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EFFECT OF SELECTED MACROECONOMIC VARIABLES ON AGRICULTURE SECTOR GROWTH IN NIGERIA (1981-2018)

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Abstract

The common risk factor normally assessed by farmers is the weather risk, and the general problem of ignoring the risk associated with the movements in macroeconomic indicators have posed some significant threat. The study examined the effects of selected macroeconomic variables on agricultural growth in Nigeria. Macroeconomic variables examined include exchange rate, interest rate, broad money supply, deposit money bank credit and Agricultural Credit Guarantee Scheme Fund (ACGSF) on agricultural growth in Nigeria. Secondary data on macroeconomic variables was obtained from the CBN statistical bulletin. Ordinary Least Squares (OLS), and Error Correction Models (ECM) were employed for empirical analysis. The outcome of the ADF unit root test showed that the variables considered in the analyses were stationary. The co-integration result showed that there exists co-integration amongst the variables in the model. The Parsimonious Error Correction Model indicates that the R2 is 60% meaning that the dynamic model is a good fit. The Durbin Watson value of approximately 2.0 indicates a lesser level of autocorrelation. This means that the successive values of the error term are serially correlated. The following coefficients, for exchange rate, interest

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Rate, broad money supply and deposit money bank credit are positively signed and statistically not significant at 5 percent level with agricultural growth. The study recommends that government should train and educate farmers on the role and effects of macroeconomic indicators on their farm enterprise. Government to implement discounted interest rates for the farmers and strengthen the ACGSF.

INTRODUCTION

The agriculture sector is enormously susceptible to risk and uncertainty. Farmers and agribusiness administrators carefully observe changing climate patterns, programs associated with farming, prices, sales and so on to lessen their exposure to risk and vulnerability (Calvin Miller, 2008). However, numerous farmers and agribusiness administrators are less acquainted with one of the major risk factors that can altogether influence their business activities' productivity – this is, policies of the government. Macroeconomic strategy changes frequently significantly affect the agrarian economy. Despite the fact that policymakers attempt to plan approaches to improve the national economy, these strategies regularly have unintended and unsafe consequences for the rural economy (Isukul *et al.,* 2020). Therefore, farmers, agribusiness practitioners, administrators and policy makers must comprehend the policy process, procedure and the likely influence that changing macroeconomic decisions could have on agriculture (Agbugba and Binaebi, 2018). This information will place them in a superior position to respond deliberately to real or foreseen changes in the economy.

Macroeconomics involves the investigation of overall growth, structure, conduct and basic leadership of an economy (O'Sullivan and Sheffrin, 2003). The central government attemts to control the activity of the national economy through different strategies, for example, changing the degree of taxation, spending, or the source of cash accessible in the economy. Fluctuating macroeconomic policies and programmmes influence incomes, costs, interest rate and trade all of which impact the agricultural economy. Some of the macroeconomic policies on the agricultural sector adopted in Nigeria from the 1970s include the financial policy where credit to the sector was given at a concessionary loan cost around 1970 and 1985; money related market changes which prompted the complete deregulation of the economy; and the creation of the Nigerian Agricultural Commerce and Rural Development Bank in 2000 (Evbuomwan et al., 2003). The Apex bank introduced the National Micro Finance Policy in 2006 as one of its agenda for complete reforms in the financial sector which is in line with its developmental function. Also, the Agricultural Credit Support Scheme was launched as an afterthought of the Federal Government and the Central Bank of Nigeria, with the active backing and involvement

of the Bankers' Committee. In 2013, an effort to stop institutional issues working contrary to sustainable growth in the agricultural sector yielded to the establishment of the Agricultural Transformation Agenda by the Goodluck Jonathan government. The plan in particular was designed to generate 3.5 million job opportunities for the populace and to increase the domestic food supply by 20 million tons (Muftaudeen and Abdullahi, 2014).

The continuous changes in monetary and fiscal policy frameworks in Nigeria with the associated poor implementations measures have resulted to great obstacle to increasing agricultural growth. This is due to the fact that fluctuations in monetary and fiscal policy tools tend to weaken the capabilities of the agricultural sector to improve food security and foreign exchange earnings (Ajayi, 2017). Apart from policy irregularities and poor implementation approaches, many macroeconomic policies in Nigeria regularly occur as temporary attempts, with little or no impact in driving the output of the real sector particularly agricultural growth. Ever since independence, the Nigerian economy appears to be facing a plunging trend mainly as a result of high interest rate which affects agricultural growth (Hermon, 2016).

Moreover, the exchange rate as a policy instrument in Nigeria has gone through significant change from the immediate post-independence era when the nation upheld fixed parity with the British pounds through the oil boom of the 1970 to the floating of the currency in 1986 with its numerous variant following the launching of the Structural Adjustment Program (SAP). In spite of government reforms on exchange rate, it has remained unsteady and has become volatile in contemporary times. Parallel to this, the agricultural sector of Nigeria has not performed acceptably as there has been huge importation of food and Agro-inputs over the decades. Also, high cost is incurred in agricultural production due to high rate of inflation (Eme, 2011).

This study intends to uncover the macroeconomic risk and uncertainties that confront agricultural economy in Nigeria, because most farmers and agribusiness operators are ignorant of the drastic impact that fluctuations in the macroeconomic variables and or government policies could have in their businesses. Even when they understand that it exist, they seem not to consider them significant and therefore relegate them in decision making process of their operations. Rather, they only focus on risk and uncertainties of output, weather, diseases, input and output prices. Based on the above, this study shall give a deeper understanding on the rate of effect of some macroeconomic variables and government policies can have on the growth of the agricultural economy in Nigeria.

OBJECTIVES OF THE STUDY

The broad objective of the study is to examine the effects of selected macroeconomic variables on agriculture sector growth in Nigeria from 1981 to 2018. Specifically, the study examined the effect:

- The effect of exchange rate on agriculture sector growth,
  The effect of interest rate on agriculture sector growth.
- The effect of broad money supply on agriculture sector growth.
- The effect of deposit money bank credit on agriculture sector growth.
- The effect of Agricultural Credit Guarantee Scheme Fund on agriculture sector growth.

RESEARCH HYPOTHESES

This study was guided by the following null hypothesis:

Ho: There is no significant relationship between selected macroeconomic variables (exchange rate, interest rate, broad money supply, deposit money bank credit, Agricultural Credit Guarantee Scheme Fund) and agricultural growth in Nigeria.

LITERATURE REVIEW

Theoretical framework

Neoclassical Growth Theory: The growth replica of Solow (1956) provided the basis for formulation of neoclassical theory. Neoclassicists considered public investments harmful to growth in the long run. The neoclassicists believed government spending crowds out private sector investment owing that government borrowing and taxes are always increased when the government is confronted with budget deficit. This they argued tends to add to the expenses to be borne by firms which are transferred to the consumers in the form of higher prices. Also, public investments discourage private investments due to associated crowding out effect. This is because government borrowing tends to raise interest rates which reduces borrowing willingness and capacity of private investors to borrow given the increased cost of borrowing and its adverse consequence on cost of production. Additionally, the increase in the tax burden constrains the productive capacity of firms due its negative implication on the production cost. Consequently, the level of economic growth tends to decline with an increasing tax burden.

Keynesian Theory of Growth: The theory emerged from Keynes (1936) publication of "the general Theory". The basic presumption of the principle is that government involvement in the economy has the capacity of generating multiplier effect on the economy which can spur the process of growth and in turn contribute emphatically to sectorial development (example agriculture). Thus, a rise in government spending has ripple effect on aggregate demand, income, investment and employment via the workings of the multiplier. Consequently, increments in government expenditure increase cumulative demand which necessitates a rise in output given the government-expenditure multiplier. Keynes considers public spending as exogenously determined which could be used to facilitate growth (Ewubare and Eyitope, 2015). Based on Keynesian assumptions, government is expected to fine-tune the economy to generate expected outcomes. These provide platforms for increasing the level of economic activity.

Unfortunately, Keynes theory is criticized for its unrealistic assumption of multiplier effect of public spending on the domestic economy given the large dependence of the domestic economy on imported goods and services.

Endogenous Growth Theory: The theory states that for any country to experience economic growth, interest in human capital, advancement and information are inevitable. The theory emphasizes why it's very important for both the public and private sector to motivate people to be innovative. The theory believes that diversifying an economy properly in other non-oil sectors is likely to influence economic growth via the following three ways, performance of the agricultural sector, manufacturing sector and solid mineral.

Input-Output Theory: The theory explains the inter-relationship between industries in an economy as input in one industry is regarded as output of another industry. The development of the theory was focused towards evaluating and measuring the relationship that exists between major sectors of an economy. The theory proposed that all sectors of an economy are mutually dependent on one another as the output produced from one sector makes up the input of another sector in the same economy. For instance, the output from agricultural sector says maize is seen as a raw material input for the manufacturing sector for the manufacture of cornflakes, flour, starch, etc. Recognizing and harnessing the role inter-dependence of different sectors play as provided by the input-output theory is essential for greater economic growth.

CONCEPTUAL FRAMEWORK

Concept of Macroeconomic policy

Macroeconomic policy encompasses combination of fiscal, monetary and commercial policies geared towards stimulating or controlling key economic indicators. These indicators include gross domestic products, money supply, interest rate, inflation rate and exchange rate, unemployment, balance of payment positions amongst others. In the widest perspective, macroeconomic policy is about growth and its sustainability that have been distinguished as key national objectives. At the most total level, macroeconomic strategy comprises of fiscal, monetary and exchange rate. The fundamental thought of macroeconomic arrangement is to utilize financial and fiscal approach to accomplish output that is neither so high that it declines joblessness problem nor so low that it triggers inflationary pressures (Ajayi 2017). Whilst fiscal focuses attention in changes in the expenditure component or taxation to enhance growth.

Policy of money deals with alternation in money supply or interest rate that influences aggregate macro-economic outcomes. The fiscal as well as monetary policy operations in the country have varied in response to macroeconomic outcomes. Monetary policy provides the platform for the central bank to adjust monetary aggregates in order to achieve set macroeconomic goals. Adjustment in monetary aggregates helps the central Bank to indirectly control key macro-economic variables. The level of development of the monetary sector determines the monetary policy instrument to be adopted by the Apex monetary Authority (CBN 2011). Monetary approach manages government intentional activities in burning through cash and imposing charges with the end goal of impacting macroeconomic variables in a desired manner. The monetary instruments prevalent in the Nigerian economy are; Direct credit control to direct the percentage or amount of loans Deposit Money Banks (DMBs) provide to different sectors of the economy, Reserve requirements to influences the credit creating ability of Deposit Money Banks by CBN, Open Market Operations (OMO) which directs the purchase or sale of government securities in both primary and secondary markets with a view to increase or reduce the extent of money in movement, Discount Window Operations to provide room for the CBN to grant loans to deposit Money Banks in compliance with its function as lender of last resort, Prudential Guidelines to direct and guide Deposit Money Banks to exercise caution in the credit allocation functions, Moral Suasion to compel banks and other financial specialists into holding fast and complying to CBN guidelines, Exchange Rate to effect the monetary base by CBN in purchase or sell of foreign exchange to be able to guarantee the existence of an optimal exchange rate (Uzah and Agbugba, 2022). Furthermore, the fiscal Policy has customarily been related to the utilization of tax collection and government expenditure to control the degree of the economy. The usage of fiscal approach is basically steered towards government's financial action

and budget. The budget is a plan of action for government. It reflects and shapes a nation's financial life (Omotigun and Ayinla, 2007). Governments regularly utilize fiscal Policy to advance solid and feasible development and decrease poverty rate. Fiscal Policy that builds total interest legitimately through an expansion in government spending is regularly called expansionary fiscal arrangement. On the contrary, fiscal policy is frequently considered contractionary or restrictive if it reduces demand through lower spending or increases the tax burden (Horton and El-Ganainy, 2009). In realizing fiscal policy, the government considers deficit, surplus and balanced budgets. In deficit budget government expenditure outweighs its revenue, in surplus budget the government revenue is greater than government expenditure while in balanced budget, government expenditure equals government revenue. Budget surplus is applied during economic recession or depression as expansionary fiscal policy to increase government expenditure and decrease tax burden on both citizens and corporates thereby decreasing production cost and ensuring maximal operation level. Likewise, increasing spending by government if rightly channeled causes improvement in the developmental infrastructure of the nation and enhancement in the general wellbeing of the citizens that puts the economy on the right economic path. However, the dispute with this surplus deficit is how it will be funded (Ajayi, 2017). Some of the key objectives of fiscal are; to achieve full employment where a country attempts to minimize joblessness to realize adequate employment level for its citizens, to minimize price fluctuation and to achieve stability, to achieve economic growth and boost the pace of economic activities, allocation of resource by diverting the resources from unproductive sectors of the economy in accordance with the long-run objectives of the government.

Concept of Exchange Rate

Exchange rate is the value of a nation’s currency in terms of another currency. It is the rate at which one cash is exchanged for another (Todaro and Smith 2011). It has two parts - local and foreign cash. According to Gbanador (2007) exchange rate is seen as the number of one unit of a nation’s currency that can be exchanged for a unit of another nation’s currency. For instance, an interbank foreign exchange rate of N362.00 (rate as at 5th February 2019) to the United States dollar means that N362.00 will be exchanged for each 1 United States dollar. In this case it is said that the price of a dollar in relation to the Naira is N362.00. In his explanation, Gbosi (2005) conceptualizes exchange rate as the value of a domestic currency in relation to foreign money and vice versa.

Exchange rate has been a huge instrument for macroeconomic administration in Nigeria, as it has been as often as possible connected in the past to save the estimation of the naira, keep up external reserve position as guaranteed value security (Ogun, 2004). The foreign exchange market has been defined by Tom Ekine (2011) as the mode of collaboration between the merchants and purchasers of remote trade in an offer to arrange a commonly worthy cost for the settlement of universal exchanges. The reason for outside trade is to allow moves or buying force designated in one cash to another, that is to exchange one money to another. In international trade, foreign exchange is required for business transactions. In fact, the exchange rate is the direct offshoot of international trade. The exchange rate and foreign exchange market exist because different countries use different currencies to pay for international trade (Gbanador 2005). The foreign exchange market is the mechanism of association among dealers and purchasers of remote trade with an intention to decide a commonly adequate rate for the settlement of universal exchanges (Ezirim 2005).

Concepts of Interest rate

Interest rate is the charge paid for the use of loans by borrowers and also income for parting with fund by the lenders. Just like other prices, interest rates perform a regulating role by distributing inadequate supply of credit among the many competing demands (Ibimodo 2006). Keynes' definition of interest rate concentrated more on the loaning rate. Keynes interest rate is the yield or profit on equity or opportunity cost of shifting present-day consumption into the future. Some examples of interest rate include the savings rate, lending rate and the discount rate (Adebiyi 2002). It is usually expressed per annum. Fluctuations in interest rates rightly impact viability of the agricultural sector by affecting borrowing of funds, expenditure and investment of funds, as the sector is a highly capital intensive one. Fluctuating interest rates directly affects agricultural industry by distressing the rate of overall economic production activities, such as yield and employment rate, exchange rates and international trade events.

Agricultural Growth in Nigeria

Agricultural growth could be described as steady increase in the actual output of agricultural goods and services within a period of time. In other words, it is a sustained process whereby the gainful capacity of the agricultural sector is expended over a period of time to bring about increasing level of agricultural output. Agricultural growth leads to agricultural development as both go hand in hand. Agricultural development itself is defined by Olusegun

(1999) as a planned and sequential effort to use resources of agriculture in a country for the gains of farmers, employees of agriculture and the whole citizen. According to Aigiobenebo (2001), agricultural development is explained to mean growth in real total agricultural output which is measured by growth in the productive index and a significant change in the sectorial structure of an economy. Agriculture development could be described to mean availability of valuable and enhanced food resources, improved amenities like water, electricity, education, road and minimized reliance of the rural population on the urban population for their general well-being. Agricultural output growth can increase growth in the non-agricultural sector of the economy via diverse means, some of which are direct and indirect. According to Johnston and Mellor (1961) agriculture adds to economic development via 5 related sectorial connections.

The sectors of the economy are connected through the following: Provisions of surplus labour to businesses in the industrial activities; Provision of food for local utilization; Supply of market for industrial goods; Provision of domestic savings; Provision of outside trade from farming fare and income to back import of intermediate and capital products.

Block and Timmer (1994) argues that agriculture in a roundabout way adds to development through its supply of improved caloric nutrient intake by the poor, availability of food, stability of food price and poverty reduction. Agricultural output in higher dimensions is very important for economic growth particularly in continents like Africa, due to solid development linkages and relative advantages in business. Greater agricultural output can yield beneficial results in three folds; sustenance of food, higher human improvement and lower pressure on water and land (UNDP, 2012).

Macroeconomic Programmes and Agricultural Growth in Nigeria

According to Nsikak-Abasi and Dumka (2015), commitments of successive Nigerian government toward growth of agricultural sector was seen since the post-independence era through and policy reviews that ensures that economic development objective of the nation is achieved. It has been that way given the abundant resources before the advent of the crude oil that has become the major source of income for Nigeria. The Nigerian government instituted and executed various policies and programs to be able to stabilize and enhance the agricultural growth. Other macroeconomic mechanisms adopted by the Nigerian authority show commitment in agricultural growth were in the areas of credit schemes to give adequate support to rural farmers with the hope of ensuring adequate supply in the country.

The Central Bank of Nigeria (CBN) has through these credit schemes made available various lending opportunities with lower interest rate for agricultural sector to be utilized by willing farmers. Some of these programs and schemes are still in existence while some have been abandoned and relegated due to their failure to achieve the targeted objectives. Some of these programs include: The Nigerian Agricultural and Cooperative Bank (NACB), World Bank Agricultural Development Projects (ADPs), Rural Banking Programme, Agricultural Credit Guarantee Scheme Fund, Mandatory Sectorial Allocation to Agriculture, Commercial Agriculture Credit Scheme (CACS) and Nigerian Incentive-based Risk sharing system for Agriculture Lending (NIRSAL).

The Nigerian Agricultural and Cooperative Bank (NACB)

The Nigerian Agricultural and Cooperative Bank was created in 1973 as an agricultural development bank to contribute to the growth of agriculture through extension of credit. The specific objectives of the bank are "to assist in promoting agricultural production and rural development and improving the standard of life of Nigeria's rural population and make the nation self-sufficient in food production (Ajakaiye, 1985). According to Ijoma (1985) the NACB devised an on-lending scheme which is a market strategy to achieve the following: i) Maximize impact to NACB funds by reaching a large number of farmers, especially those who could have been excluded due to the small size of their holdings; and ii) Combine credit component with extension services, input procurement, proper project formulation and supervision. The bank lends to government bodies and cooperatives which in turn, on-lend to the ultimate beneficiaries. At the time of recovery, the on-lending institutions are held responsible for recovering the dues from beneficiaries.

World Bank Agricultural Development Projects (ADPs)

This is an attempt at comprehensive integrated development of rural areas, not necessarily a financial scheme. The projects were developed as a new strategy for enhanced fibre and food production with the small-scale farmer as the pivot. The success of these experimental projects, as a result of the introduction of inputs like fertilizers, pesticides, improved seeds, and crop varieties and modern techniques of farming, has encouraged further government participation (Agbugba *et al.* 2021). The ADPs involves four activities. The first activity involves construct of extensive network of feeder roads in the agriculturally productive rural areas to

facilitate the evacuation of farm produce and timely delivery of farm inputs like treated seeds, pesticides and fertilizers.

The second is about construct and establishing farm service centers which will be storage and distribution centres for farm inputs. These are intended to ensure that farmers travel a maximum of 5 to 6 kilometers to purchase farm inputs, obtain credit or seek requisite extension advice. Third; effective extension services are provided, and farmers are trained in on-farm adaptive research utilization and modern techniques of farming. The fourth activity is about establishing a project monitoring and evaluation system.

According to Okorie, 1985, the ADP projects were reported to have performed well in their operational areas. The ADPs are based primarily on investment in physical and institutional infrastructure. Physical infrastructures comprise rural feeder roads, dams, ponds, wells, buildings and soil conservation embankments and institutional infrastructure includes farm service centres.

The Rural Banking Programme

The Rural Banking Programme was instituted July 1977. The objectives of the programme include cultivation of banking habits in rural areas, mobilization of savings and their use for profitable ventures in rural areas, improvement of agriculture and agro-based businesses, reduction of the exodus of young men to the cities and the achievement of the national objective of self-sufficiency in food production. The programme was in two phases during which banks were directed to branches open in rural areas. 30%, later raised to 40% of funds mobilized were to be retained in investments in rural areas. In the first phase, 1977 to 1980, 200 bank branches were opened in the rural areas and in the second phase, 1980-1983, 266 branches were allocated to different commercial banks for development and commissioning in the rural areas. The first phase was completed but the second phase was not fully implemented (Ike, 1986). The non-completion of the second phase was due to problems of inadequate infrastructure, lack of suitable accommodation, high cost of renting properties, poor access roads and absence of police protection and security encountered in implementing the programme (Abe, 1984).

The Rural Banking Programme led to improved rural banking habits, provision of credit for small scale ventures and increased rural employment opportunities (Abe, 1984).

The Agricultural Credit Guarantee Scheme Fund

The Agricultural Credit Guarantee Scheme Fund (ACGSF) is a policy instrument of the Federal Government of Nigeria on Agricultural Credit. The scheme started effectively in 1978 and was established to provide guarantee on loans granted by financial institutions to farmers for agricultural production and agro-allied processing (Nwosu and Oguoma 2010). The general purpose of the scheme is to encourage banks to lend to those engaged in agricultural production and agro-processing activities. Thus, the specific objectives of the scheme is the stimulation of total agricultural production for both domestic consumption and export; and the encouragement of financial institutions to participate in increasing the productive capacity of agriculture through a capital lending programme (Agbugba *et al.,* 2021).

Mandatory Sectorial Allocation to Agriculture

According to Sanyal and Babu, 2010, Commercial and Merchant banks were mandated to extend a minimum of 6% of their loan portfolio to agriculture which was later increased to 12%. Trade policy on abolition of export duties on scheduled export crops in 1973 in order to promote agricultural export trade. Liberation of imports in respect of food agricultural machinery and equipment. A summary of the microeconomic policies in Agriculture during the period were as follows: Agricultural Commodity Marketing and Pricing Policy: In 1977, Six national commodity boards were established which include commodity boards for cocoa, groundnuts, palm produce, cotton, rubber and food grains. Land use Policy was promulgated by the Federal Government in 1978 vesting the ownership of all lands on the government to give genuine farmers access to farmland. Agricultural extension and technology transfer policy aimed at improving the adoption of improved agricultural technology by farmers with the National Accelerated Food Production Project (NAFPP) and Agricultural Development Projects (ADPs) as implementing agencies. Input supply and distribution policy was promulgated to ensure adequate and orderly supply, of agricultural inputs notably fertilizers, agro-chemicals, seeds, machinery and equipment (Dimgba *et al*., 2023).

In 1975, Government Centralized Fertilizer Procurement and distribution with numerous agro-service centers nationwide. In 1972 Government created National Seeds Service (NSS) to produce and multiply improved seeds such as rice, maize, cowpea, millet, sorghum, wheat and cassava. Agricultural input subsidy policy on fertilizer, seed (50%) agro-chemicals (50%) and tractor hiring services (50%). Agricultural research policy: The policy was aimed at coordination and harmonization of agricultural research and extension linkage. Agricultural cooperatives policy: In 1979, a department of agricultural cooperatives within the Federal Ministry of

Agriculture, Water Resources and Rural Development was created to actualize this policy aimed at encouragement of farmers to form cooperatives and the use of same for the distribution of farm inputs and imported food commodities. Water Resources and irrigation policy brought about the establishment of eleven River Basin Development Authorities in 1977 charged with the responsibility of developing Nigeria's lands and water resources. Agricultural mechanization policy: The policy was instrumental to the creation of the Ministry of Science and Technology and the establishment of some universities of science and technology. The operation of tractor hiring units in all the states of Nigeria reduced import duty on tractors and agricultural equipment and implements, generalized and liberalized subsides on farm clearing and establishment of a centre for agricultural mechanization.

The Commercial Agriculture Credit Scheme (CACS)

CACS was established in 2009 to finance large-ticket projects along the agricultural value chain. The scheme was administered at a single digit rate of 9 percent to beneficiaries. State Governments, including the Federal Capital Territory (FCT), can access a maximum of N1.0 Billion each for on lending to farmers' cooperatives or other areas of agricultural interventions that suit them (Oguoma, 2002).

The Nigerian Incentive-based Risk sharing system for Agriculture Lending (NIRSAL)

According to Business news (2014), NIRSAL was introduced by the CBN in 2011 to provide farmers with affordable financial products and reduce the risks of such loans to the benefiting farmers. The apex bank in August 2009, signed an agreement with the Alliance for Green Revolution in Africa (AGRA) to develop the mechanism for unlocking the access of farmers, agro processors, agribusiness and input suppliers to financing in the agricultural value chain. It is aimed at de-risking the sector by repackaging agriculture to become a real business that will guarantee food security, create employment, supply needed raw material to the industrial sector as well as serve as a veritable vehicle for wealth creation. NIRSAL was expected to break the age-old transition (small-holding subsistence agriculture production that is not commercially viable) in two ways. This would be done by fixing the agricultural value chain in order for banks to lend to the sector without much apprehension. This in turn will encourage banks to lend to agricultural value chain from their balance sheets and without recourse to government funds, by offering the unprecedented incentives and technical assistance.

This is to be achieved through NIRSAL-five solution components. The first component of the solution include the Risk Sharing Facility (RSF). RSF is designed to support the deployment of different risk-sharing instrument to reduce the risk of lending to agriculture by commercial banks. The second component involves the Insurance Component (IC). IC is intended to identify existing insurable risks, existing solutions for coverage in the development of such solutions and link such products to the loans provided by the banks to beneficiaries. Third, the Technical Assistance Component (TAC), is about creating the support banks that have clearly demonstrated interest and verifiable commitment to enter into agricultural lending especially small-holder agricultural lending. The Bank Incentive Mechanism (BIM), which is the fourth component of the solution, is designed to ensure that all deposit money banks (DMBs) which show strong commitment to lending to agriculture, was further incentivized through the use of low guarantee fees. It also include the RSF and scaling up access to capital for agricultural lending at a lower rate from the CBN. Lastly, the fifth component of the solution involves the Agricultural Bank Rating System (ABRS). ABRS was planned by the CBN to stimulate SMEs in the country.

METHODOLOGY

This section presents the methods adopted in carrying out the study thereby capturing the nature and sources of data, model specification and techniques of data analysis.

Types and Sources of Data Collection

Secondary data sourced from publication of the Central Bank of Nigeria Statistical Bulletin, 2018 was used (see table 4.1). Time series data relating to the dependent and explanatory variables were employed for a period covering 1981 and 2018. In table 4.1 the dataset sourced from the Central Bank of Nigeria Statistical bulletin is presented.

Table 4.1: Data on Agricultural Gross Domestic Product (AGDP) and macroeconomic variables.

YEAR	AGDP (N' Bn.)	EXR (N/USD	INT (%)	M2 (N' Bn.)	ACGSF (N' Thousand)	DMBCA (N' Bn.)
1981	2,364.37	0.61	7.75	14.47	35,642.40	0.6
1982	2,425.96	0.67	10.25	15.79	31,763.90	0.8
1983	2,409.08	0.72	10.00	17.69	36,307.50	0.9
1984	2,303.51	0.76	12.50	20.11	24,654.90	1.1

1985	2,731.06	0.89	9.25	22.30	44,243.60	1.3
1986	2,986.84	2.02	10.50	23.81	68,417.40	1.8
1987	2,891.67	4.02	17.50	27.57	102,152.50	2.4
1988	3,174.57	4.54	16.50	38.36	118,611.00	3.1
1989	3,325.95	7.39	26.80	45.90	129,300.30	3.5
1990	3,464.72	8.04	25.50	52.86	98,494.50	4.2
1991	3,590.84	9.91	20.01	75.40	79,107.40	5.0
1992	3,674.79	17.30	29.80	111.11	91,953.10	7.0
1993	3,743.67	22.05	18.32	165.34	80,845.80	10.8
1994	3,839.68	21.89	21.00	230.29	104,463.00	17.8
1995	3,977.38	21.89	20.18	289.09	164,133.10	25.3
1996	4,133.55	21.89	19.74	345.85	225,519.50	33.3
1997	4,305.68	21.89	13.54	413.28	242,028.30	27.9
1998	4,475.24	21.89	18.29	488.15	219,144.20	27.2
1999	4,703.64	92.69	21.32	628.95	241,839.00	31.0
2000	4,840.97	102.11	17.98	878.46	361,449.00	41.0
2001	5,024.54	111.94	18.29	1,269.32	728,545.40	55.8
2002	7,817.08	120.97	24.85	1,505.96	1,050,982.30	59.8
2003	8,364.83	129.36	20.71	1,952.92	1,151,015.00	62.1
2004	8,888.57	133.50	19.18	2,131.82	2,083,744.70	67.7
2005	9,516.99	132.15	17.95	2,637.91	9,366,392.90	48.6
2006	10,222.47	128.65	17.26	3,797.91	4,195,099.68	49.4
2007	10,958.47	125.83	16.94	5,127.40	4,087,447.94	149.6
2008	11,645.37	118.57	15.14	8,008.20	6,497,958.93	106.4
2009	12,330.33	148.88	18.99	10,780.63	8,328,565.78	135.7
2010	13,048.89	150.30	17.59	11,525.53	7,840,496.63	128.4
2011	13,429.38	153.86	16.02	13,303.49	10,028,988.81	255.2
2012	14,329.71	157.50	16.79	15,483.85	9,332,484.23	316.4
2013	14,750.52	157.31	16.72	15,688.96	9,256,676.80	343.7

2014	15,380.39	158.55	16.55	18,913.03	12,456,250.87	478.9
2015	15,952.22	193.28	16.85	20,029.83	10,857,380.83	1,870.6
2016	16,607.34	253.49	16.87	23,591.73	7,858,643.35	1,979.8
2017	17,179.50	305.79	17.58	24,140.63	5,849,388.73	2,012.3
2018	17,543.70	352.61	16.65	26,791.28	5,423,172.46	2042.40

Source: CBN statistical bulletin (Various Issues)

Model Specification

The econometric relationship between the dependent variable and the independent variables is presented below;

AGDP = F(EXR, INTR, M2, ACGSF, DMBCA) (1)

$AGDP = a_0 + a_1EXR + a_2INTR + a_3M2 + a_4ACGSF + a_5DMBCA + U$ (2)

Where;

AGDP = Agricultural contribution to Gross Domestic Product (Agricultural Growth);

EXR = Exchange Rate;

INTR = Interest Rate;

M2 = Broad Money Supply;

ACGSF = Agricultural Credit Guarantee Scheme Fund;

DMBCA = Deposit Money Bank Credit to Agriculture.

U = Error term.

a0 = intercept of constant term;

a_1-a_5 = coefficients of the independent variables;

Log = natural log

t = time trend

On the a priori expectation, $a_1 <> 0$, $a_2 < 0$, $a_3 > 0$, $a_4 > 0$, $a_5 > 0$.

EXPLANATION OF VARIABLES IN THE MODEL

Dependent variables

Agricultural contribution to Gross Domestic Product: this refers to total monetary value of agricultural commodities and services generated in an economy usually in a year. This is used to assess the performance of the Nigerian agriculture.

Definition for independent variables

Exchange Rate, is the price of on unit of foreign exchange in respect to domestic currency. Interest Rate: This is payment made for use of credit by borrowers. It can also be viewed as the cost of borrowing money, measured in Naira, per year, per Naira borrowed. Broad Money Supply is the whole load of money and other liquid instruments in a nation's economy at a specific time . Agricultural Credit Guarantee Scheme Fund: these are funds provided by federal government of Nigeria to guarantee banks against inherent risk in their lending to agricultural sector. Deposit Money Bank Credit to Agriculture, is the loan obligation given by a bank to a farmer at a loan cost, and proved by a promissory note which indicates in addition to other things, the principal amount of cash obtained, the financing cost the money lender is charging, and date of reimbursement (www.eduproject.com.ng).

TECHNIQUE OF DATA ANALYSIS

The ordinary least squares (OLS), unit root, co-integration and error correction mechanism methods were utilized by the study. The OLS was employed to examine the short run behavior of the variables pertaining to the research. Unit Root Test was used to test for the order of integration of the individual times series items, as adopted by Isukul *et al.* (2019). Augmented Dickey-fuller (ADF) test was the type unit root test used for the work and the general form of ADP is estimated by the following regression.

$$\Delta y_t = \alpha_0 + \alpha_1 y_{t-1} + \sum \alpha_1 \Delta y_i + \delta_t + U_t \quad (3)$$

Where;

y= time series, t= trend in time, $\Delta =$ operator (first difference), $\propto_{0=}$ constant, n= lags (number) and U= error term.

Co-Integration Test: The basic argument of Johansen's procedure is that the rank of matrix of variables are used to determine whether or not the two variables are co-integrated. A lack of co-integration suggests that such variables have no long-run relationship. Co-integration is conducted based on the test proposed by Johansen (1998). Johansen's methodology takes its starting point in the vector auto regression (VAR) of order P given by

$$y_t = \mu + \Delta_1 y_{t-1} + - - + \Delta p y_{t-p} + U_t \quad (4)$$

Where: $y_{t=}$ nx1 vector (variables) usually order (1) and U_t = nx1 vector (innovations).

The VAR may be as expressed as:

$$\Delta y_t = \mu + \eta y_{t-1} + \sum \tau_i \Delta y_{t-1} + U_t \quad (3.6$$

To determine the number of co-integration vectors, Johansen (1988) and Johansen and Juselius (1990) suggested two statistic test, the first one is the trace test (trace). It tests the null hypothesis that the number of distinct co-integrating vector is less than or equal to q against a general unrestricted alternatives q = r. the test calculated as follows:

$$\lambda \text{ trace } (r) = {}^{-T}\sum In^{(1-\lambda t)} \quad (5)$$

Where: T is the number of usable observations, and the λt's are the estimated eigenvalue from the matrix.

Error Correction Model

The Error Correction Mechanism (ECM) was used to ascertain the short run dynamics to long run equilibrium relationship and as well measure the speed of adjustment from the short-run equilibrium to the long-run equilibrium state. The greater the co-efficient of the parameter, the higher the speed of adjustment of the model from the short-run to the long-run.

The ECM equation is presented as follows:

$$Y_t = \alpha_0 + \sum \alpha_{1t} P_{t-1} + \sum \alpha_{2t} Qt_{-1} + \sum \alpha_{3t} R_{t-1} + \delta_1 ECM_{t-1} + U_{1-t} \quad (6)$$

The following parameters test were used to explain the various methods; the coefficient of determination R^2 test**.** R^2 test measures the goodness of fit of a model. The T-test was used to determine the individual significance of the explanatory variables. The F-test was used to determine the joint significance of the explanatory variables. That is, the overall test of significance of the model. The Durbin-Watson test, was used to determine the presence of serial auto correlation.

RESULTS AND DISCUSSION

Analysis of Short Run Result

Table 4.2 presents the results of ordinary least square. The short-run result as seen in table 4.2 in chapter four shows that R2 is 0.979, indicating that the variation in Agricultural growth (AGDP) explained by Exchange Rate (EXR), Interest Rate (INTR), Broad Money Supply (M2), Agricultural Credit Guarantee Scheme Fund and (ACGSF) Deposit Money Bank Credit to Agriculture (DMBCA) is 98 percent. Therefore, the explanatory power of the model estimated is 98 percent. This shows the goodness of fit of the model. The goodness of fit of the model was supported by the statistical significant of the entire regression model with F-Value of 297.18 and the probability (F-statistic) of 0.000000. Moreover, the coefficient of Exchange Rate (EXR) variable showed positive sign and statistically significant at 5 percent level. The positive sign does not conform to the apriori expectation which hypothesized a negative sign. This means that a percentage increase in exchange rate will increase Agricultural growth (AGDP) in Nigeria during the period. The result indicates that Exchange rate significantly has effect on AGDP in Nigeria during the study period. Furthermore, the coefficient of Interest Rate (INTR) variable showed positive sign and statistically not significant at 5 percent level. The positive sign does not conform to the apriori expectation which hypothesized a negative sign. This means that a percentage increase in interest rate will increase Agricultural growth (AGDP) during the studied period. Also, the result revealed that interest rate does not significantly has effect on AGDP in Nigeria during the period of study.

The coefficient of Broad Money Supply (M2) variable showed positive sign and statistically significant at 5 percent level. This conforms to the apriori expectation. This means that a percentage increase in broad money supply will increase Agricultural growth (AGDP) in Nigeria during the studied period. Also, the result reveals that broad money supply significantly has effect on AGDP in Nigeria during the study period.

The coefficient of Agricultural Credit Guarantee Scheme Fund (ACGSF) variable showed positive sign and statistically significant at 5 percent level. This conforms to the apriori expectation. This means that a percentage increase in Agricultural Credit Guarantee Scheme Fund will increase Agricultural growth (AGDP) in Nigeria during the studied period. Also, the result indicates that Agricultural Credit Guarantee Scheme Fund significantly has effect on AGDP in Nigeria during the study period. The coefficient of Deposit Money Bank Credit to Agriculture (DMBCA) variable appeared with a negative sign and statistically not significant at 5 percent level. The negative sign does not conform to the apriori expectation which hypothesized a positive sign. This means that a percentage increase in Deposit Money Bank

Credit to Agriculture will decrease Agricultural growth (AGDP) in Nigeria during the studied period. Also, the result shows that Deposit Money Bank Credit to Agriculture does not significantly has effect on AGDP in Nigeria during the period of study.

The Durbin Watson value of 1.59 is a little far from 2.0. This indicates the presence of serial autocorrelation, which means that the successive values of the error term are serially dependent or correlated. The analysis of the short-run so far shows that the OLS regression result is fairly good but its adoption for policy may be misleading due to existence of autocorrelation and high R-square. The reason for the above could be as a result of the non-stationarity of time series data that are used for the study. Hence, there is need to carry out unit root (Stationarity) test and long-run analysis in order to conform the long-run equilibrium of the model and resolve all inconsistencies in data variables.

Table 4.2: OLS Regression Results

Dependent Variable: AGDP

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXR	26.61974	3.386311	7.860984	0.0000
INTR	38.94355	29.88843	1.302964	0.2019
M2	0.238243	0.070924	3.359129	0.0020
ACGSF	0.000405	7.84E-05	5.168749	0.0000
DMB	-1.089515	0.605422	-1.799596	0.0814
C	2333.585	538.6667	4.332150	0.0001

R-squared	0.978918	Mean dependent var	7693.512
Adjusted R-squared	0.975624	S.D. dependent var	5159.264
S.E. of regression	805.5081	Akaike info criterion	16.36476
Sum squared resid	20762986	Schwarz criterion	16.62333
Log likelihood	-304.9305	Hannan-Quinn criter.	16.45676
F-statistic	297.1759	Durbin-Watson stat	1.588535
Prob(F-statistic)	0.000000		

Source: Author's Computed Result from (E-View 8.1)

Long Run Analysis of Result

Since most short run analysis may be characterized by spurious result, a stationarity test becomes necessary to stabilize the data. However, unit root test in this study is used to investigate whether or the time series used for the analysis are stationary and to find out their order of integration. This was followed by the Johansen co-integration test and the error correction mechanism to determine whether a long run equilibrium relationship exists between the variables.

Unit Root Test for Stationarity (Augmented Dickey Fuller)

The stationarity test presented in table 4.3. The unit root process in each of the variables was examined using the Augmented Dickey-Fuller test methodology. The outcome of the ADF unit root test reported in the table was that agricultural growth (AGDP), exchange rate (EXR), interest rate (INTR), agricultural credit guarantee scheme fund (ACGSF) and deposit money bank (DMB) variables are stationary at first difference, that is integrated of order one [1(1)] while broad money supply (M2) is stationary at second difference, that is, integrated of order two [1(2)]. The same stationarity test is presented in the table showed that at various level of significance (1%, 5% and 10%) the entire variables (AGDP, EXR, INTR, ACGSF, M2 and DMB) in this study were stationary with probability value of less than 0.05. Reason being that using the OLS regression techniques at 'Levels' in estimating the model would lead to spurious regression result since all of the variables were not stationary.

Table 4.3 Unit Root Stationarity Test for the Variables: Points of order of integration

Variables	ADF Test	Prob. Value	Critical Value			Order of Integration
			1% Critical Value	5% Critical Value	10% Critical Value	
AGDP	-5.68373	0.0002	-4.235	-3.5403	-3.2024	Order One
EXR	-3.79304	0.0286	-4.235	-3.5403	-3.2024	Order One
INTR	-6.2068	0.0001	-4.2436	-3.5443	-3.2047	Order One
ACGSF	-7.01444	0.0000	-4.235	-3.5403	-3.2024	Order One
M2	-6.45939	0.0000'	-4.235	-3.5403	-3.2024	Order two
DMB	-5.5984	0.0003	-4.23497	-3.5403	-3.20245	Order One

Source: Author's Computed Result from (E-Views 8.1)

Johansen Test for Co-Integration

Co-integration is conducted based on the test proposed by Johansen. Co-integration deals withthe methodology of modeling non-stationary time series variables. For details result of the Johansen co-integration, see the table 4.4 below.

The long-run connection among the variables is examined using Johansen methodology. The result is presented in Table 4.4 above. Six co-integrating equations at 5% level of significance were noticed as the trace statistic is higher than critical values at 5%. Similarly, the Max-Eigen statistics finds evidence to support the claim that there exist six co-integrating equations in the model. Based on the outcomes of the trace and Max-Eigen statistics, it therefore indicates that there exists a long-run connection. Given that there are six co-integrating equations, the requirement for fitting in an error correction model is satisfied.

Table 4.4: Test of co-integration for AGDP model

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.999470	438.4949	95.75366	0.0001
At most 1 *	0.907958	182.0605	69.81889	0.0000
At most 2 *	0.756711	100.9531	47.85613	0.0000
At most 3 *	0.591482	52.89386	29.79707	0.0000
At most 4 *	0.351746	22.45643	15.49471	0.0038
At most 5 *	0.203088	7.718357	3.841466	0.0055

Source: Computed Result Using (E-View 8.1)

Error Correction Model (ECM)

Error correction model (ECM) is a means of integrating the short-run behavior of an economic variable with its long-run behavior. Table 4.5 presents the results of error correction model. The parsimonious ECM is attained by transforming the over-parameterized ECM to make it more interpretable for policy implementation. Owing to the long-run connection among variables as confirmed from the co-integration test, the parsimonious error correction model is achieved from a general-to-specific approach by gradually deleting insignificant variables from the over-parameterized ECM as reported in table 4.5. The Parsimonious Error Correction Model (ECM) reveals that the dynamic model is a good fit. This is due to the fact that the variation in

the dependent variable accounts for 60% of the total variation of the independent variables in the model. Specifically, the R^2 value of 0.604 indicated that the variation in AGDP explained by exchange rate (EXR), interest rate (INTR), broad money supply (M2), Agricultural credit guarantee scheme fund (ACGSF) and deposit money bank credit (DMB) is 60 percent. Hence, the explanatory power of the model evaluated is 60%. The goodness of fit of the model is further expressed by the value of F-statistics at 2.17 which is statistically significant at 5% level.

Table 4.5: Parsimonious ECM for AGDP Model

Dependent Variable: D(AGDP)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(AGDP(-1))	0.548239	0.189175	2.898053	0.0089
D(AGDP(-2))	0.405573	0.176665	2.295723	0.0326
D(EXR)	9.939523	5.464729	1.818850	0.0839
D(EXR(-1))	-12.76321	6.118038	-2.086160	0.0500
D(EXR(-2))	-16.94483	6.238835	-2.716024	0.0133
D(INTR(-1))	-49.76294	21.81714	-2.280910	0.0337
D(INTR(-2))	-37.40380	20.04275	-1.866201	0.0767
D(M2)	0.185095	0.083337	2.221034	0.0381
D(M2(-1))	0.094842	0.092822	1.021761	0.3191
D(ACGSF)	9.76E-05	4.81E-05	2.029458	0.0559
D(ACGSF(-1))	-0.000187	6.71E-05	-2.789875	0.0113
D(ACGSF(-2))	-6.79E-05	4.86E-05	-1.397017	0.1777
D(DMB)	-0.756582	0.384991	-1.965191	0.0634
ECM(-1)	-0.979121	0.216103	-4.530812	0.0002
C	108.2865	114.4065	0.946506	0.3552

R-squared	0.603673	Mean dependent var	432.4177
Adjusted R-squared	0.526244	S.D. dependent var	488.0676
S.E. of regression	400.6189	Akaike info criterion	15.12143
Sum squared resid	3209910.	Schwarz criterion	15.78800
Log likelihood	-249.6249	Hannan-Quinn criter.	15.35153
F-statistic	2.175953	Durbin-Watson stat	1.609725
Prob(F-statistic)	0.054804		

Source: Computed Result Using (E-View 8.1)

This implied that the overall regression result is significant. The Durbin Watson (DW) value of 1.6 which is approximately 2.0, indicates a lesser level of autocorrelation. Meaning that the successive values of the error term are serially dependent or correlated. Moreover, an essential feature to be noticed in table 4.5 is the coefficient of the parameter of error correction term. The result shows that the first and second lags of AGDP are positively and significantly related to current level of agricultural growth. This is indicative that the past levels of growth are reliable in forecasting the current level of agricultural growth. Furthermore, the coefficient of exchange rate (EXR) is positively signed and statistically not significant at 5 percent level with AGDP. Meaning that a percentage increase in exchange rate will increase the AGDP by 9.94%. The positive impact of exchange rate agrees with the theoretical expectation while the result of lack of significance contravenes the earlier study of Abdullahi (2014). The implication of the statistically not significant of exchange rate with AGDP is that exchange rate has no effect on AGDP in Nigeria during the period of study. Therefore, the study accepts the null hypothesis which states that 'there is no significant relationship between exchange rate (EXR) and AGDP in Nigeria'.

The coefficient of interest rate (INTR) is negatively signed but statistically significant at 5 percent level with AGDP. Meaning that a percentage increase in INTR will decrease AGDP by 49.76%. The negative impact of interest rate agrees with the theoretical expectations and supports earlier study by Omojimite (2012). The implication of the statistically significance of interest rate with AGDP is that interest rate (INTR) has effect on AGDP in Nigeria during the period of study. Therefore, the study accepts the alternative hypothesis which states that 'there is significant relationship between interest rate and AGDP in Nigeria'. Furthermore, the coefficient of broad money supply (M2) is positively signed and statistically significant at 5 percent level with AGDP. This means that a percentage increase in broad money supply will increase the AGDP by 0.19%. The positive impact of money supply does not only agree with the theoretical expectations but also supports earlier study by Ali et. Al. (2010).

The implication of the statistically significance of broad money supply with AGDP is that broad money supply had effect on AGDP in Nigeria during the period of study. Hence the study accepts the alternative hypothesis which says, 'there is significant relationship between broad money supply and AGDP in Nigeria'. The coefficient of agricultural credit guarantee scheme fund (ACGSF) is positively signed but statistically significant at 5 percent at level with AGDP. This means that a percentage increase in ACGSF will increase AGDP by 9.76%. The positive

impact of ACGSF agrees with the apriori expectation and agrees with earlier study by Ewubare and Eyitope (2015). The implication of the statistically significance of the agricultural credit guarantee scheme fund with AGDP is that agricultural credit guarantee scheme fund has effect on AGDP in Nigeria. Therefore, the study accepts the alternative hypothesis which says, 'there is a significant relationship between agricultural credit guarantee scheme fund and AGDP in Nigeria.'

The coefficient of deposit money bank credit (DMB) is negatively signed but statistically not significant at 5 percent level with AGDP. Meaning that a percentage increase in deposit money bank credit will decrease AGDP by 0.76%. The negative impact of DMB disagrees with the theoretical expectation and contravenes the earlier study by Iganiga and Unemhili (2011). The implication of the statistically not significance of deposit money bank credit with AGDP is that DMB does not have effect on AGDP in Nigeria during the period of study. Therefore, the study accepts the null hypothesis which states that 'there is no significant relationship between deposit money bank credit and AGDP in Nigeria.

CONCLUSION

This study is on effects of selected macroeconomic variables on agricultural growth in Nigeria (1981-2018). It study empirically examined the effects some macroeconomic variables could have on agricultural growth in Nigeria. And the need for farmers and agribusiness operators to get familiar with macroeconomic changes that could significantly affect their business operations' profitability. The knowledge of this will help them strategically make better informed decisions in the operations rather than focus only on the conventional risk and uncertainties that affect agricultural sector such as weather, pests, diseases, input and output prices etc.

The objectives of the study were to; examine the effect of exchange rate, interest rate, broad money supply, deposit money bank credit and Agricultural Credit Guarantee Scheme Fund on agricultural growth in Nigeria. Based on these objectives, an empirical model that links selected macroeconomic variables to agricultural growth was specified and estimated using ordinary least square regression analysis and complemented with multivariate Johansen co-integration test. Meanwhile, Error Correction Mechanism is the main technique of analysis. The secondary data on AGDP, exchange rate, interest rate, broad money supply, deposit money bank credit and Agricultural Credit Guarantee Scheme Fund used are yearly observations obtained

from the Central Bank of Nigeria (CBN) statistical bulletin. The results of the unit root test showed that all the variables were stationary. Also there exists six co-integration equation amongst the variables in the model.

The parsimonious Error Correction Model (ECM) indicated that with R^2 of 60%, the dynamic model is a good fit. The Durbin Watson (DW) value of 1.6 which is approximately 2.0, suggests a lesser level of auto-correlation. Meaning that the successive values of the error term are serially dependent or correlated. Moreover, the result of the Error Correction term shows that the first and second lags of AGDP are positively and significantly related to current level of agricultural growth. This is indicative that the past levels of growth are reliable in forecasting the current level of agricultural growth. Furthermore, the coefficient of exchange rate (EXR) is positively signed and statistically not significant at 5 percent level with AGDP. Meaning that a percentage increase in exchange rate will increase the AGDP by 9.94%. The coefficient of interest rate (INTR) is negatively signed but statistically significant at 5 percent level with AGDP. Meaning that a percentage increase in interest rate will decrease AGDP by 49.76%. The coefficient of broad money supply (M2) is positively signed and statistically significant at 5 percent level with AGDP. This means that a percentage increase in broad money supply will increase the AGDP by 0.19%. Also the coefficient of agricultural credit guarantee scheme fund (ACGSF) is positively signed but statistically significant at 5 percent at level with AGDP. This means that a percentage increase in agricultural credit guarantee scheme fund will increase AGDP by 9.76%.

The coefficient of deposit money bank credit (DMB) is negatively signed but statistically not significant at 5 percent level with AGDP. Meaning that a percentage increase in deposit money bank credit will decrease AGDP by 0.76%. Thus, it could be concluded that changes in macroeconomic variables especially Interest Rate, Broad Money Supply and Agricultural Credit Guarantee Scheme Fund affect agricultural growth in Nigeria. Therefore, farmers and agribusiness operators should pay close attention to fluctuations of macroeconomics indicators and should take cognizance of them while making productive and investment decisions in their operations.

RECOMMENDATION

Based on the findings from the study, the following recommendations are made;

The study recommends that government should train and educate farmers on the role and effects of macroeconomic indicators on their farm enterprize. Government to implement discounted interest rate for the farmers and strengthen the Nogerian Agricultural Credit Guarantee Scheme Fund.

Contribution to knowledge

Farmers and agribusiness investors should pay close attention to fluctuations in macroeconomic variables and should take advantage of them while making productive and investment decisions in their operations as their effect on profitability is quite significant and enormous.

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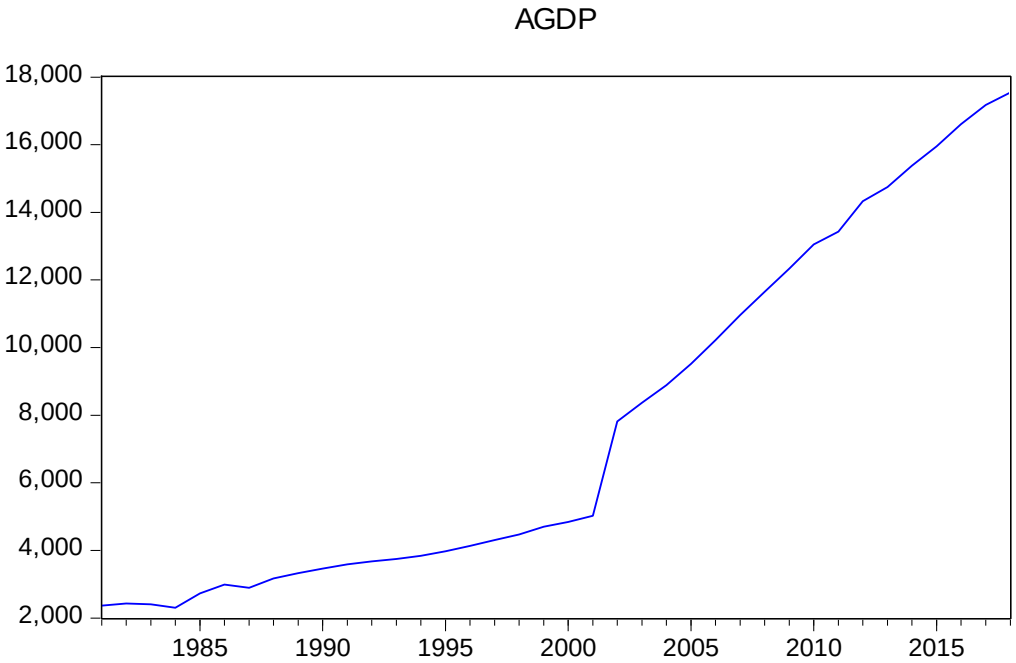
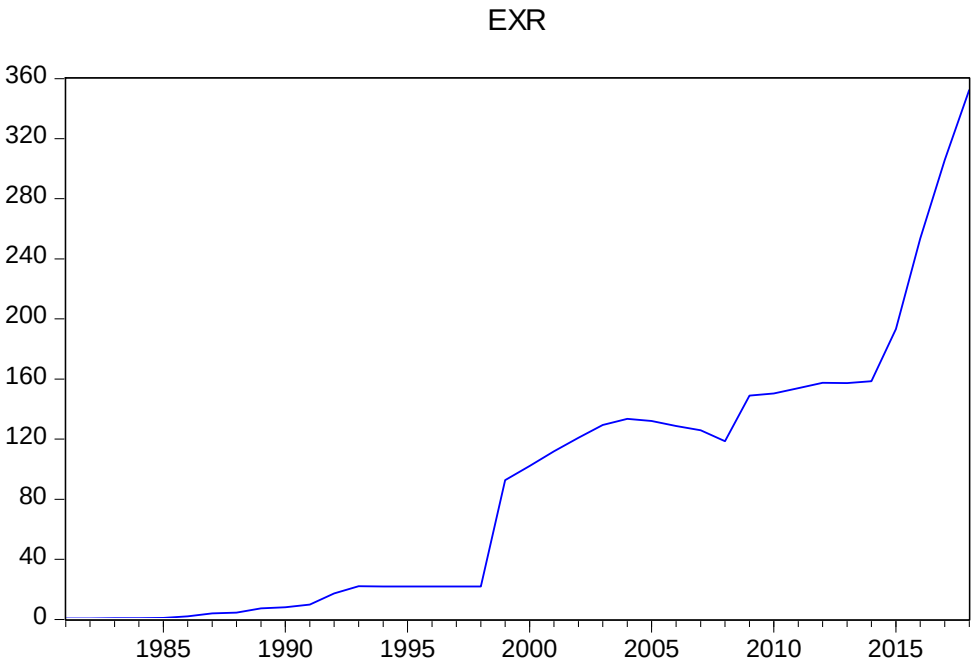
APPENDIX 1

VARIABLE TRENDS

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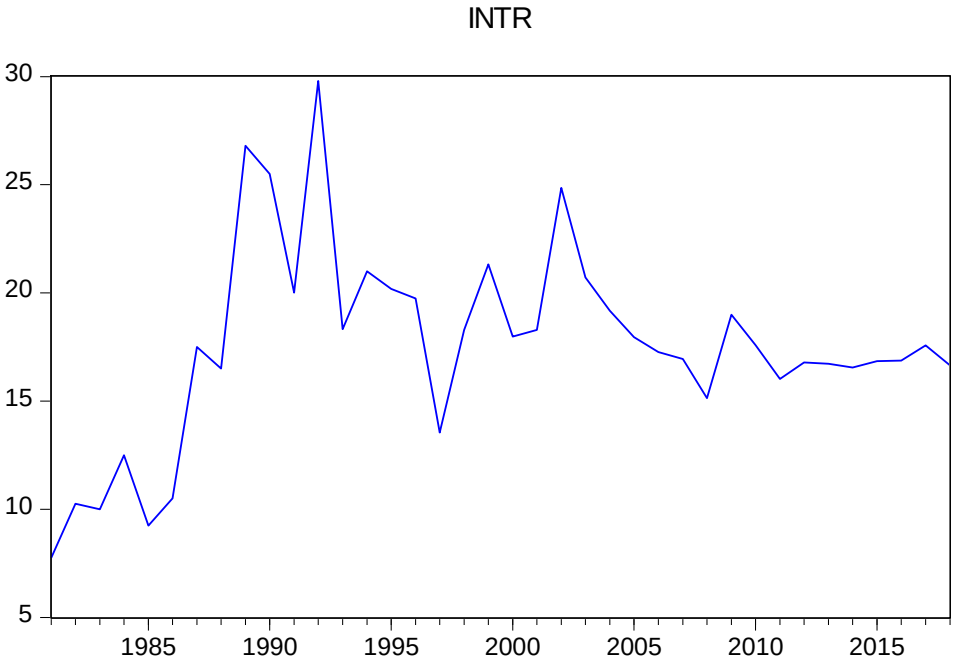
INTR
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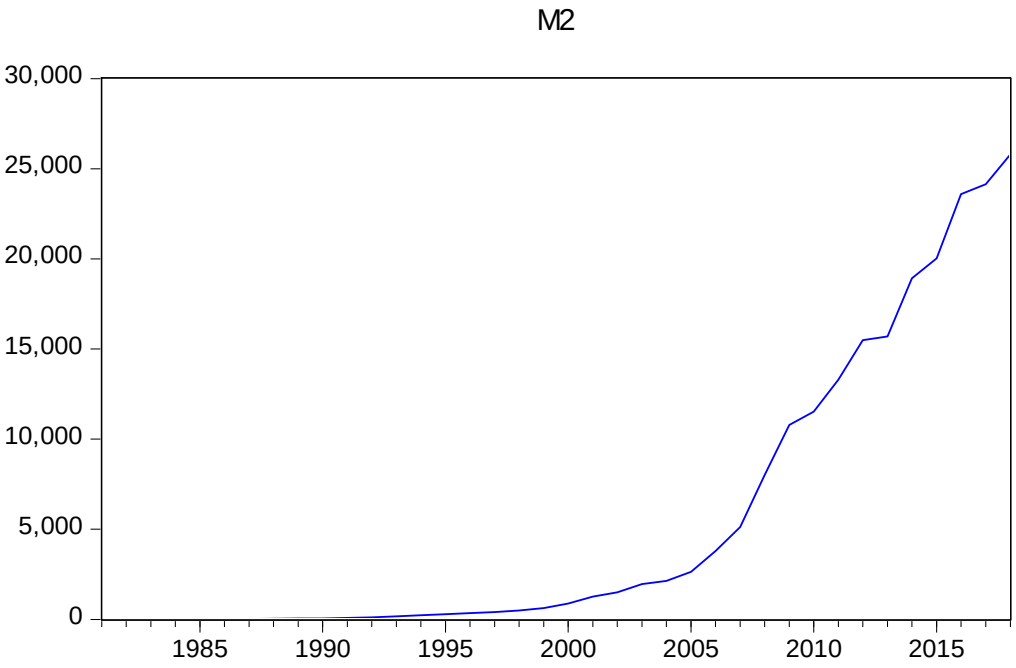
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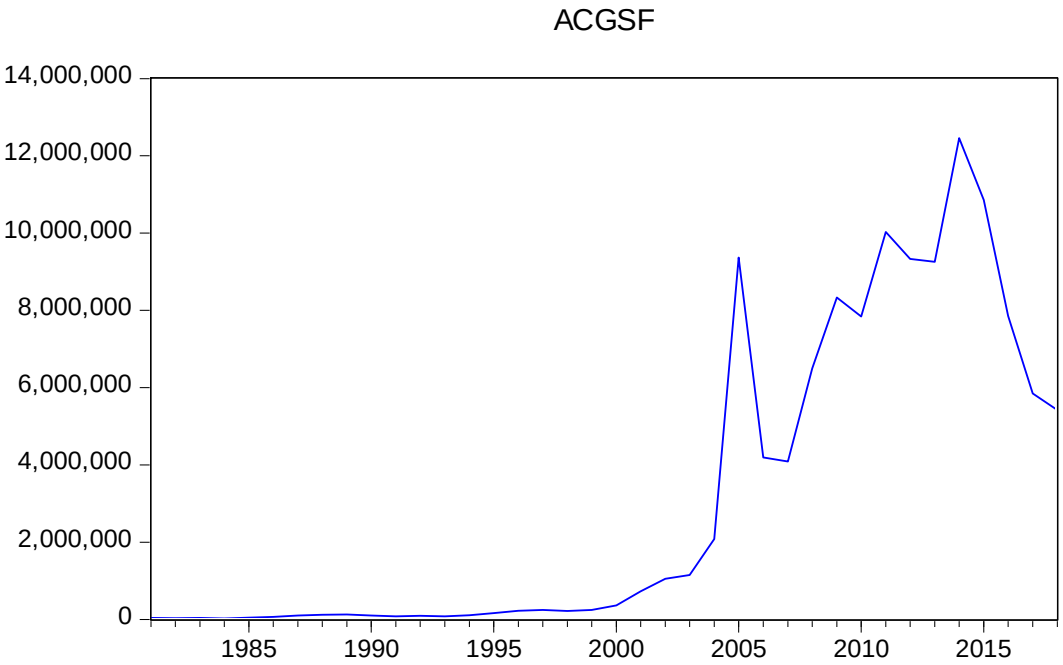
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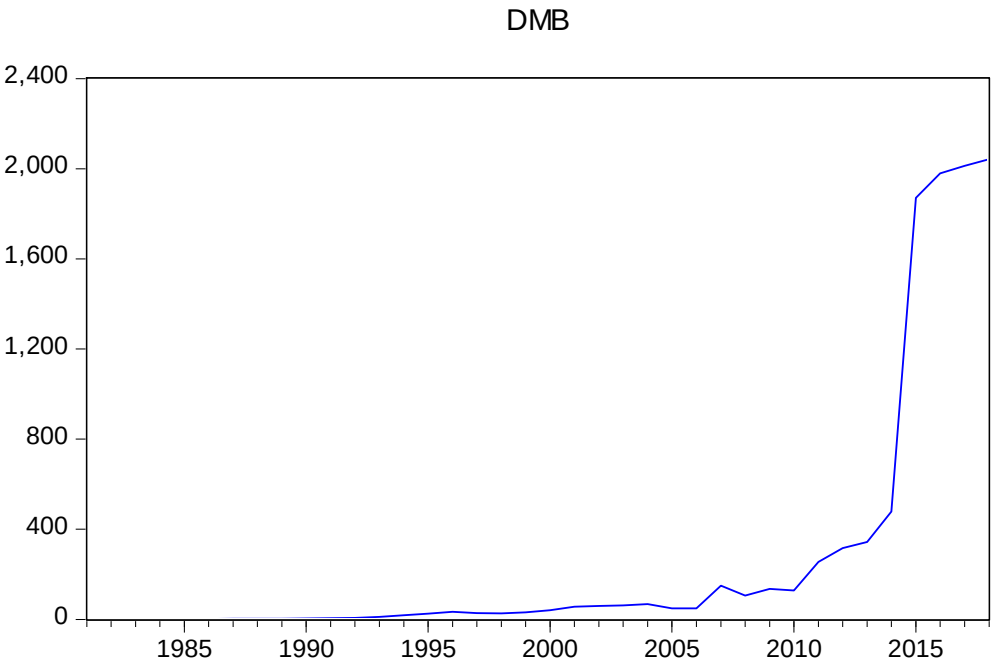


APPENDIX 2

UNIT ROOT TEST

Null Hypothesis: AGDP has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.525276	0.8025
Test critical values:	1% level	-4.226815	
	5% level	-3.536601	
	10% level	-3.200320	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(AGDP)
Method: Least Squares
Date: 05/20/19 Time: 00:14
Sample (adjusted): 1982 2018
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
AGDP(-1)	-0.068463	0.044886	-1.525276	0.1364
C	-32.58738	148.4031	-0.219587	0.8275
@TREND("1981")	50.07026	20.56269	2.435006	0.0203

R-squared	0.258492	Mean dependent var	410.2522
Adjusted R-squared	0.214874	S.D. dependent var	483.6305
S.E. of regression	428.5322	Akaike info criterion	15.03621
Sum squared resid	6243755.	Schwarz criterion	15.16683
Log likelihood	-275.1700	Hannan-Quinn criter.	15.08226
F-statistic	5.926243	Durbin-Watson stat	1.977524
Prob(F-statistic)	0.006194		

Null Hypothesis: D(AGDP) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.683725	0.0002
Test critical values:	1% level	-4.234972	
	5% level	-3.540328	
	10% level	-3.202445	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(AGDP,2)
Method: Least Squares
Date: 05/20/19 Time: 00:14
Sample (adjusted): 1983 2018
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(AGDP(-1))	-1.003773	0.176605	-5.683725	0.0000
C	21.06522	159.4279	0.132130	0.8957
@TREND("1981")	20.53460	8.220828	2.497874	0.0177

R-squared	0.495202	Mean dependent var	8.405833
Adjusted R-squared	0.464608	S.D. dependent var	614.4511
S.E. of regression	449.5970	Akaike info criterion	15.13424
Sum squared resid	6670537.	Schwarz criterion	15.26620
Log likelihood	-269.4162	Hannan-Quinn criter.	15.18029
F-statistic	16.18631	Durbin-Watson stat	1.973002
Prob(F-statistic)	0.000013		

Null Hypothesis: EXR has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.628150	0.9710
Test critical values:	1% level	-4.234972	

	5% level	-3.540328
	10% level	-3.202445

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(EXR)
Method: Least Squares
Date: 05/20/19 Time: 00:15
Sample (adjusted): 1983 2018
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXR(-1)	-0.073856	0.117576	-0.628150	0.5344
D(EXR(-1))	0.434797	0.202981	2.142062	0.0399
C	-7.855702	8.318752	-0.944337	0.3521
@TREND("1981")	1.037373	0.815222	1.272504	0.2124

R-squared	0.305086	Mean dependent var	9.776111
Adjusted R-squared	0.239938	S.D. dependent var	19.12593
S.E. of regression	16.67428	Akaike info criterion	8.570052
Sum squared resid	8897.016	Schwarz criterion	8.745998
Log likelihood	-150.2609	Hannan-Quinn criter.	8.631462
F-statistic	4.682953	Durbin-Watson stat	2.080942
Prob(F-statistic)	0.008022		

Null Hypothesis: D(EXR) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.793039	0.0286
Test critical values:	1% level	-4.234972	
	5% level	-3.540328	
	10% level	-3.202445	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(EXR,2)
Method: Least Squares
Date: 05/20/19 Time: 00:15
Sample (adjusted): 1983 2018
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EXR(-1))	-0.635682	0.167592	-3.793039	0.0006
C	-4.211326	5.906702	-0.712974	0.4809

@TREND("1981")	0.558925	0.287895	1.941419	0.0608

R-squared	0.307269	Mean dependent var	1.298889
Adjusted R-squared	0.265285	S.D. dependent var	19.27379
S.E. of regression	16.52062	Akaike info criterion	8.526751
Sum squared resid	9006.720	Schwarz criterion	8.658711
Log likelihood	-150.4815	Hannan-Quinn criter.	8.572809
F-statistic	7.318776	Durbin-Watson stat	2.038249
Prob(F-statistic)	0.002341		

Null Hypothesis: INTR has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 5 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.063157	0.0014
Test critical values:	1% level	-4.273277	
	5% level	-3.557759	
	10% level	-3.212361	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(INTR)
Method: Least Squares
Date: 05/20/19 Time: 00:16
Sample (adjusted): 1987 2018
Included observations: 32 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INTR(-1)	-0.962794	0.190157	-5.063157	0.0000
D(INTR(-1))	-0.085032	0.167500	-0.507656	0.6163
D(INTR(-2))	0.178724	0.167533	1.066798	0.2967
D(INTR(-3))	0.490601	0.167450	2.929841	0.0073
D(INTR(-4))	0.349257	0.176137	1.982865	0.0589
D(INTR(-5))	0.092645	0.145722	0.635762	0.5309
C	20.80000	3.868313	5.377020	0.0000
@TREND("1981")	-0.126490	0.059575	-2.123228	0.0442

R-squared	0.679197	Mean dependent var	0.192187
Adjusted R-squared	0.585629	S.D. dependent var	4.373805
S.E. of regression	2.815491	Akaike info criterion	5.120468
Sum squared resid	190.2477	Schwarz criterion	5.486902
Log likelihood	-73.92749	Hannan-Quinn criter.	5.241931
F-statistic	7.258880	Durbin-Watson stat	2.296684
Prob(F-statistic)	0.000104		

Null Hypothesis: D(INTR) has a unit root

Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.206804	0.0001
Test critical values:	1% level	-4.243644	
	5% level	-3.544284	
	10% level	-3.204699	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(INTR,2)
Method: Least Squares
Date: 05/20/19 Time: 00:16
Sample (adjusted): 1984 2018
Included observations: 35 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(INTR(-1))	-1.849352	0.297956	-6.206804	0.0000
D(INTR(-1),2)	0.256019	0.173509	1.475543	0.1502
C	2.079101	1.451755	1.432129	0.1621
@TREND("1981")	-0.084906	0.064422	-1.317980	0.1972

R-squared	0.753853	Mean dependent var	-0.019429
Adjusted R-squared	0.730033	S.D. dependent var	7.232897
S.E. of regression	3.758096	Akaike info criterion	5.592912
Sum squared resid	437.8218	Schwarz criterion	5.770666
Log likelihood	-93.87597	Hannan-Quinn criter.	5.654273
F-statistic	31.64707	Durbin-Watson stat	1.898934
Prob(F-statistic)	0.000000		

Null Hypothesis: ACGSF has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.475943	0.3374
Test critical values:	1% level	-4.226815	
	5% level	-3.536601	
	10% level	-3.200320	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(ACGSF)
Method: Least Squares
Date: 05/20/19 Time: 00:17
Sample (adjusted): 1982 2018

Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ACGSF(-1)	-0.318865	0.128785	-2.475943	0.0184
C	-710295.9	691585.6	-1.027054	0.3116
@TREND("1981")	96515.20	48461.23	1.991596	0.0545

R-squared	0.153143	Mean dependent var	145608.9
Adjusted R-squared	0.103327	S.D. dependent var	1832105.
S.E. of regression	1734872.	Akaike info criterion	31.64837
Sum squared resid	1.02E+14	Schwarz criterion	31.77898
Log likelihood	-582.4948	Hannan-Quinn criter.	31.69442
F-statistic	3.074217	Durbin-Watson stat	2.045517
Prob(F-statistic)	0.059262		

Null Hypothesis: D(ACGSF) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.014443	0.0000
Test critical values:	1% level	-4.234972	
	5% level	-3.540328	
	10% level	-3.202445	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(ACGSF,2)
Method: Least Squares
Date: 05/20/19 Time: 00:17
Sample (adjusted): 1983 2018
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(ACGSF(-1))	-1.198081	0.170802	-7.014443	0.0000
C	276373.6	665360.0	0.415375	0.6806
@TREND("1981")	-4852.492	30081.15	-0.161313	0.8728

R-squared	0.598616	Mean dependent var	-11731.60
Adjusted R-squared	0.574289	S.D. dependent var	2873577.
S.E. of regression	1874909.	Akaike info criterion	31.80567
Sum squared resid	1.16E+14	Schwarz criterion	31.93763
Log likelihood	-569.5021	Hannan-Quinn criter.	31.85173
F-statistic	24.60772	Durbin-Watson stat	2.086647
Prob(F-statistic)	0.000000		

Null Hypothesis: M2 has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.815910	0.9996
Test critical values:	1% level	-4.226815	
	5% level	-3.536601	
	10% level	-3.200320	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(M2)
Method: Least Squares
Date: 05/20/19 Time: 00:18
Sample (adjusted): 1982 2018
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
M2(-1)	0.024198	0.029658	0.815910	0.4202
C	-423.5770	305.6295	-1.385916	0.1748
@TREND("1981")	52.63399	20.53985	2.562530	0.0150

R-squared	0.503820	Mean dependent var	696.6705
Adjusted R-squared	0.474633	S.D. dependent var	1024.863
S.E. of regression	742.8432	Akaike info criterion	16.13645
Sum squared resid	18761744	Schwarz criterion	16.26707
Log likelihood	-295.5244	Hannan-Quinn criter.	16.18250
F-statistic	17.26174	Durbin-Watson stat	2.302569
Prob(F-statistic)	0.000007		

Null Hypothesis: D(M2) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.459389	0.0000
Test critical values:	1% level	-4.234972	
	5% level	-3.540328	
	10% level	-3.202445	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(M2,2)

Method: Least Squares
Date: 05/20/19 Time: 00:18
Sample (adjusted): 1983 2018
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(M2(-1))	-1.111066	0.172008	-6.459389	0.0000
C	-700.7099	288.7568	-2.426644	0.0209
@TREND("1981")	76.46814	16.75832	4.562995	0.0001

R-squared	0.558435	Mean dependent var	45.81472
Adjusted R-squared	0.531673	S.D. dependent var	1097.402
S.E. of regression	751.0003	Akaike info criterion	16.16034
Sum squared resid	18612046	Schwarz criterion	16.29230
Log likelihood	-287.8862	Hannan-Quinn criter.	16.20640
F-statistic	20.86707	Durbin-Watson stat	1.932750
Prob(F-statistic)	0.000001		

Null Hypothesis: DMB has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 8 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		2.057383	1.0000
Test critical values:	1% level	-4.309824	
	5% level	-3.574244	
	10% level	-3.221728	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DMB)
Method: Least Squares
Date: 05/20/19 Time: 00:19
Sample (adjusted): 1990 2018
Included observations: 29 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DMB(-1)	3.740421	1.818048	2.057383	0.0544
D(DMB(-1))	-3.700742	1.908110	-1.939480	0.0683
D(DMB(-2))	-4.479748	1.890970	-2.369022	0.0292
D(DMB(-3))	-4.564736	1.944250	-2.347814	0.0305
D(DMB(-4))	-1.545921	2.047998	-0.754845	0.4601
D(DMB(-5))	-1.339794	1.955534	-0.685129	0.5020
D(DMB(-6))	0.612394	1.845254	0.331875	0.7438
D(DMB(-7))	1.037419	1.615412	0.642201	0.5288
D(DMB(-8))	10.07029	1.323403	7.609391	0.0000
C	159.0207	80.15725	1.983860	0.0627
@TREND("1981")	-14.30896	5.701951	-2.509485	0.0219

R-squared	0.967709	Mean dependent var	70.30690
Adjusted R-squared	0.949769	S.D. dependent var	257.7376
S.E. of regression	57.76496	Akaike info criterion	11.23234
Sum squared resid	60062.22	Schwarz criterion	11.75097
Log likelihood	-151.8689	Hannan-Quinn criter.	11.39477
F-statistic	53.94229	Durbin-Watson stat	1.762202
Prob(F-statistic)	0.000000		

Null Hypothesis: D(DMB) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=2)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.598397	0.0003
Test critical values:	1% level	-4.234972	
	5% level	-3.540328	
	10% level	-3.202445	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DMB,2)
Method: Least Squares
Date: 05/20/19 Time: 00:21
Sample (adjusted): 1983 2018
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(DMB(-1))	-0.979867	0.175026	-5.598397	0.0000
C	-78.98007	81.80618	-0.965454	0.3413
@TREND("1981")	6.900828	3.860491	1.787552	0.0830

R-squared	0.487204	Mean dependent var	0.830556
Adjusted R-squared	0.456125	S.D. dependent var	307.2001
S.E. of regression	226.5535	Akaike info criterion	13.76349
Sum squared resid	1693774.	Schwarz criterion	13.89545
Log likelihood	-244.7429	Hannan-Quinn criter.	13.80955
F-statistic	15.67652	Durbin-Watson stat	1.985362
Prob(F-statistic)	0.000016		

APPENDIX 3

COINTEGRATION REGRESSION RESULTS

Date: 05/20/19 Time: 00:26
Sample (adjusted): 1985 2018
Included observations: 34 after adjustments
Trend assumption: Linear deterministic trend
Series: AGDP EXR INTR M2 ACGSF DMB
Lags interval (in first differences): 1 to 3

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.999470	438.4949	95.75366	0.0001
At most 1 *	0.907958	182.0605	69.81889	0.0000
At most 2 *	0.756711	100.9531	47.85613	0.0000
At most 3 *	0.591482	52.89386	29.79707	0.0000
At most 4 *	0.351746	22.45643	15.49471	0.0038
At most 5 *	0.203088	7.718357	3.841466	0.0055

Trace test indicates 6 cointegratingeqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.999470	256.4343	40.07757	0.0001
At most 1 *	0.907958	81.10749	33.87687	0.0000
At most 2 *	0.756711	48.05919	27.58434	0.0000
At most 3 *	0.591482	30.43743	21.13162	0.0019
At most 4 *	0.351746	14.73808	14.26460	0.0421
At most 5 *	0.203088	7.718357	3.841466	0.0055

Max-eigenvalue test indicates 6 cointegratingeqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

APPENDIX 4

REGRESSION RESULTS

Dependent Variable: AGDP
Method: Least Squares
Date: 05/20/19 Time: 00:22
Sample: 1981 2018
Included observations: 38

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXR	26.61974	3.386311	7.860984	0.0000
INTR	38.94355	29.88843	1.302964	0.2019
M2	0.238243	0.070924	3.359129	0.0020
ACGSF	0.000405	7.84E-05	5.168749	0.0000
DMB	-1.089515	0.605422	-1.799596	0.0814
C	2333.585	538.6667	4.332150	0.0001

R-squared	0.978918	Mean dependent var	7693.512
Adjusted R-squared	0.975624	S.D. dependent var	5159.264
S.E. of regression	805.5081	Akaike info criterion	16.36476
Sum squared resid	20762986	Schwarz criterion	16.62333
Log likelihood	-304.9305	Hannan-Quinn criter.	16.45676
F-statistic	297.1759	Durbin-Watson stat	1.588535
Prob(F-statistic)	0.000000		

APPENDIX 5

PARSIMONIOUS ECM

Dependent Variable: D(AGDP)
Method: Least Squares
Date: 06/07/19 Time: 14:27
Sample (adjusted): 1984 2018
Included observations: 35 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(AGDP(-1))	0.548239	0.189175	2.898053	0.0089
D(AGDP(-2))	0.405573	0.176665	2.295723	0.0326
D(EXR)	9.939523	5.464729	1.818850	0.0839
D(EXR(-1))	-12.76321	6.118038	-2.086160	0.0500
D(EXR(-2))	-16.94483	6.238835	-2.716024	0.0133
D(INTR(-1))	-49.76294	21.81714	-2.280910	0.0337
D(INTR(-2))	-37.40380	20.04275	-1.866201	0.0767
D(M2)	0.185095	0.083337	2.221034	0.0381
D(M2(-1))	0.094842	0.092822	1.021761	0.3191
D(ACGSF)	9.76E-05	4.81E-05	2.029458	0.0559
D(ACGSF(-1))	-0.000187	6.71E-05	-2.789875	0.0113

D(ACGSF(-2))	-6.79E-05	4.86E-05	-1.397017	0.1777
D(DMB)	-0.756582	0.384991	-1.965191	0.0634
ECM(-1)	-0.979121	0.216103	-4.530812	0.0002
C	108.2865	114.4065	0.946506	0.3552

R-squared	0.603673	Mean dependent var	432.4177
Adjusted R-squared	0.526244	S.D. dependent var	488.0676
S.E. of regression	400.6189	Akaike info criterion	15.12143
Sum squared resid	3209910.	Schwarz criterion	15.78800
Log likelihood	-249.6249	Hannan-Quinn criter.	15.35153
F-statistic	2.175953	Durbin-Watson stat	1.609725
Prob(F-statistic)	0.054804		

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.794200	Prob. F(2,18)	0.4672
Obs*R-squared	2.838110	Prob. Chi-Square(2)	0.2419

Test Equation:

Dependent Variable: RESID

Method: Least Squares

Date: 06/07/19 Time: 14:28

Sample: 1984 2018

Included observations: 35

Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(AGDP(-1))	-0.209785	0.284057	-0.738529	0.4697
D(AGDP(-2))	0.130450	0.290704	0.448737	0.6590
D(EXR)	-1.314900	5.752460	-0.228581	0.8218
D(EXR(-1))	-0.338530	6.256376	-0.054110	0.9574
D(EXR(-2))	-0.796141	6.347050	-0.125435	0.9016
D(INTR(-1))	2.323728	24.17779	0.096110	0.9245
D(INTR(-2))	-2.724533	20.39263	-0.133604	0.8952

D(M2)	0.001139	0.098092	0.011609	0.9909
D(M2(-1))	0.032469	0.106682	0.304356	0.7643
D(ACGSF)	1.89E-05	5.08E-05	0.371229	0.7148
D(ACGSF(-1))	-3.02E-05	7.23E-05	-0.417295	0.6814
D(ACGSF(-2))	-6.24E-06	4.95E-05	-0.126186	0.9010
D(DMB)	0.151551	0.421544	0.359513	0.7234
ECM(-1)	-0.124519	0.242933	-0.512565	0.6145
C	36.44091	121.2513	0.300540	0.7672
RESID(-1)	0.559045	0.467450	1.195948	0.2472
RESID(-2)	-0.100497	0.457187	-0.219816	0.8285

R-squared	0.081089	Mean dependent var	-9.74E-15
Adjusted R-squared	-0.735721	S.D. dependent var	307.2607
S.E. of regression	404.8060	Akaike info criterion	15.15115
Sum squared resid	2949622.	Schwarz criterion	15.90660
Log likelihood	-248.1450	Hannan-Quinn criter.	15.41193
F-statistic	0.099275	Durbin-Watson stat	2.001375
Prob(F-statistic)	0.999987		

Heteroskedasticity Test: White

F-statistic	0.830219	Prob. F(14,20)	0.6333
Obs*R-squared	12.86425	Prob. Chi-Square(14)	0.5372
Scaled explained SS	9.505414	Prob. Chi-Square(14)	0.7974

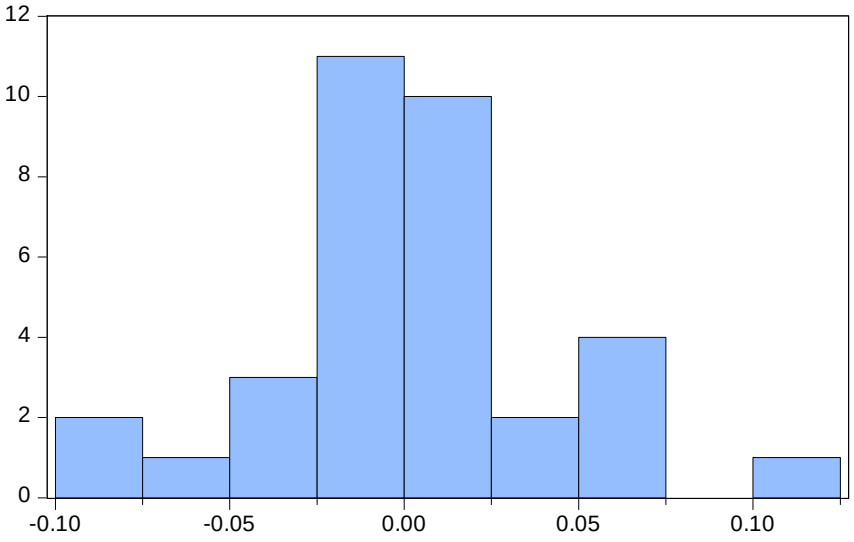
Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 06/07/19 Time: 14:29
Sample: 1984 2018
Included observations: 35

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	141146.0	69090.51	2.042914	0.0545
D(AGDP(-1))^2	-0.015359	0.027584	-0.556810	0.5838

D(AGDP(-2))^2	-0.023867	0.027445	-0.869631	0.3948
D(EXR)^2	-2.617611	35.32879	-0.074093	0.9417
D(EXR(-1))^2	-20.21817	36.44348	-0.554782	0.5852
D(EXR(-2))^2	-29.78188	36.04185	-0.826314	0.4184
D(INTR(-1))^2	-1292.134	1210.132	-1.067763	0.2983
D(INTR(-2))^2	-660.1843	1224.284	-0.539241	0.5957
D(M2)^2	-0.009785	0.013028	-0.751032	0.4614
D(M2(-1))^2	-0.004021	0.014062	-0.285927	0.7779
D(ACGSF)^2	-3.47E-09	4.05E-09	-0.857202	0.4015
D(ACGSF(-1))^2	-2.62E-09	4.27E-09	-0.613119	0.5467
D(ACGSF(-2))^2	-4.30E-09	4.30E-09	-0.999856	0.3293
D(DMB)^2	-0.069820	0.128290	-0.544233	0.5923
ECM(-1)^2	0.144226	0.053343	2.703751	0.0137

R-squared	0.367550	Mean dependent var	91711.72
Adjusted R-squared	-0.075165	S.D. dependent var	197954.6
S.E. of regression	205259.4	Akaike info criterion	27.59946
Sum squared resid	8.43E+11	Schwarz criterion	28.26604
Log likelihood	-467.9906	Hannan-Quinn criter.	27.82957
F-statistic	0.830219	Durbin-Watson stat	1.847988
Prob(F-statistic)	0.633257		

APPENDIX 6



Series: Residuals
Sample 1984 2017
Observations 34

Mean	1.30e-17
Median	-0.001246
Maximum	0.103164
Minimum	-0.099944
Std. Dev.	0.041002
Skewness	-0.158313
Kurtosis	3.806443
Jarque-Bera	1.063352
Probability	0.587619