967  | 0.642909              | 1.724920  | 0.1038 |
| D(LNINV(-2))       | 1.006459  | 0.688385              | 1.462058  | 0.1631 |
| ECM(-1)            | -0.751859 | 0.140136              | -5.365209 | 0.0001 |
| <hr/>              |           |                       |           |        |
| R-squared          | 0.974060  | Mean dependent var    | 0.024444  |        |
| Adjusted R-squared | 0.943257  | S.D. dependent var    | 5.895698  |        |
| S.E. of regression | 1.404400  | Akaike info criterion | 3.817279  |        |
| Sum squared resid  | 31.55744  | Schwarz criterion     | 4.697011  |        |
| Log likelihood     | -48.71101 | Hannan-Quinn criter.  | 4.124329  |        |
| F-statistic        | 31.62198  | Durbin-Watson stat    | 2.050879  |        |
| Prob(F-statistic)  | 0.000000  |                       |           |        |

Source: Computed by Author. Note: \*\*\*, \*\* =1% and 5% significant levels respectively.

Finally, a sensitivity analysis/ robustness check was carried out on VECM equation (15) to ascertain that the model was not spurious or outcome of chance. The results indicated that private sector credit (LNPS) which replaced financial sector real gross domestic product as a proxy for financial sector reforms was stationary at first difference in Augmented Dickey-Fuller (ADF) for both intercept and when trend specification was added. The Johansen cointegration results of LNPS and other variables (LNINV, LNAGRGDP1, LNSAV, LNPCI, LNLFA, LNER, LNIR) earlier specified indicated the presence of two and one cointegrating vectors in the system at 1 percent significant level for both Trace and Maximum Eigenvalues vectors as displayed in tables 8 and 9 respectively. This confirms the existence of a long-run relationship between financial sector reforms and the policy variables in Nigeria.

The impulse response function analysis in robustness test showed that variables responded in a similar pattern to the one time shock of financial sector reforms (LNPS) as that of the baseline model (LNFSRGDP). This could probably be due to the order of integration of LNPS which was stationary at first difference at 1 percent significance as earlier reported. The Variance Decomposition Analysis (VDC) results revealed that the average values of 5.41 percent, 0.60 percent, 2.50 percent, 0.67 percent, 5.66 percent, 1.09 percent, 0.30 percent of LNAGINV, LNAGRGDP1, LNSAV, LNPCI, LNLFA, LNER and LNIR respectively contributed to the variations in financial sector reforms (83.82 percent) over the 30-years. The impact of financial sector reforms shock (proxy by LNPS) on agricultural output growth was lower with 0.60 percent when compared with 78.85 percent of table 4 (baseline Table). This is because a well structured, effective and efficient financial sector reforms is expected to impact more on

agricultural growth at a lower value of 3.84 percent which is the case of financial sector reforms (LNFSRGDP) in the baseline model than the higher value of 83.82 percent LNPSC obtained in sensitivity analysis with agricultural growth value of 0.60 percent. This implies that the financial sector reform was not strong, effective and efficient to cause an astronomical growth in the agricultural sector. This result is in line with several theoretical and the empirical studies of Chen and Feng, 2000; Chow and Li, 2002 at the international, national and provincial levels who affirmed that the financial sector could be a catalyst of economic growth if it is well developed and healthy. The result further agrees with the theoretical argument and is consistent with the results of VAR model; Cross-country/panel empirical studies of Ghirmay (2009), Levine and Zervos (1998); Benhabid and Spiegel (2000) which provided evidence that financial sector real gross domestic product used as proxy in financial sector reforms or financial development has greater significance and positive effect on long-term growth through its investment and productivity effects than proxies used in monetary aggregates such as private sector credit (PSC). This implies that financial sector reforms played a significant role in the growth of agricultural sector by increasing its productivity level and independently generated positive investments in the sector which was a converse of the sensitivity result (PSC). A similar trend was experienced for per capita income (0.67 percent), labour force in agriculture (5.57 percent) and exchange rate (1.09 percent) were lower in sensitivity test except for savings (2.46 percent) and interest rates (0.30 percent) that were higher in sensitivity test than that of the baseline test.

Furthermore, the shock of LNAGRDP1 on LNPSC was lower in sensitivity analysis with 14.25 percent than 33.35 percent shocks on LNFSRGDP recorded in tables 5 (baseline table) respectively. From the above results, it could be deduced that financial sector reforms shocks greatly influenced microeconomic policy variables in the baseline model especially agricultural output growth than those financial sector reforms shocks in sensitivity analysis in the long-run during the period under review. In the short-run, the coefficient of the error correction term was statistically significant and correctly signed (negative) indicating a different adjustable speed to long-run equilibrium. Thus, correcting any deviations from the long-run equilibrium. This affirms that financial sector reforms positively impacted on agricultural growth in the short-run just as in the base line analysis.

690 **Table 8 Johansen Cointegration Trace Test**

| Null Hypothesis | Alternative Hypothesis | Test Statistic | Critical Value |
|-----------------|------------------------|----------------|----------------|
|                 |                        |                | 0.05           |
| r = 0           | r = < 1                | 216.539        | 159.530***     |
| r = 1           | r = < 2                | 130.879        | 125.615**      |
| r = 2           | r = < 3                | 86.672         | 95.754         |
| r = 3           | r = < 4                | 55.859         | 69.819         |
| r = 4           | r = < 5                | 34.548         | 47.856         |
| r = 5           | r = < 6                | 20.901         | 29.797         |
| r = 6           | r = < 7                | 9.524          | 15.495         |
| r = 7           | r = < 8                | 0.773          | 3.841          |

691 Source: Computed by Author. Notes: r indicates the number of co-integrating vector. \*\*\* is the  
692 significance level at 1%. P-values are obtained using response surfaces in Mackinnon *et al.*,  
693 (1999).

694 **Table 9 Johansen Cointegration Maximum Eigenvalue Test**

| Null Hypothesis | Alternative Hypothesis | Test Statistic | Critical Value |
|-----------------|------------------------|----------------|----------------|
|                 |                        |                | 0.05           |
| r = 0           | r = 1                  | 85.660         | 52.363***      |
| r = 1           | r = 2                  | 44.207         | 46.231**       |
| r = 2           | r = 3                  | 30.813         | 40.078         |
| r = 3           | r = 4                  | 21.311         | 33.877         |
| r = 4           | r = 5                  | 13.647         | 27.584         |
| r = 5           | r = 6                  | 11.376         | 21.132         |
| r = 6           | r = 7                  | 8.752          | 14.265         |
| r = 7           | r = 8                  | 0.773          | 3.842          |

695 Source: Computed by Author. Notes: r indicates the number of co-integrating vector. \*\*\* is the  
696 significance level at 1%. P-values are obtained using response surfaces in Mackinnon *et al.*,  
697 (1999).

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## **Conclusion and Recommendations**

The vector error correction model (VECM) result revealed that financial sector reforms had significant effects on agricultural output growth in Nigeria both in the long and short-run in the baseline model and the sensitivity analysis/robustness check respectively. Also, it was discovered that financial sector reforms in the baseline test impacted more on microeconomic policy variables especially growth in agricultural output than those in the sensitivity test in the long-run. Based on the outcome of this work, it is concluded that the assertions made by Ghirmay, 2009; Liang and Teng, 2006; Watchel, 2000; Neusser and Kugler, 1998 regarding the use of financial sector real gross domestic product as a better indicator of financial sector reforms than monetary aggregates such as private sector credit commonly used as a proxy for financial sector reforms is true since it impacted more positively on agricultural investments and growth in Nigeria.

It is therefore suggested that the Government adopts strong macroeconomic policies targeted to bring meaningful growth in the agricultural and financial sector against foreign-based economic policies since the results confirmed the significant impact of financial sector reforms on agricultural growth in Nigeria in the long and short-run. A well secured bank-based financial system through strong financial regulation, good supervision, regular and sustainable institutional reforms could be created in doing this. The current restructuring in the financial institutions should be seriously addressed with appropriate regulatory frameworks instituted to prevent future recurrence. The empirical results showed that financial sector drives agricultural growth both in the long and short-run. Therefore, more focus should be centered on financial sector development in order to aid more agricultural growth in the economy since financial sector enhances agricultural performance in Nigeria in the long-run and in the short-run.

There should be a well-formulated regulatory framework that will support a level playing field in a liberalized economy. A liberalized macroeconomic environment would foster the growth and expansion of competitive economic entities, which would in turn encourage growth and competition within the financial sector, develop a strong, transparent institutional and legal framework for financial sector activities. Government and corporate individual should jointly improve and provide enabling environment in the country such as economic, institutional and

social infrastructures that will create incentives for the growth of business opportunities on a sustainable basis and allow financial institutions to expand.

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