AN ASSESSMENT OF THE DETERMINANTS OF AGRICULTURAL OUTPUT IN NIGERIA: 1981-2018.

BY

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A PROJECT SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF A BACHELOR OF SCIENCE (B.Sc) DEGREE IN ECONOMICS TO THE DEPARTMENT OF ECONOMICS, FACULTY OF MANAGEMENT AND SOCIAL SCIENCES

BAZE UNIVERSITY, ABUJA

SEPTEMBER, 2020

# DECLARATION.

**I, AISHA RA’IDAH MOHAMMED, do hereby declare that this research project is as a result of research that has been undertaken by me under the guidance of my supervisor DR. ABBAS MARAFA, and that no part of it has been published for another degree elsewhere. Apart from references to other works which have been duly cited, this thesis is my original work.**

# ……………………………… ………………………………. AISHA RA’IDAH MOHAMMED 22/09/2020 (BU/17C/BS/2742)

**APPROVAL.**

This research project “An assessment of the determinants of agricultural output in Nigeria (1981- 2018)” by Aisha Ra’idah Mohammed has been approved by the department of Economics, Faculty of Management and Social Sciences, Baze University, Abuja, Nigeria.

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**DEDICATION**

I dedicate this research project to my unconditionally loving parents, my cat Pan who was there to support me emotionally and listen to me cry in the middle of the night, my friends who pulled me out of my depression while working on this project and my Saheb who was always ready to support me with his kind and encouraging words.

Also the kitchen microwave which came through for me while I was starving at 3am working on this beast.

# ACKNOWLEDGEMENT.

I thank the Almighty God for overseeing me throughout my academic stay at Baze university and his never ending grace. A special thank you to my supervisor Dr. Abbas Marafa who without his support and encouragement would have made this research impossible to conduct and also a big thank you to all my lecturers in the faculty of economics who helped to shape me into the young and aspiring economist I am today. Finally I would like to express my gratitude to my parents and guardians for their financial and moral support and also their unconditional love as well as my doctor for providing me with therapy to keep my sanity in check during my stay at the university.

# ABSTRACT.

*This study assesses the determinants of agricultural output in Nigeria using annual data covering periods from 1981 to 2018. The variables employed were Agricultural Growth (AG), Agricultural Credit (AC), Government Expenditure on Agriculture (GEA) and Money Supply (MS) with Agricultural Growth (AG) as the dependent variable. The study employed the use of econometric analysis such as; Descriptive statistics, Unit root test (ADF), Granger causality test, Johansen co-integration test and Ordinary least square (OLS) regression. Specifically, this study was carried out to assess whether or not the selected variables have any impact on the level of agricultural output in Nigeria and to investigate the causal relationship between these variables and agricultural output. The study revealed that Agricultural Credit (AC) and Government Expenditure on Agriculture (GEA) both have negative effects on Agricultural output whereas Money Supply (MS) has a positive effect on Agricultural output spanning the period of 1981-2018. The study however recommended programs which will support the agricultural sector by providing the farmers with easy access to loans without the issues they face at the banks. The study also recommended the government making financial adjustments on the*

*country’s annual budgets in such a way that more funds are allocated to the agricultural sector which can make it a priority.*

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# LIST OF ACRONYMS

**GDP Gross Domestic Product**

**AG Agricultural Growth**

**AC Agricultural Credit**

**MS Money Supply**

**GEA Government Expenditure on Agriculture**

**OLS Ordinary Least Square**

**SAP Structural Adjustment Program**

**FDI Foreign Direct Investment**

**CBN Central Bank of Nigeria**

**ADF Augmented Dickey-Fuller**

# CHAPTER ONE INTRODUCTION.

# BACKGROUND OF THE STUDY.

Agricultural output has been the backbone of the Nigerian economy long before the discovery and exploration of crude oil resulting in the country’s dependence on crude oil for the economy’s growth. Agriculture made provision of employment for about 30% of the population as at 2010 and approximately 70% of the population engages in agricultural production at a subsistence level.

Before the discovery of crude oil (the pre-colonial era), agriculture first served as the major source of livelihood and served up to 75% of the whole population. Agriculture however was mostly embarked on for sustenance and not for export. In the terms of trade however, it was only used for the trade by barter system. Overtime, the productivity began to increase significantly and soon enough was the country’s main source of revenue as it was used for exports before the advent of oil discovery in the early 1970s.

As of 1999, agriculture provided 41% of Nigeria’s total gross domestic product (GDP), this percentage exemplified a normal decrease of 24.7% from its input of 65.7 percent to the GDP in 1957. It was predicted that the decrease will continue due to the fact that as economic development occurs, the virtual size of the agricultural sector usually declines.

The agricultural sector is becoming more important to the cause of national development especially in developing countries such as Nigeria which has been acknowledged by all. Despite the years of neglect the sector has faced, it still remains one of the major contributions to Nigeria’s economic stability. It has also been acknowledged that without proper sustainable development of this sector, the levels of growth and development the country aims for will continue to be an illusion (Emeh, 2014).

The agricultural sector in Nigeria has faced a number of problems which ultimately hinders the growth rate of the sector. These problems range from the neglect by the government down to the little issues the farmers face when growing their crops or rearing their livestock. The major issue facing the agricultural sector in developing countries such as Nigeria is the issue of financing. Since the government focuses mainly on the oil sector of the country, the agricultural sector is not fed enough to flourish. This means that the government does not spend enough on the sector for maintenance. Also, the farmers face a challenge trying to secure loans for their farms. These are just some of the basic issues faced by the sector which can ultimately affect the output rates and overall growth of the sector.

Ultimately, government spending and access to loans by the sector can have a progressive effect on the development rate of agriculture in the country. However, if certain factors are not taken into consideration in addition to the financial contribution, there may be a negative effect on the agricultural growth. Some of these subordinate factors could however be enhanced in such a way that in addition to the financing of the sector, agriculture can flourish even more

and in some cases when the financing levels are low, the sector is able to make progress and produce altering results.

# STATEMENT OF RESEARCH PROBLEMS.

Nigeria, based on the resources it has readily available, has every means of becoming a major factor in the world economy. The country is abundant in both Human capital and Natural resources and has incredible soil which can be used as an agricultural advantage.

Before the oil boom in the late 1960s, Nigeria mostly depended on agriculture as a source of foreign revenue but then quickly switched to oil and gas as a source of revenue generated. The influence of agriculture on the economic growth of Nigeria is very low paralleled to what it used to be in the past. The agriculture now retains the features of a peasant economy that produce on subsistent levels, which was prominent in the pre-independence period.

Despite the revenue gotten from exports, agriculture possesses a massive role in the expansion of the economy in the sense that it provides job opportunities, produces the raw materials used by industries for further processing, contributes to food security and reduces the level of poverty in the country.

However, agriculture does not just happen and grow successfully, in fact, there are a number of factors which influence the output or productivity of agriculture in Nigeria which is exactly what this paper talks about. It is aimed at looking at the major variables involved in determining the

level of agricultural growth in the country and in the type of relationship that exists between the chosen variables and the growth rate of agriculture.

The level of agricultural output currently has been calculated as not enough to feed the nation due to some factors in relation to the Malthusian theory of population which assumed that the world population grows at a geometrical rate and that food supply grows in an arithmetic progression. This implies that food supply grows at a slower frequency than the population.

The slow growth of agriculture depends on a number of factors such as government expenditure, climate change and agricultural loans.

This study aimed to look at some of these key factors and see how they affect agricultural output, what the relationship is and how they can be altered or worked on to increase agricultural productivity thus leading to an increase in the country’s GDP.

# RESEARCH QUESTIONS.

1. What is the relationship between the selected independent variables and agricultural growth?
2. What is the nature of the relationship between the variables and agricultural growth

# OBJECTIVES OF THE STUDY.

The extensive objective of the study was to assess the determinants of agricultural output in Nigeria. To attain the broad objective, the following detailed objectives were pursued;

1. To assess the relationship between the selected variables and agricultural growth.
2. To determine the nature of the relationship between the variables and agricultural growth.

# STATEMENT OF HYPOTHESIS.

The hypotheses that were tested in this paper are as follows:

*H0* : The selected determinants have no significant relationship with agricultural growth in Nigeria.

*H0* : The selected determinants have no causal relationship with agricultural growth in Nigeria.

# SIGNIFICANCE OF THE STUDY.

The impact of agricultural output in Nigeria and its economy cannot be stressed enough. Apart from providing employment for the citizens and an increase in exportable commodities, it is also embarked on a sustenance level, that is, on a small scale level for consumption.

Agriculture also shows its importance on a wider scale, that is, nationwide. Nigeria as an example depends on agriculture as a part of its national revenue and as a way to increase the country’s GDP.

In Nigeria’s agricultural history, the sector has always been considered inferior as the country depends solely on crude oil exportation. This has not only affected the GDP of the country in terms of export and low foreign exchange earnings, but it has also affected the country internally as we do not produce on such high scales to feed the nation. As the ban on rice was implemented, the agricultural sector began to look up as rice farmers as well as farmers of other crops began to produce on a commercial level and not just for sustenance. This has improved the agricultural sector in a way but it still faces some challenges which hinders its growth. These hindrances are nothing more than the determinants not fully given attention to which slow down the progress of the agricultural segment.

The issues of the agricultural sector can also be related to the Malthusian theory of population which states that population grows at a geometric level while food progresses at an arithmetic level. this further goes to say that a country might not achieve economic growth if there isn’t enough food supply to feed the entire population. Nigeria is currently facing this issue as we have a high population density which keeps multiplying in a geometric fashion and an agricultural sector that is not fully concentrated on which then grows in an arithmetic fashion. This affects the growth rate of the country severely.

The study was therefore aimed at examining the factors that determine agricultural growth in Nigeria and how these factors can be efficiently focused and worked on to increase agricultural

productivity to improve the country’s GDP. Knowing the major determinants of agricultural growth and how the variables affect the growth rate can drastically increase the economic growth rate of a country if properly enhanced and maintained.

The result of this study shall contribute significantly to the entire nation by suggesting ways to reduce the import rates of the country so as to boost the GDP and agricultural growth and also to get the government to focus on the selected determinants so as to eradicate the issue of hunger in Nigeria. The study also aims to contribute as material for academic references in the line of agricultural economics to be precise.

# SCOPE AND LIMITATION OF THE STUDY.

This work focuses on discussing the determinants of agricultural output in Nigeria and assessing the affiliation between these factors and the level of productivity in agriculture. For this study, time series data ranging from 1981 to 2018 was adopted. The time period chosen for this research was based on the availability of data for the research.

# ORGANIZATION OF THE RESEARCH.

This research was organized in five chapters each chapter containing a detailed explanation contributing to the main research.

Chapter 1 of this study focused on the introduction, statement of research problems, statement of hypothesis, research questions, significance of the study and the scope and limitations of the study.

Chapter 2 looked explicitly at the literature review and conceptual framework of the study. The theoretical framework shall also be looked at in this chapter.

Chapter 3 included the research design, methods of data collection, procedure for data analysis and the model specification.

Chapter 4 looked at the data analysis and results presentation, test of hypothesis and the discussion of findings.

The final chapter, chapter 5, consisted of the conclusion, recommendation and suggestion for further research. Finally, the references and appendices of the study round up the research.

**CHAPTER 2**

**LITERATURE REVIEW, CONCEPTUAL AND THEORETICAL FRAMEWORK.**

# INTRODUCTION.

This chapter reviewed the literature related to the research work with emphasis on the relationship between the selected variables and agricultural growth. It also looked at the conceptual framework used to better explain the idea behind the subject matter using implemented concepts.

# CONCEPTUAL FRAMEWORK.

Government expenditure on Agriculture

Determinants of Agricultural Growth.

Money Supply

Agricultura l Credit

Agricultural Growth.

**Fig. 2.1: Conceptual Framework.**

The above diagram shows the relationship between the selected variables for the course of the research and agricultural growth in Nigeria. The diagram explains how Agricultural Credit, Money Supply and Government Expenditure on Agriculture are elements that affect the rate of growth of Agriculture in Nigeria. The study aimed to see in what way they affect the growth of agriculture and to determine the type of relationship that exists between them.

**Agricultural Growth.**

Agricultural productivity is the core quantity of individual output. It encompasses livestock enterprise output, crop enterprise output, by-products, forage and cultivations and various output which covers the value of output from those agricultural activities but are neither livestock or crop enterprise output. Agricultural output is measured as the relationship between agricultural outputs and agricultural inputs.

**Agricultural Credit.**

Agricultural credit refers to the substitute methods of financing used in agricultural transactions. The finances are usually used to meet the financial requirements of farmers which allows them to purchase new equipment, maintain the equipment on the farm and carry out many other agricultural activities in order to keep the farm up and running.

**Money Supply.**

Money supply is the total currency and other liquidated instruments of a country at a particular period. This also refers to the amount of money in circulation in a particular economy. The money in exchange involves the money in the deposits accounts and in the form of other liquid assets.

**Government Expenditure on Agriculture.**

Government spending on agriculture refers to the part or portion of a country’s national budget which is directed particularly at the agricultural sector of a country. This more specifically, means the amount of money the government sets aside and spends on the agricultural sector of the economy in order to promote growth. The money channeled to this sector is normally for the purchase of new equipment used by the farmers, pesticides and medication used for the livestock as well as the crops on the farm and also for the overall maintenance of the farm in order to yield higher output.

# EMPIRICAL LITERATURE.

Folawewo and Olakajo (2010) investigated the determinants of agricultural exports in oil exporting economies using Nigeria as empirical evidence and using time series data covering from 1970-2007. The study made use of the Ordinary Least Square (OLS) test and discovered that the world price for Nigeria major agricultural commodities, world income and Nigeria past agricultural output were determinants of agricultural exports. The study recommended that Nigeria be committed to development of efficient technology in

agricultural production since present agricultural output was found to insignificantly influence its export.

Ochalibe, et al. (2019) examined the impact of exchange rate and interest rate policy instruments dynamics on agricultural growth in Nigeria using time series data covering from 1980-2018, they concluded that inflation rate in Nigeria is volatile over the period of study and inflation volatility has a negative but significant impact on agricultural growth. The study recommended that exchange rate be stabilized and interest rate reduced to encourage investment in agriculture, hence stimulating growth.

Nwanji, et al. (2019) studied the effects of foreign trade on agricultural output in Nigeria using time series data ranging from 1981-2018. The study showed that foreign trade in fact exerts negatively on agricultural output in Nigeria.

Oyetade et al. (2019) examined the impact of macroeconomic factors and Structural Adjustment Program (SAP) on agricultural output in Nigeria adopting the time series data ranging from 1981-2017. The results showed relationship that exists between the agricultural output which is the dependent variable and the independent variables. It also revealed the variations between the dependent and independent variables which are Gross Domestic Product (GDP) growth rate, interest rate, foreign direct investment (FDI), commercial bank loan on agriculture, SAP and inflation rate.

Oyakhilomen and Zibah (2014) examined the relationship between Agricultural Production and Economic growth in Nigeria, looking at the implication on rural poverty alleviation specifically, it was found that agricultural production was significant in influencing the favourable trend of economic growth in Nigeria. This study adopted the time series data ranging from

Brownson et al. (2012) carried out a study estimating the long run and short run determinants of cash crop volatility in Nigeria. The time series data derived from the FAO database covered a period ranging from 1961-2010 and the results of the study showed that the nominal inflation rate, nominal exchange rate, loan granted by ACGSF and import substitution policy era influenced the output volatility of cocoa, cotton, rubber and palm oil in both the long and short run periods in Nigeria.

Olarinde and Abdullahi (2014) investigated the impact of macroeconomic policies on agricultural output specifically on crop production in Nigeria looking specifically at the implications on food security. The paper adopted the time series data stretching over the period between 1978-2011. The findings of the research showed that in the long run, agricultural output is responsive to changes in government spending, agricultural credit, inflation rate, interest and exchange rates. While results of the variance decomposition indicate that, a significant variation in Nigeria’s agricultural food output is due to changes in exchange rate and government expenditure movements.

Enilolobo et al. (2019) investigated the effect of macroeconomic indicators on agricultural output in Nigeria using quarterly time series data for the period 1981-2018 from various publications of the Central Bank of Nigeria statistical Bulletin and National Bureau of Statistics. The results of the study revealed that the inflation rate in Nigeria is volatile over the period of study and inflation volatility has a negative but significant impact on agricultural growth. Exchange rate and cost of funds also possess varying impacts on agricultural output.

Omekwe et al. (2018) carried out a study examining the determinants of agricultural output in Nigeria covering the period between 1985-2016 making use of data obtained from the CBN statistical bulletin. The findings of the study showed that agricultural funding; agricultural credits as well as climate change are key determinants of agricultural output in Nigeria.

Abolagba et al. (2010) examined the factors that influence agricultural exports with specific reference to cocoa and rubber. The results showed that rubber export is influenced significantly by domestic rubber production, producer price, exchange rate, domestic consumption and interest rate. For cocoa however, the results showed that cocoa output, domestic consumption and rainfall significantly influence cocoa export.

Obasi, et al., (2013) examined and identified factors that affect agricultural productivity in Imo state, Nigeria. The results revealed that age, level of education, years of farming

experience, farm size, extension contract, fertilizer use, planting materials and labour use are the main determinants of agricultural productivity in the state.

Ibrahim and Onoriode (2015) focused on the determinants of agricultural export earnings in Nigeria for the period 1980-2011. The study showed that world income and exchange rate is key variables that explain changes in agricultural export earnings.

Yaqub, (2019) examined the Exchange rate changes and output performance in Nigeria: a sectoral analysis using seemingly unrelated regression estimation technique and found that exchange rate had a significant contractionary effect on agricultural output hence existing structures do not support an expansionary depreciation argument.

Olorunshogo, (2010), carried out a similar study as the one of Yaqub (2010) using descriptive statistical analysis, his result reveals that change in monetary policy instruments cause changes in agricultural output with a long-run equilibrium relationship between the monetary policy variables and growth in output.

Egbuwalo, (2003) carried out an analysis of agricultural production and financing under a deregulated economy using Nigeria as a case study and using cross sectional data. Egbuwalo observed that agricultural finance remains a thing of interest in the effort to raise agricultural output.

Enoma (2010) also examined the impact of agricultural credit on economic growth in Nigeria and discussed the measures aimed at increasing agricultural production and highlighted the relationship between agricultural development and economic growth. The author concluded that agricultural credit, interest rate and exchange rates were all important in affecting aggregate output in Nigeria.

Sunday, et al. (2012), examined agricultural productivity and macroeconomic variable fluctuations in Nigeria using techniques of co-integration and error correction models. The results revealed that in the short and long-run periods, the coefficients of real total exports, external reserves, inflation rate and external debt have significant negative relationship with agricultural productivity in the country, whereas industry’s capacity utilization rate and nominal exchange rate have positive association with agricultural productivity in both periods.

# THEORETICAL FRAMEWORK.

The theoretical background of this study is rooted in the Cobb Douglas production function which provides a useful basis for analyzing productivity drivers. The function is a relationship between what goes into a production process (input) and what comes out (output). It therefore shows that output is as a function of inputs of labour, capital and improvement in technology which can be applied to the issue of Agricultural output as determinants. This theoretical model starts with the idea of production functions, namely,

that the quality of output (Q) in any sector is a function of the amounts and quantities of input or factors of production.

This production function is widely used to represent the relationship of an output and two inputs. Cobb-Douglas considered a simplified view of the economy in which production output is determined by the amount of labour involved and the amount of capital invested. While there are many other factors affecting economic performance, their model proved to be remarkably accurate (Anigbogu, Abosi&Okoli, 2015).

Another concept associated with the Cobb-Douglas production function is the concept of marginal product. This refers to the change in the output that results from one additional unit of a single production factor ceteris parabis.

In Agricultural production, efficient allocation of agricultural inputs helps farmers to attain their desired objectives. It avails the farmers the opportunity of improving their productivity and income. At the micro-economic level, efficient allocation of agricultural resources such as credit, facilities, seedlings, labour among others) help farmers to contribute to food production, employment generation and export product for foreign exchange earnings.

# CHAPTER 3 METHODOLOGY.

# INTRODUCTION.

This chapter discusses the research methodology and data source used in this study. Section two discusses the research design used for the study, section three discusses the methods of data collection, section four presents the method of data analysis, section five presents the model specification for the study and section six discusses the justification of methods used in the course of the study.

# RESEARCH DESIGN.

This research design used for the course of this research is quantitative research. The aim of this research design is to evaluate the correlation between the dependent variable (Agricultural Output), and the independent variables which are Agricultural credit, Money supply and Government expenditure on agriculture.

# METHODS OF DATA COLLECTION.

The type of data necessary for this study is secondary data due to the fact that the research work is analytical in nature. Time series data relating to the dependent and independent variables were employed for a period covering 1981 and 2018 due to the availability of data. The data used in this study were sourced through Central Bank of Nigeria (CBN) statistical bulletins.

# METHOD OF DATA ANALYSIS.

* + 1. **Descriptive statistics.**

A diagnostics test is first performed on the dependent variables and independent variables by way of descriptive statistics. The dependent variable in the study is Agricultural Growth (AG) and the independent variables are Agricultural credit (AC), Money supply (MS) and Government expenditure on Agriculture (GEA).

* + 1. **Unit Root Test (ADF).**

The ADF Unit root test is carried out in order to determine whether the selected variables in the study are stationary or non-stationary. This is as a result of most time series data being non-stationary which can most likely give misleading results. The unit root test is adopted in order to find out the stochastic properties of the time series data.

The null hypothesis fails to be rejected if the test statistics in total terms is greater than the test critical values in absolute terms at the conventional levels of significance (1%, 5% and 10%). However, a level of significance of 5% was applied in the analysis of this research. The hypotheses of the ADF unit root testing is specified as; the null hypothesis states that there is unit root, meaning the variables are not stationary while the alternative hypothesis states that there is no unit root meaning the variables are stationary.

Decision rule: reject null if p-value is less than alpha ( = 5%).

* + 1. **Co-Integration Test.**

The co-integration test was carried out to determine whether there exists a long run equilibrium relationship amongst the selected variables in the study.

The hypothesis of the co-integration testing is specified as;

H0: there is no co-integrating equation between the selected variables. H1: there is a co-integrating equation between the selected variables.

Decision rule: reject null if p-value is less than alpha ( = 5%).

* + 1. **Ordinary Least Square (OLS).**

This study adopted the use of linear regression approach using ordinary least square (OLS) in determining the correlation between agricultural growth and the determining variables selected for the study.

* + 1. **Granger Causality Test.**

The Granger causality test is used to examine if there is a particular variable which can be useful in forecasting another. The test will reveal the existence of either a bi-directional, unidirectional or no causal relationship between the selected variables and agricultural growth in the study. The null hypothesis states that the variable under consideration does not granger cause the other variable.

Decision rule: reject the null hypothesis if the p-value is less than 0.1 and the F-statistic is greater than 3.

# MODEL SPECIFICATION.

The main focus of this study is to analyze the determinants of agricultural output in the Nigerian economy. From the analytical framework and literature review, a model is hereby specified in a functional form as follows:

**AG = f(GEA, AC, MS)…** **(3.1)**

Where:

AG = Agricultural Growth

GEA = Government Expenditure on Agriculture, AC = Agricultural Credit,

MS = Money Supply.

In an explicit form, the functional and econometric relationship is specified as:

**GDP =** **0 +** **1 GEA +** **2 AC +** **3 MS +** **t…** **(3.2)**

Where: “” is the error term assumed to be normally distributed with the mean of zero and constant variance; 0 = Constant terms/ intercept; 1; 2; 3; 4 = slope coefficient.

**CHAPTER 4**

**DATA ANALYSIS, RESULTS AND INTERPRETATION.**

# INTRODUCTION.

The aim of this chapter is to present the data analysis carried out for this research. In order to achieve that, the chapter is divided into seven parts. The first part contains the introduction, the second part entails the descriptive statistics, part three holds the unit root test, part four contains the co-integration test, part five is the OLS regression, part six is the Granger causality test and part seven discusses the findings of the data analysis.

# DESCRIPTIVE STATISTICS.

Table 4.1 shows the descriptive statistics on the variables, while figure 4.1 plotted the data to get the glimpse of the data.

**Table 4.1: Descriptive Statistics.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | AC | AG | GEA | MS |
| Mean | 121.5077 | 7693.524 | 16.55474 | 5857.074 |
| Median | 37.14650 | 4772.305 | 6.700000 | 753.7047 |
| Maximum | 610.1497 | 17544.15 | 65.40000 | 29774.43 |
| Minimum | 0.590600 | 2303.510 | 0.010000 | 14.47117 |
| Std. Dev. | 178.3168 | 5159.287 | 20.06081 | 8925.156 |
| Skewness | 1.560239 | 0.610525 | 0.944058 | 1.454377 |
| Kurtosis | 4.018851 | 1.837097 | 2.566919 | 3.792869 |
|  |  |  |  |  |
| Jarque-Bera | 17.06112 | 4.501904 | 5.941521 | 14.39169 |
| Probability | 0.000197 | 0.105299 | 0.051264 | 0.000750 |
|  |  |  |  |  |
| Sum | 4617.292 | 292353.9 | 629.0800 | 222568.8 |
| Sum Sq. Dev. | 1176485. | 9.85E+08 | 14890.14 | 2.95E+09 |
|  |  |  |  |  |
| Observations | 38 | 38 | 38 | 38 |

**Source: Author’s Computation from E-views 9.**

The mean and standard deviation of Agricultural Growth are 7693.524 and 5159.287 respectively. The mean and standard deviation of Agricultural Credit, Government Expenditure

on Agriculture and Money supply are (121.5077, 178.3168), (16.55474, 20.06081) and

(5857.074, 8925.156) respectively.

The mean above shows the average values of variables during the specified time period, while the standard deviation takes into account the deviation of the minimum and maximum variable values of the mean. Other statistics on the data can be seen in table 4.1 above while figure 4.1 shows the trends of the variables over the study period

700

Agricultural Credit

20,000

Agricultural Output

600

500

400

300

200

100

16,000

12,000

8,000

4,000

0

1985 1990 1995 2000 2005 2010 2015

0

1985 1990 1995 2000 2005 2010 2015

Agricultural expenditure (N' Billion)

70

60

50

40

30

20

10

0

1985 1990 1995 2000 2005 2010 2015

32,000

28,000

24,000

20,000

16,000

12,000

8,000

4,000

0

Money Supply2 (M2/M3) (N' Billion)

1985 1990 1995 2000 2005 2010 2015

**Figure 4.1: Trends of the variables (1981-2018).**

# UNIT ROOT TEST.

Table 4.2 shows the stationarity of the variables tested using Augmented Dickey Fuller (ADF) unit root test so as to ascertain whether the variables are stationary or non-stationary at levels or 1st difference.

**Table 4.2: Unit Root Test Results.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| VARIABLES | ADF UNIT ROOT TEST | | | | |
| LEVEL | | DIFFERENCE | | ORDER OF  INTEGRATION |
|  | t-stats | prob | t-stats | prob |  |
| AG | -2.064703 | 0.5477 | -5.775102 | 0.0002 | I(1) |
| AC | -2.370249 | 0.3882 | -6.994827 | 0.0000 | I(1) |
| GEA | -2.156112 | 0.4989 | -6.832882 | 0.0000 | I(1) |
| MS | -0.961015 | 0.9374 | -3.946784 | 0.0200 | I(1) |

**Source: Author’s computation from E-views 9**

The table 4.2 presents the unit root test results of the selected variables. All the variables are non-stationary at levels and stationary at 1st difference. This then shows that the variables do not have a unit root. Hence, all the variables are employed in the model in their log form.

# JOHANSEN CO-INTEGRATION TEST.

The Johansen co-integration test is used to determine the long-run relationship between the variables. The aim of the analysis is to prove and predict the existence of co-integration between the variables.

**Table 4.3: The Johansen Co-integration Test Result.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| UNRESTRICTED COINTEGRATION RANK TEST (TRACE) | | | | |
| Hypothesized No. of CE(s) | Eigen Value | Trace Statistic | 0.05 Critical Value | Probability |
| None | 0.510559 | 42.35701 | 47.85613 | 0.1490 |
| At most 1 | 0.218571 | 16.63533 | 29.79707 | 0.6668 |
| At most 2 | 0.153436 | 7.756635 | 15.49471 | 0.4918 |
| At most 3 | 0.047717 | 1.760137 | 3.841466 | 0.1846 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| UNRESTRICTED COINTEGRATION RANK TEST (MAXIMUM EIGEN VALUE) | | | | |
| Hypothesized No. of CE(s) | Eigen Value | Max-Eigen Statistic | 0.05 Critical Value | Probability |
| None | 0.510559 | 25.72168 | 27.58434 | 0.0849 |
| At most 1 | 0.218571 | 8.878693 | 21.13162 | 0.8421 |
| At most 2 | 0.153436 | 5.996499 | 14.26460 | 0.6137 |
| At most 3 | 0.047717 | 1.760137 | 3.841466 | 0.1846 |

**Source: Author’s computation from E-views 9.**

Table 4.3 presents the results derived from the conducted Johansen co-integration test. On the contrary, the null hypothesis is not rejected which further concludes that a long run relationship does not exist between the variables in this study. This means that a long run relationship between Agricultural growth, Agricultural Credit, Money supply and Government Expenditure on Agriculture in Nigeria between the years 1981-2018 does not exist at a 0.05 level of significance.

# ORDINARY LEAST SQUARE (OLS) REGRESSION.

The OLS regression results shows the relationship between AG which is the dependent variable and the independent variables used in the study.

**Table 4.4: OLS Regression Results**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Dependent Variable: LAG | | | | |
| Method: Least Squares |  |  |  |  |
| Date: 09/11/20 Time: 12:47 | | | | |
| Sample: 1981 2018 |  |  |  |  |
| Included observations: 38 | | | | |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
| LAC | -0.104970 | 0.052603 | -1.995517 | 0.0540 |
| LGEA | -0.060446 | 0.021059 | -2.870308 | 0.0070 |
| LMS | 0.410792 | 0.039204 | 10.47827 | 0.0000 |
| C | 6.411994 | 0.138791 | 46.19876 | 0.0000 |
| R-squared | 0.977586 | Mean dependent var | | 8.718510 |
| Adjusted R-squared | 0.975608 | S.D. dependent var | | 0.693449 |
| S.E. of regression | 0.108303 | Akaike info criterion | | -1.508475 |
| Sum squared resid | 0.398801 | Schwarz criterion |  | -1.336097 |
| Log likelihood | 32.66102 | Hannan-Quinn criter. | | -1.447144 |
| F-statistic | 494.2952 | Durbin-Watson stat | | 0.908908 |
| Prob(F-statistic) | 0.000000 |  | |  |

**Source: Author’s computation from E-views 9.**

Table 4.4 presents the result derived from the OLS test, the value of the R squared is 0.98, this means that 98% of the dependent variable AG is explained by the independent variables in the model. R squared is 98% indicating a good fit for the model.

For a unit increase in Agricultural Credit, the AG will decrease by 0.10% in Nigeria.

For a unit increase in Government Expenditure in Agriculture, the AG will decrease by 0.06% in Nigeria.

For a unit increase in Money supply, the AG will increase by 0.41% in Nigeria.

The value of the constant is 6.411, therefore, when the independent variables are equated to zero, AG will increase by 6.411 percentage points. At a 5% level of significance, Agricultural credit, Government expenditure on Agriculture, Money supply and the intercept ( c) are statistically significant as their p-values (0.0540, 0.0070, 0.0000 and 0.0000 respectively) are all less than 0.05. this concludes that all the independent variables have a significant effect on the Nigerian economy.

# GRANGER CAUSALITY TEST.

Table 4.5 presents the results gotten from the granger causality test.

**Table 4.5: Granger Causality Test.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Pairwise Granger Causality Tests Date: 09/11/20 Time: 12:55 Sample: 1981 2018  Lags: 2 | | | | |
| **Null Hypothesis:** | **Obs.** | **F-Statistic** | **Prob.** | **Comment** |
| LGEA does not Granger Cause LAG | 36 | 1.13082 | 0.3357 | Fail to reject null |
| LAG does nor Granger Cause LGEA |  | 0.23627 | 0.7910 | Fail to reject null |
| LMS does not Granger Cause LAG | 36 | 2.96923 | 0.0661 | Fail to reject null |
| LAG does not Granger Cause LMS |  | 0.03928 | 0.9615 | Fail to reject null |
| LAC does nor Granger Cause LAG | 36 | 1.19695 | 0.3157 | Fail to reject null |
| LAG does not Granger Cause LAC |  | 0.54402 | 0.5859 | Fail to reject null |
| LMS does not Granger Cause LGEA | 36 | 0.28036 | 0.7574 | Fail to reject null |
| LGEA does not Granger Cause LMS |  | 5.01353 | 0.0130 | Reject null |
| LAC does not Granger Cause LGEA | 36 | 0.66805 | 0.5199 | Fail to reject null |
| LGEA does not Granger Cause LAC |  | 1.23321 | 0.3053 | Fail to reject null |
| LAC does not Granger Cause LMS | 36 | 1.98466 | 0.1545 | Fail to reject null |
| LMS does not Granger Cause LAC |  | 4.34718 | 0.0217 | Reject null |

**Source: Author’s computation from E-views 9**

The result is as follows: there is no causal relationship between Government Expenditure (GEA) and Agricultural Growth (AG), Money Supply (MS) and Agricultural Growth (AG), Agricultural Credit (AC) and Agricultural Growth (AG) and Agricultural Credit (AC) and Government Expenditure (GEA). There exists, however, a unidirectional relationship between Money Supply (MS) and Government Expenditure(GEA) and also between Agricultural Credit (AC) and Money Supply (MS).

**CHAPTER FIVE.**

**SUMMARY, CONCLUSION AND RECOMMENDATIONS.**

# INTRODUCTION.

This chapter discusses the results from the analyses run in chapter four. It aims to look summarize the results as well as their meanings, conclude what all the results mean and also discuss possible recommendations in order to enhance the determinants of agricultural output.

# SUMMARY OF FINDINGS.

The unit root test results of the selected variables show that all the selected variables are not stationary at levels but are however stationary at 1st difference. The Johansen co-integration test result shows that there is no long run relationship between the dependent and independent variables between the selected period at a 0.05 level of significance. The results derived from the OLS test shows that the value of R squared is 0.98, this then means that 98% of the dependent variable (AG) is explained by the independent variables in the model. The R squared being 98% indicates a good fit for the model.

The granger causality test concluded that there are no causal relationships between the selected variables (GEA, AC, MS) and Agricultural Growth (AG). But there exists however a unidirectional relationship between (MS and GEA) and also between (AC and MS).

# CONCLUSION.

The empirical result revealed that Agricultural Credit had a negative impact on Agricultural output with a coefficient of 0.105. Government Expenditure on Agriculture also had a negative impact on Agricultural growth with a coefficient of 0.060 while Money Supply had a positive impact on the Agricultural growth rates with a coefficient of 0.411. The test also reveals that there is no long run relationship between the variables at the selected time period at the given (0.05) level of significance.

# RECOMMENDATIONS.

In light of the findings of the study, the research has the following recommendations:

* + 1. The study recommends providing easier access to agricultural loans for the farmers so as to increase the productivity of the agricultural sector. With adequate financing which is easily accessible, maintenance and purchase of farm equipment used for production will be made much easier which will hasten the production process and thus significantly have a positive impact on the output levels of the agricultural sector.
    2. The study also recommends financial adjustments on the government’s budget so as to allocate more funds to the agricultural sector. This will thereby increase the governments expenditure on agriculture and will provide funding for the smooth running of the sector.

With these policies and adjustments put in place by the government, the level of output gotten from the agricultural sector is bound to increase which by extension can lead to an increase in the country’s GDP.

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**APPENDIX A DATA FOR THE STUDY**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Years | AG | GEA | MS | AC |
| 1981 | 2,364,373.15 | 0.01 | 14.47 | 0.59 |
| 1982 | 2,425,960.89 | 0.01 | 15.79 | 0.79 |
| 1983 | 2,409,081.92 | 0.01 | 17.69 | 0.94 |
| 1984 | 2,303,505.42 | 0.02 | 20.11 | 1.05 |
| 1985 | 2,731,062.47 | 0.02 | 22.30 | 1.31 |
| 1986 | 2,986,835.38 | 0.02 | 23.81 | 1.83 |
| 1987 | 2,891,672.33 | 0.05 | 27.57 | 2.43 |
| 1988 | 3,174,567.62 | 0.08 | 38.36 | 3.07 |
| 1989 | 3,325,947.09 | 0.15 | 45.90 | 3.47 |
| 1990 | 3,464,716.26 | 0.26 | 47.42 | 4.22 |
| 1991 | 3,590,837.44 | 0.21 | 75.40 | 5.01 |
| 1992 | 3,674,792.83 | 0.46 | 111.11 | 6.98 |
| 1993 | 3,743,665.81 | 1.8 | 165.34 | 10.75 |
| 1994 | 3,839,675.45 | 1.18 | 230.29 | 17.76 |
| 1995 | 3,977,381.94 | 1.51 | 289.09 | 25.28 |
| 1996 | 4,133,548.21 | 1.59 | 345.85 | 33.26 |
| 1997 | 4,305,679.63 | 2.06 | 413.28 | 27.94 |
| 1998 | 4,475,241.38 | 2.89 | 488.15 | 27.18 |
| 1999 | 4,703,643.68 | 59.32 | 628.95 | 31.05 |
| 2000 | 4,840,971.20 | 6.34 | 878.46 | 41.03 |
| 2001 | 5,024,542.11 | 7.06 | 1,269.32 | 55.85 |
| 2002 | 7,817,084.50 | 9.99 | 1,505.96 | 59.85 |
| 2003 | 8,364,832.10 | 7.54 | 1,952.92 | 62.10 |
| 2004 | 8,888,573.40 | 11.26 | 2,131.82 | 67.74 |
| 2005 | 9,516,991.54 | 16.33 | 2,637.91 | 48.56 |
| 2006 | 10,222,474.98 | 17.92 | 3,797.91 | 49.39 |
| 2007 | 10,958,469.13 | 32.48 | 5,127.40 | 149.58 |
| 2008 | 11,645,370.98 | 65.4 | 8,643.43 | 106.35 |
| 2009 | 12,330,325.55 | 22.44 | 9,687.51 | 135.70 |
| 2010 | 13,048,892.80 | 28.22 | 11,101.46 | 128.41 |
| 2011 | 13,429,378.77 | 41.2 | 12,628.32 | 255.21 |
| 2012 | 14,329,705.62 | 33.3 | 15,503.41 | 316.36 |
| 2013 | 14,750,523.21 | 39.43 | 18,743.07 | 343.70 |
| 2014 | 15,380,389.34 | 36.7 | 20,415.61 | 478.91 |
| 2015 | 15,952,220.14 | 41.27 | 20,885.52 | 449.31 |
| 2016 | 16,607,337.33 | 36.3 | 24,259.00 | 525.95 |
| 2017 | 17,179,495.29 | 50.26 | 28,604.47 | 528.24 |
| 2018 | 17,544,147.74 | 53.99 | 29,774.43 | 556.67 |

**APPENDIX B DESCRIPTIVE STATISTICS**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | AC | AG | GEA | MS |
| Mean | 121.5077 | 7693.524 | 16.55474 | 5857.074 |
| Median | 37.14650 | 4772.305 | 6.700000 | 753.7047 |
| Maximum | 610.1497 | 17544.15 | 65.40000 | 29774.43 |
| Minimum | 0.590600 | 2303.510 | 0.010000 | 14.47117 |
| Std. Dev. | 178.3168 | 5159.287 | 20.06081 | 8925.156 |
| Skewness | 1.560239 | 0.610525 | 0.944058 | 1.454377 |
| Kurtosis | 4.018851 | 1.837097 | 2.566919 | 3.792869 |
|  |  |  |  |  |
| Jarque-Bera | 17.06112 | 4.501904 | 5.941521 | 14.39169 |
| Probability | 0.000197 | 0.105299 | 0.051264 | 0.000750 |
|  |  |  |  |  |
| Sum | 4617.292 | 292353.9 | 629.0800 | 222568.8 |
| Sum Sq. Dev. | 1176485. | 9.85E+08 | 14890.14 | 2.95E+09 |
|  |  |  |  |  |
| Observations | 38 | 38 | 38 | 38 |

**APPENDIX C TRENDS ON THE VARIABLES**

700

Agricultural Credit

20,000

Agricultural Output

600

500

400

300

200

100

16,000

12,000

8,000

4,000

0

1985 1990 1995 2000 2005 2010 2015

0

1985 1990 1995 2000 2005 2010 2015

Agricultural expenditure (N' Billion)

70

60

50

40

30

20

10

0

1985 1990 1995 2000 2005 2010 2015

32,000

28,000

24,000

20,000

16,000

12,000

8,000

4,000

0

Money Supply2 (M2/M3) (N' Billion)

1985 1990 1995 2000 2005 2010 2015

**OUTPUT OF UNIT ROOT TEST LAG AT LEVEL**

**APPENDIX D**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Null Hypothesis: LAG 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 | | -2.064703 | | 0.5477 |
| 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(LAG) | | | | |
| Method: Least Squares |  |  |  |  |
| Date: 09/11/20 Time: 11:47 | | | | |
| Sample (adjusted): 1982 2018 | | | | |
| Included observations: 37 after adjustments | | | | |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
| LAG(-1) | -0.192950 | 0.093451 | -2.064703 | 0.0466 |
| C | 1.495818 | 0.702950 | 2.127916 | 0.0407 |
| @TREND("1981") | 0.012373 | 0.005872 | 2.107249 | 0.0425 |
| R-squared | 0.115531 | Mean dependent var | | 0.054168 |
| Adjusted R-squared | 0.063503 | S.D. dependent var | | 0.074292 |
| S.E. of regression | 0.071895 | Akaike info criterion | | -2.349626 |
| Sum squared resid | 0.175740 | Schwarz criterion |  | -2.219011 |
| Log likelihood | 46.46808 | Hannan-Quinn criter. | | -2.303578 |
| F-statistic | 2.220567 | Durbin-Watson stat | | 1.866312 |
| Prob(F-statistic) | 0.124053 |  | |  |

**APPENDIX E**

**LAG AT 1ST DIFFERENCE**

AT 1ST DIFFERENCE

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Null Hypothesis: D(LAG) 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 | | -5.775102 | | 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(LAG,2) | | | | |
| Method: Least Squares |  |  |  |  |
| Date: 09/11/20 Time: 11:48 | | | | |
| Sample (adjusted): 1983 2018 | | | | |
| Included observations: 36 after adjustments | | | | |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
| D(LAG(-1)) | -1.009067 | 0.174727 | -5.775102 | 0.0000 |
| C | 0.048090 | 0.028381 | 1.694482 | 0.0996 |
| @TREND("1981") | 0.000378 | 0.001246 | 0.303215 | 0.7636 |
| R-squared | 0.503070 | Mean dependent var | | -0.000131 |
| Adjusted R-squared | 0.472953 | S.D. dependent var | | 0.106511 |
| S.E. of regression | 0.077325 | Akaike info criterion | | -2.201950 |
| Sum squared resid | 0.197311 | Schwarz criterion |  | -2.069990 |
| Log likelihood | 42.63510 | Hannan-Quinn criter. | | -2.155893 |
| F-statistic | 16.70387 | Durbin-Watson stat | | 1.990131 |
| Prob(F-statistic) | 0.000010 |  | |  |

**APPENDIX F LAC AT LEVEL**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Null Hypothesis: LAC 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 | | -2.370249 | | 0.3882 |
| 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(LAC) | | | | |
| Method: Least Squares |  |  |  |  |
| Date: 09/11/20 Time: 11:41 | | | | |
| Sample (adjusted): 1982 2018 | | | | |
| Included observations: 37 after adjustments | | | | |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
| LAC(-1) | -0.280721 | 0.118435 | -2.370249 | 0.0236 |
| C | 0.155517 | 0.091141 | 1.706336 | 0.0971 |
| @TREND("1981") | 0.049505 | 0.022628 | 2.187738 | 0.0357 |
| R-squared | 0.159246 | Mean dependent var | | 0.187576 |
| Adjusted R-squared | 0.109790 | S.D. dependent var | | 0.257537 |
| S.E. of regression | 0.242988 | Akaike info criterion | | 0.085999 |
| Sum squared resid | 2.007475 | Schwarz criterion |  | 0.216614 |
| Log likelihood | 1.409014 | Hannan-Quinn criter. | | 0.132047 |
| F-statistic | 3.219946 | Durbin-Watson stat | | 2.093563 |
| Prob(F-statistic) | 0.052405 |  | |  |

**APPENDIX G**

**LAC AT 1ST DIFFERENCE**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Null Hypothesis: D(LAC) 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 | | -6.994827 | | 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(LAC,2) | | | | |
| Method: Least Squares |  |  |  |  |
| Date: 09/11/20 Time: 11:45 | | | | |
| Sample (adjusted): 1983 2018 | | | | |
| Included observations: 36 after adjustments | | | | |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
| D(LAC(-1)) | -1.194141 | 0.170718 | -6.994827 | 0.0000 |
| C | 0.297248 | 0.102389 | 2.903130 | 0.0065 |
| @TREND("1981") | -0.003886 | 0.004231 | -0.918492 | 0.3650 |
| R-squared | 0.597225 | Mean dependent var | | -0.003957 |
| Adjusted R-squared | 0.572814 | S.D. dependent var | | 0.399457 |
| S.E. of regression | 0.261083 | Akaike info criterion | | 0.231700 |
| Sum squared resid | 2.249426 | Schwarz criterion |  | 0.363660 |
| Log likelihood | -1.170597 | Hannan-Quinn criter. | | 0.277757 |
| F-statistic | 24.46580 | Durbin-Watson stat | | 2.031045 |
| Prob(F-statistic) | 0.000000 |  | |  |

**APPENDIX H LGEA AT LEVEL**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Null Hypothesis: LGEA 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 | | -2.156112 | | 0.4989 |
| 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(LGEA) | | | | |
| Method: Least Squares |  |  |  |  |
| Date: 09/11/20 Time: 11:49 | | | | |
| Sample (adjusted): 1982 2018 | | | | |
| Included observations: 37 after adjustments | | | | |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
| LGEA(-1) | -0.265145 | 0.122974 | -2.156112 | 0.0382 |
| C | -0.687106 | 0.568665 | -1.208280 | 0.2353 |
| @TREND("1981") | 0.058537 | 0.033689 | 1.737570 | 0.0913 |
| R-squared | 0.138989 | Mean dependent var | | 0.232269 |
| Adjusted R-squared | 0.088341 | S.D. dependent var | | 0.749834 |
| S.E. of regression | 0.715948 | Akaike info criterion | | 2.247186 |
| Sum squared resid | 17.42776 | Schwarz criterion |  | 2.377800 |
| Log likelihood | -38.57293 | Hannan-Quinn criter. | | 2.293233 |
| F-statistic | 2.744234 | Durbin-Watson stat | | 2.401504 |
| Prob(F-statistic) | 0.078550 |  | |  |

**APPENDIX I**

**LGEA AT 1ST DIFFERENCE**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Null Hypothesis: D(LGEA) 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 | | -6.832882 | | 0.0000 |
| 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(LGEA,2) | | | | |
| Method: Least Squares |  |  |  |  |
| Date: 09/11/20 Time: 11:50 | | | | |
| Sample (adjusted): 1984 2018 | | | | |
| Included observations: 35 after adjustments | | | | |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
| D(LGEA(-1)) | -1.893355 | 0.277095 | -6.832882 | 0.0000 |
| D(LGEA(-1),2) | 0.347269 | 0.165549 | 2.097687 | 0.0442 |
| C | 0.961189 | 0.285595 | 3.365568 | 0.0021 |
| @TREND("1981") | -0.025067 | 0.011770 | -2.129698 | 0.0412 |
| R-squared | 0.743336 | Mean dependent var | | 0.002045 |
| Adjusted R-squared | 0.718497 | S.D. dependent var | | 1.272197 |
| S.E. of regression | 0.674987 | Akaike info criterion | | 2.158965 |
| Sum squared resid | 14.12385 | Schwarz criterion |  | 2.336719 |
| Log likelihood | -33.78189 | Hannan-Quinn criter. | | 2.220326 |
| F-statistic | 29.92679 | Durbin-Watson stat | | 2.088359 |
| Prob(F-statistic) | 0.000000 |  | |  |

**APPENDIX J LMS AT LEVEL**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Null Hypothesis: LMS 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 | | -0.961015 | | 0.9374 |
| 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(LMS) | | | | |
| Method: Least Squares |  |  |  |  |
| Date: 09/11/20 Time: 11:50 | | | | |
| Sample (adjusted): 1982 2018 | | | | |
| Included observations: 37 after adjustments | | | | |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
| LMS(-1) | -0.085354 | 0.088816 | -0.961015 | 0.3433 |
| C | 0.393666 | 0.182957 | 2.151680 | 0.0386 |
| @TREND("1981") | 0.019254 | 0.021025 | 0.915747 | 0.3662 |
| R-squared | 0.031921 | Mean dependent var | | 0.206196 |
| Adjusted R-squared | -0.025025 | S.D. dependent var | | 0.124843 |
| S.E. of regression | 0.126395 | Akaike info criterion | | -1.221201 |
| Sum squared resid | 0.543176 | Schwarz criterion |  | -1.090586 |
| Log likelihood | 25.59222 | Hannan-Quinn criter. | | -1.175153 |
| F-statistic | 0.560554 | Durbin-Watson stat | | 1.189118 |
| Prob(F-statistic) | 0.576079 |  | |  |

**APPENDIX K**

**LMS AT 1ST DIFFERENCE**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Null Hypothesis: D(LMS) 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 | | -3.946784 | | 0.0200 |
| 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(LMS,2) | | | | |
| Method: Least Squares |  |  |  |  |
| Date: 09/11/20 Time: 11:51 | | | | |
| Sample (adjusted): 1983 2018 | | | | |
| Included observations: 36 after adjustments | | | | |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
| D(LMS(-1)) | -0.646018 | 0.163682 | -3.946784 | 0.0004 |
| C | 0.163242 | 0.054924 | 2.972129 | 0.0055 |
| @TREND("1981") | -0.001454 | 0.001917 | -0.758720 | 0.4534 |
| R-squared | 0.327622 | Mean dependent var | | -0.001303 |
| Adjusted R-squared | 0.286872 | S.D. dependent var | | 0.141461 |
| S.E. of regression | 0.119459 | Akaike info criterion | | -1.332030 |
| Sum squared resid | 0.470926 | Schwarz criterion |  | -1.200070 |
| Log likelihood | 26.97654 | Hannan-Quinn criter. | | -1.285972 |
| F-statistic | 8.039779 | Durbin-Watson stat | | 2.024004 |
| Prob(F-statistic) | 0.001431 |  | |  |

**APPENDIX L COINTEGRATION**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Date: 09/11/20 Time: 14:19 | | | | |
| Sample (adjusted): 1983 2018 | | | | |
| Included observations: 36 after adjustments | | | | |
| Trend assumption: Linear deterministic trend | | | | |
| Series: LAG LAC LGEA LMS | | | | |
| Lags interval (in first differences): 1 to 1 | | | | |
| Unrestricted Cointegration Rank Test (Trace) | | | | |
| Hypothesized |  | Trace | 0.05 |  |
| No. of CE(s) | Eigenvalue | Statistic | Critical Value | Prob.\*\* |
| None | 0.510559 | 42.35701 | 47.85613 | 0.1490 |
| At most 1 | 0.218571 | 16.63533 | 29.79707 | 0.6668 |
| At most 2 | 0.153436 | 7.756635 | 15.49471 | 0.4918 |
| At most 3 | 0.047717 | 1.760137 | 3.841466 | 0.1846 |
| Trace test indicates no cointegration 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 |  | Max-Eigen | 0.05 |  |
| No. of CE(s) | Eigenvalue | Statistic | Critical Value | Prob.\*\* |
| None | 0.510559 | 25.72168 | 27.58434 | 0.0849 |
| At most 1 | 0.218571 | 8.878693 | 21.13162 | 0.8421 |
| At most 2 | 0.153436 | 5.996499 | 14.26460 | 0.6137 |
| At most 3 | 0.047717 | 1.760137 | 3.841466 | 0.1846 |
| Max-eigenvalue test indicates no cointegration at the 0.05 level | | | | |
| \* denotes rejection of the hypothesis at the 0.05 level | | | | |
| \*\*MacKinnon-Haug-Michelis (1999) p-values | | | | |
| Unrestricted Cointegrating Coefficients (normalized by b'\*S11\*b=I): | | | | |
| LAG | LAC | LGEA | LMS |  |
| -6.853852 | 0.200502 | -1.887285 | 3.708410 |  |
| 7.473744 | 3.120025 | -0.390581 | -4.067084 |  |
| -2.776027 | 1.911058 | -0.064824 | -0.484510 |  |
| 3.827617 | -0.466387 | -0.047230 | -0.243652 |  |
| Unrestricted Adjustment Coefficients (alpha): | | | | |
| D(LAG) | 0.018357 | -0.021788 | 0.012976 | -0.008021 |
| D(LAC) | 0.006800 | -0.042876 | -0.085833 | 0.000544 |
| D(LGEA) | 0.113953 | 0.184365 | -0.064850 | -0.113124 |
| D(LMS) | -0.068336 | 0.001065 | -0.001927 | -0.010219 |

|  |  |  |  |
| --- | --- | --- | --- |
| 1 Cointegrating Equation(s): | | Log likelihood | 49.77540 |
| Normalized cointegrating coefficients (standard error in parentheses) | | | |
| LAG | LAC | LGEA | LMS |
| 1.000000 | -0.029254 | 0.275361 | -0.541070 |
|  | (0.08990) | (0.04456) | (0.06426) |
| Adjustment coefficients (standard error in parentheses) | | | |
| D(LAG) | -0.125813 |  |  |
|  | (0.08796) |  |  |
| D(LAC) | -0.046604 |  |  |
|  | (0.29738) |  |  |
| D(LGEA) | -0.781016 |  |  |
|  | (0.85197) |  |  |
| D(LMS) | 0.468366 |  |  |
|  | (0.10239) |  |  |
| 2 Cointegrating Equation(s): | | Log likelihood | 54.21475 |
| Normalized cointegrating coefficients (standard error in parentheses) | | | |
| LAG | LAC | LGEA | LMS |
| 1.000000 | 0.000000 | 0.253907 | -0.541273 |
|  |  | (0.03658) | (0.04147) |
| 0.000000 | 1.000000 | -0.733396 | -0.006970 |
|  |  | (0.17685) | (0.20051) |
| Adjustment coefficients (standard error in parentheses) | | | |
| D(LAG) | -0.288653 | -0.064299 |  |
|  | (0.12373) | (0.03815) |  |
| D(LAC) | -0.367049 | -0.132411 |  |
|  | (0.43276) | (0.13343) |  |
| D(LGEA) | 0.596879 | 0.598071 |  |
|  | (1.21344) | (0.37412) |  |
| D(LMS) | 0.476327 | -0.010378 |  |
|  | (0.15147) | (0.04670) |  |
| 3 Cointegrating Equation(s): | | Log likelihood | 57.21300 |
| Normalized cointegrating coefficients (standard error in parentheses) | | | |
| LAG | LAC | LGEA | LMS |
| 1.000000 | 0.000000 | 0.000000 | -0.295800 |
|  |  |  | (0.02468) |
| 0.000000 | 1.000000 | 0.000000 | -0.716007 |
|  |  |  | (0.06548) |
| 0.000000 | 0.000000 | 1.000000 | -0.966786 |
|  |  |  | (0.10175) |
| Adjustment coefficients (standard error in parentheses) | | | |
| D(LAG) | -0.324675 | -0.039501 | -0.026975 |
|  | (0.12584) | (0.04386) | (0.02308) |
| D(LAC) | -0.128776 | -0.296442 | 0.009478 |
|  | (0.41734) | (0.14545) | (0.07655) |
| D(LGEA) | 0.776904 | 0.474139 | -0.282867 |

|  |  |  |  |
| --- | --- | --- | --- |
|  | (1.25192) | (0.43632) | (0.22962) |
| D(LMS) | 0.481675 | -0.014059 | 0.128679 |
|  | (0.15700) | (0.05472) | (0.02880) |

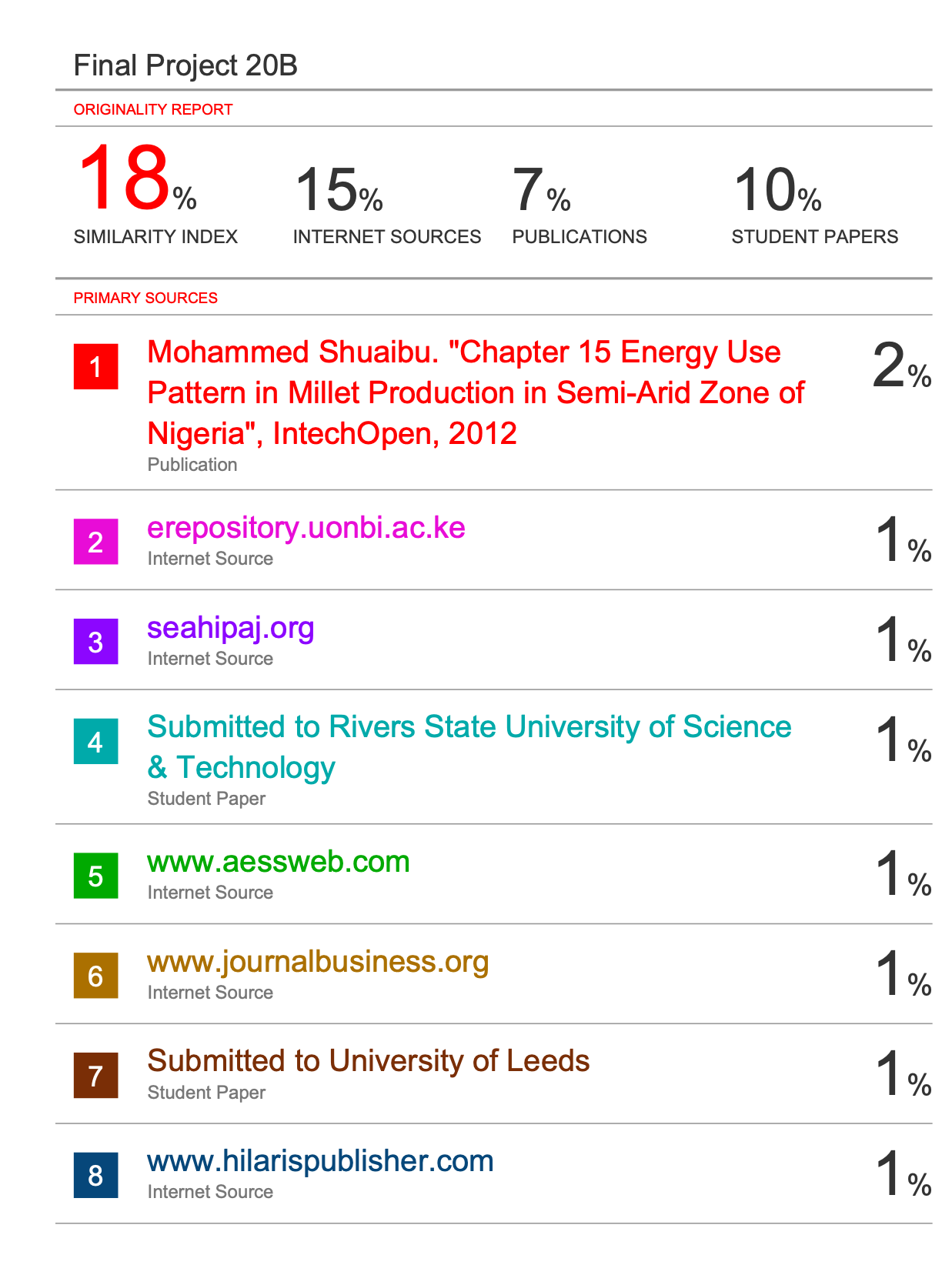
**APPENDIX M**

**OLS**

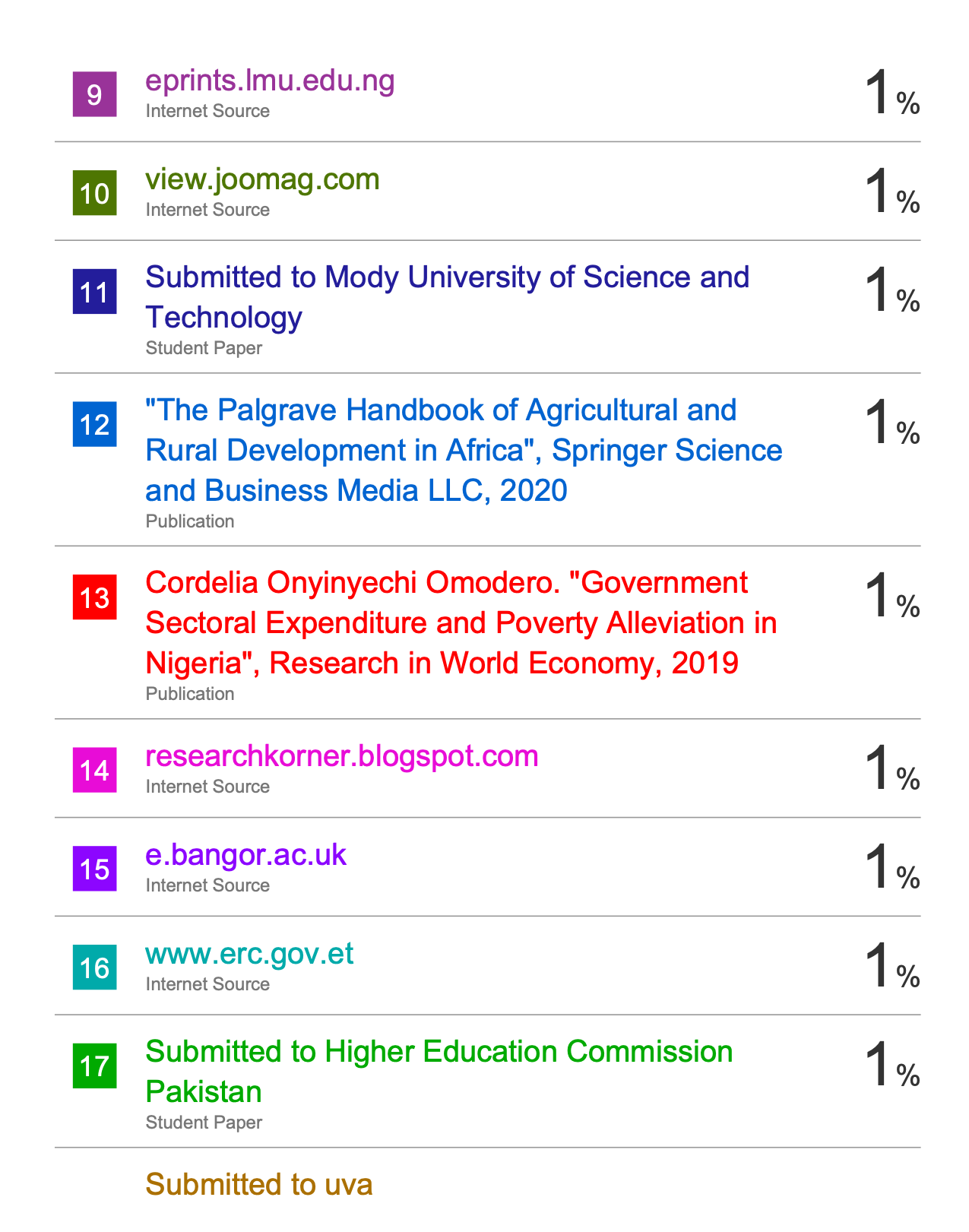
|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Dependent Variable: LAG | | | | |
| Method: Least Squares |  |  |  |  |
| Date: 09/11/20 Time: 12:47 | | | | |
| Sample: 1981 2018 |  |  |  |  |
| Included observations: 38 | | | | |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
| LAC | -0.104970 | 0.052603 | -1.995517 | 0.0540 |
| LGEA | -0.060446 | 0.021059 | -2.870308 | 0.0070 |
| LMS | 0.410792 | 0.039204 | 10.47827 | 0.0000 |
| C | 6.411994 | 0.138791 | 46.19876 | 0.0000 |
| R-squared | 0.977586 | Mean dependent var | | 8.718510 |
| Adjusted R-squared | 0.975608 | S.D. dependent var | | 0.693449 |
| S.E. of regression | 0.108303 | Akaike info criterion | | -1.508475 |
| Sum squared resid | 0.398801 | Schwarz criterion |  | -1.336097 |
| Log likelihood | 32.66102 | Hannan-Quinn criter. | | -1.447144 |
| F-statistic | 494.2952 | Durbin-Watson stat | | 0.908908 |
| Prob(F-statistic) | 0.000000 |  | |  |

**APPENDIX N GRANGER CAUSALITY**

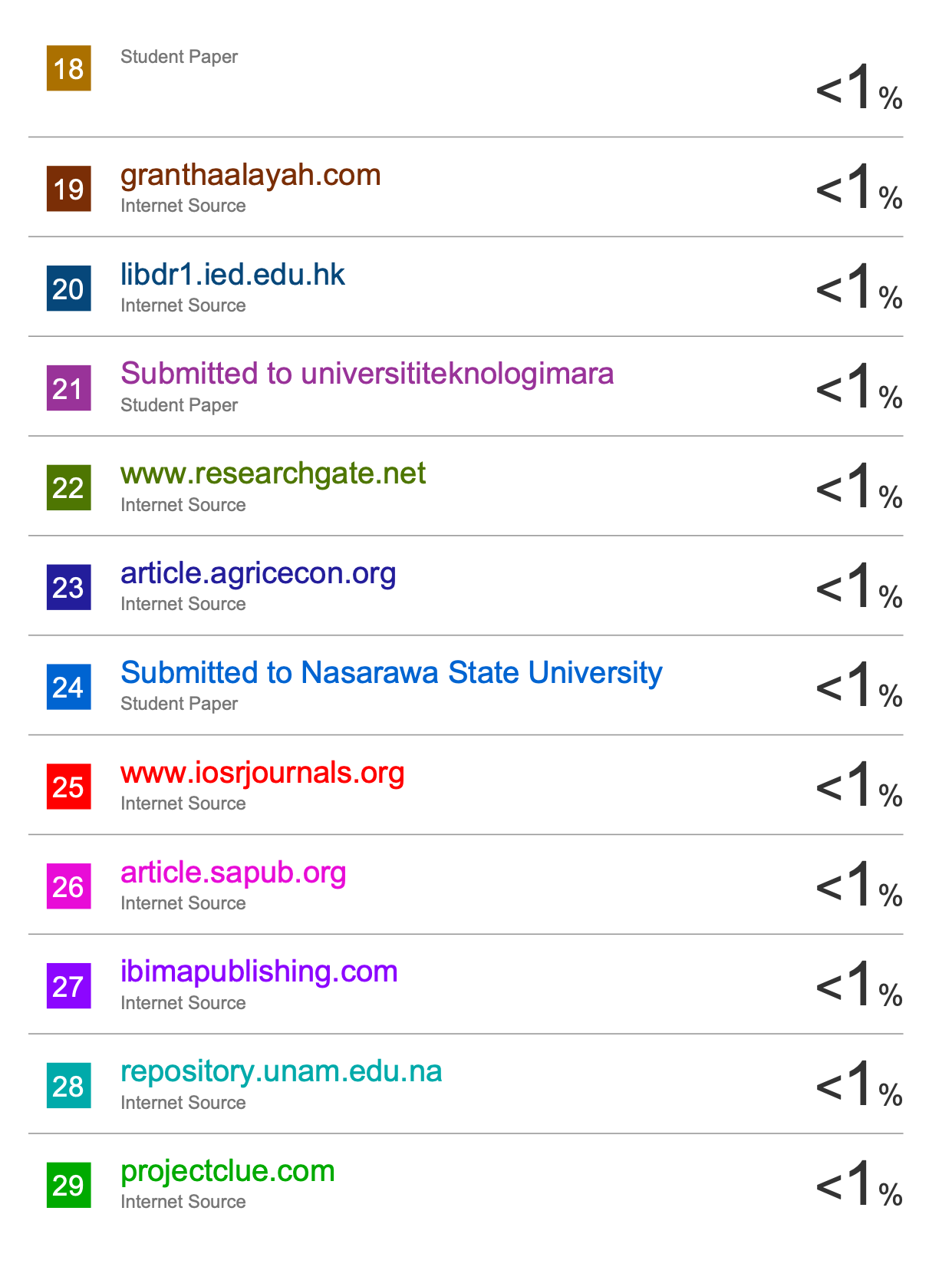
|  |  |  |  |
| --- | --- | --- | --- |
| Pairwise Granger Causality Tests |  |  |  |
| Date: 09/11/20 Time: 12:55 |  |  |  |
| Sample: 1981 2018 |  |  |  |
| Lags: 2 |  |  |  |
| Null Hypothesis: | Obs | F-Statistic | Prob. |
| LGEA does not Granger Cause LAG | 36 | 1.13082 | 0.3357 |
| LAG does not Granger Cause LGEA |  | 0.23627 | 0.7910 |
| LMS does not Granger Cause LAG | 36 | 2.96923 | 0.0661 |
| LAG does not Granger Cause LMS |  | 0.03928 | 0.9615 |
| LAC does not Granger Cause LAG | 36 | 1.19695 | 0.3157 |
| LAG does not Granger Cause LAC |  | 0.54402 | 0.5859 |
| LMS does not Granger Cause LGEA | 36 | 0.28036 | 0.7574 |
| LGEA does not Granger Cause LMS |  | 5.01353 | 0.0130 |
| LAC does not Granger Cause LGEA | 36 | 0.66805 | 0.5199 |
| LGEA does not Granger Cause LAC |  | 1.23321 | 0.3053 |
| LAC does not Granger Cause LMS | 36 | 1.98466 | 0.1545 |
| LMS does not Granger Cause LAC |  | 4.34718 | 0.0217 |



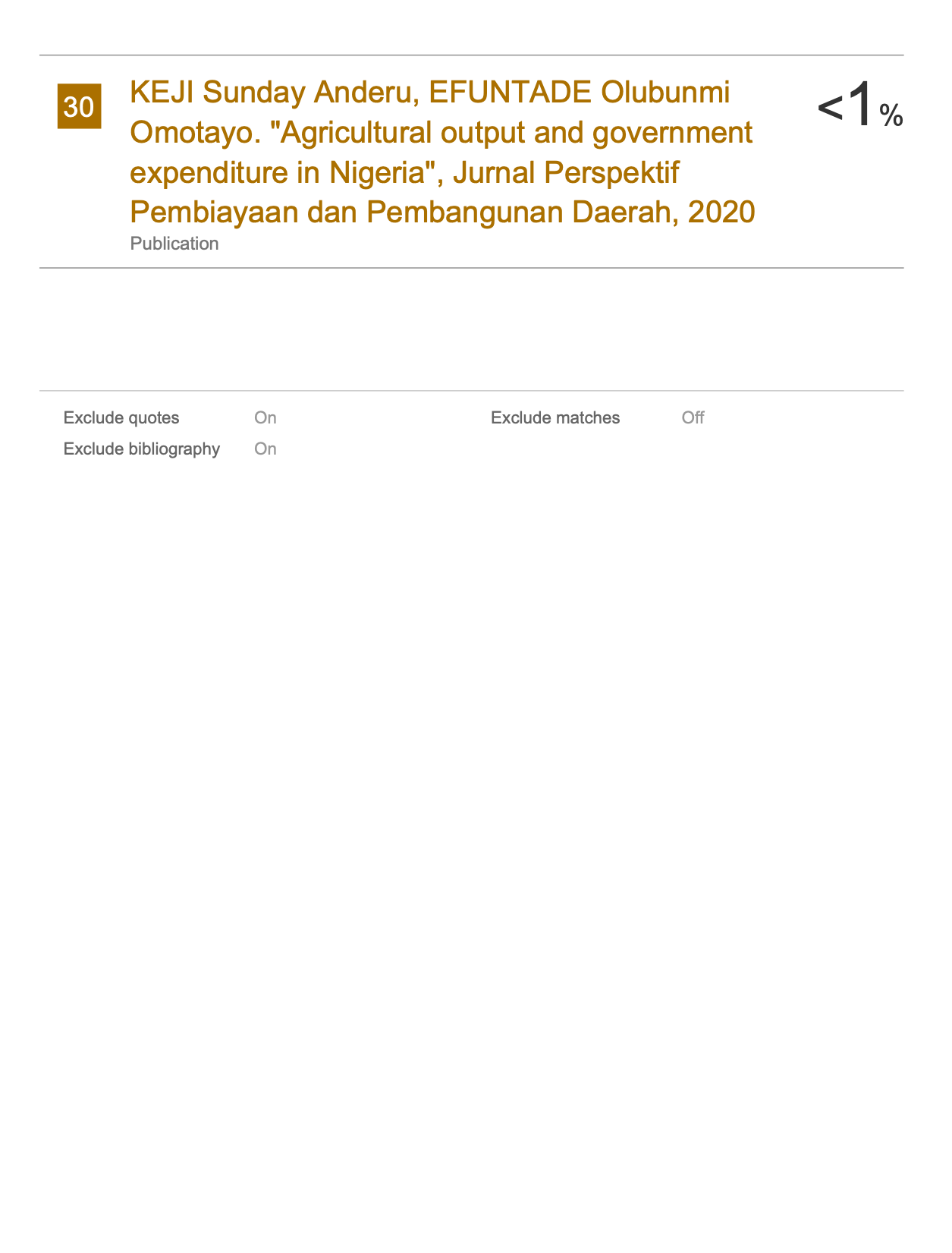
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