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Toward achieving sustainable development agenda: Nexus between Agriculture, Trade Openness, and Oil rents in Nigeria

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Festus F. Adedoyin
Department of Accounting, Economics and Finance,
Bournemouth University, United Kingdom
E-mail: fadedoyin@bournemouth.ac.uk

Olawumi A. Osundina
Department of Economics, Babcock University,
Ilishan-Remo, Ogun State, Nigeria.
E-mail: osundinaol@babcock.edu.ng

Festus V. Bekun
Faculty of Economics Administrative and Social sciences,
Istanbul Gelisim University, Istanbul, Turkey
E-mail: festus.bekun@emu.edu.tr

Simplice A. Asongu
(Corresponding author)
African Governance and Development Institute,
P.O. Box 8413, Yaoundé, Cameroon
E-mails: asongus@afridev.org /
asongusimplice@yahoo.com

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Toward achieving sustainable development agenda: Nexus between Agriculture, Trade Openness, and Oil rents in Nigeria

Festus F. Adedoyin, Olawumi A. Osundina, Festus V. Bekun & Simplice A. Asongu

Abstract

Over the years, agriculture has been considered as a panacea for long-term economic growth as believed by the physiocracy school of thought. Aligning this with the United Nations' Sustainable Development Goals (specifically UN-SDG-2 which highlights zero hunger), the present study empirically complements existing studies by exploring the interactions between agriculture, trade openness and oil rents using annual time frequency series data from 1981-2017. A series of analysis is conducted. First, a battery of non-stationarity and stationarity unit root tests are performed; these range from the traditional Augmented Dickey-Fuller (ADF) and Phillips Perron (PP) techniques to the relatively recent Zivot Andrews (ZA) unit root test which accounts for a single structural break to ascertain stationarity properties in the variables under review. Subsequently, the recent Bayer and Hanck (2013) test in conjunction with the Johansen co-integration test were used for the co-integration analysis. Furthermore, to detect the direction of causality, the Toda-Yamamoto Granger Causality test alongside the impulse response function technique shows insightful outcomes. From the empirical results, co-integration is apparent and a long-run equilibrium relationship is traced between the outlined variables over the investigated period. The causality results and impulse response analysis highlight the existence of one-way causality links running from agriculture to trade and from trade to oil rents. These are revealing given the dwindling oil market prices. More insights are elucidated in the conclusion section accordingly.

Keywords: Agriculture, sustainability; Bayer-Hanck cointegration; Nigeria

JEL code: Q10, O13, C32, C33

1. Introduction

The current state of the global world, which is characterized by different forms of disarray, does not only call for urgent attention, but an urgent solution which, if not permanent, should be sustainable over a long period of time. Effort in this direction is the adoption of global goals mostly referred to as the Sustainable Development Goals (SDGs). These SDGs[1] were adopted by all United Nations States in the year 2015as a universal wakeup call to eradicate poverty, protect the planet and guarantee peace and prosperity to all people by the year 2030 (Tchamyou *et al.*, 2019a, 2019b). These SDGs are 17 in number and are all integrated as outcomes, with each of the areas complementing one another to reflect a policy framework that enhances sustainability in social, economic and environmental aspects of development (UN, 2015). This in effect contributes to economic growth and development recognized as key areas that have preoccupied development experts. This assertion is found valid because better macroeconomic policy and conditions foster a prosperous nation (Cole, 2003; Foster & Frieden 2017). Economic growth, regarded as an increase in the general output of the country's gross domestic product (GDP), consequently promotes foreign direct investment (FDI), which enhances the well-being of the citizenry (Borensztein *et al*., 1998; Asongu & Odhiambo, 2020a, 2020b).

Economic growth and welfare featuring in the topmost agenda of any government are achieved via several strategies. The link between this agenda and the strategies are enormously available to every nation on the path to attain economic prosperity. Andas Eric (2008) has it, these strategies include, but not limited to, two and three gap approaches, linkages theories, and export-led strategy. However, the choice of strategy to be considered most appropriate is based on availability of natural endowments. Unfortunately, there is the term resource curse which describes a situation whereby resource-rich nations (i.e. countries blessed with abundant natural resources), experience difficulty in taking advantage of their natural endowments (Gylfason, 2001, 2006; Mehlum *et al*., 2006; Torvik, 2009; Shao & Yang, 2014; Kim & Lin, 2015). Countries like such experience retarded economic growth and slow development compared with their counterparts that are less endowed with natural resources. The possible explanation for the

[1]SDG 1—no poverty; SDG 2—zero hunger; SDG 3—good health and well-being; SDG 4—quality education; SDG 5—gender equality; SDG 6—clean water and sanitation; SDG 7—affordableand clean energy; SDG 8—decent work and economic growth; SDG 9—industry, innovation, and infrastructure; SDG 10—reduced inequalities; SDG 11—sustainable cities and communities; SDG 12—responsible consumption and production; SDG 13—climate action; SDG 14—life below water; SDG 15—life on land; SDG 16—peace, justice, and strong institutions; SDG 17—partnerships for the goals.

situation ranges from weak strategies to ensure the efficient use of such endowments that would culminate in economic growth, to poor and unstable government regimes, political rules and corruption. All these account for this resource curse (Bekun & Akadiri, 2019; Sertoglu *et al*., 2017; Judge, 2011). This scenario perfectly describes the case of the country Nigeria; and it is yet troubling how the abundant resource nation is yet to manage resource endowments to meet-up with economic growth and development. Such most third and developing nations suffer from this term resource curse as they have been unable to translate their tremendous wealth in natural resources into the joint good of all citizenry (Auty, 2002; Ahungwa *et al*., 2014; Gokmenoglu *et al*., 2016). This is still a puzzle to development experts in these regions.

Agriculture is a long age practice which has been discovered as a channel to economic development. Among all that SDGs are designed for is the aim of non-tolerance to poverty and hunger which also reflects in the three broad development contexts; eliminating poverty, structural transformations and building resilience. The emphasis on putting an end to all forms of hunger and malnutrition involves the promotion of sustainable agriculture, support to small-scale farmers, equal access to land, technology and markets; doing this translates to investment in infrastructure and technology to improve productivity in agriculture, and also places the country on a better edge to open up to trade. This context complements the believe of the Physiocrats that the development of any nation rests entirely on the agricultural sector (Bekun *et al*., 2018; Sertoglu *et al*., 2017; Izuchukwu, 2011; Burkett, 2003). These thinkers refer to agriculture as the panacea for the much-anticipated growth of the less developed countries, hence also emancipation from the "resource curse". Timmer (2014) also asserts that rarely can any country be found to successfully transform its economy to have a low rate of poverty without a sustained growth in productivity in agriculture. In the same fashion, Nobel Laureate Economist Gunner Myrdal asserted that: "*it is in the agricultural sector that the battle for long-term economic growth will either be won or lost*" (Turan, 2006, 332). Hence, in light of this quote, we provide empirical evidence from the current study, which is also tailored towards empirically complementing documented studies by exploring the interaction between agriculture, trade openness and oil rents using annual time frequency series data from 1981-2017.

The Review of Nigeria's Agroeconomy

Nigeria, the Sub-Saharan Africa's largest economy, bordering the Gulf of Guinea, between Benin and Cameroon, has a total area including land and water areas of 923,768 sq km, with a total population of 205,323,504 people (World Fact Book, 2020). According to the World Poverty Clock (2020), approximately 50% of the population which is comprised of 102,125,917 people, live in extreme poverty. Nigeria is mainly an agrarian country with a massive endowment of natural resources- natural gas, petroleum, tin, iron ore, coal, limestone and agricultural land of 78% of the land area and water area of 13,000 sq km. All these give the agricultural sector and sub-sectors like crop production, aquaculture, and animal husbandry, among others, vast potentials to strive and contribute to growth and development of the country. And for sustainability, Agboola *et al*. (2020) emphasizes that agriculture can no longer be ignored, and thus suggests agricultural sector a necessity for diversification of the economy as the study confirms a positive effect of the forestry, crop production and fishery on economic growth. The most prominent cash crops with economic value cultivated in Nigeria are cocoa, rubber, cashew, sesame groundnut, palm oil, palm kernel, etc. Nevertheless, the sector has been plagued by low productivity and a weak agricultural system. The country's enormous irrigation potentials remain largely untapped. The Nigerian agricultural system is mostly of small-scale and is characterized by the adoption of crude and rudimentary tools and implements. The use of much-fragmented land accompanied by poor management is captured as a constraint (Okoro, 2011). Furthermore, urbanization in housing units and modern infrastructures has drastically reduced the volume of land available to agricultural production development. It is worthy of mention that, only about 50 % of Nigeria's arable land is under cultivation. Even small available fragments of lands are being cultivated by peasant and traditional farmers who employ crude implements. The outcome of such practices brings about reduction in yields and proceeds from agriculture. These and other numerous issues deter both peasants and traditional farmers (Ekpo & Egwaikhide, 1994).

On the other hand, the oil sector, being the main driver of the Nigerian economy, becomes the key contributor to gross domestic product as the country relies heavily on oil as its main source of foreign exchange earnings and government revenue. The oil industry has brought mixed feelings to the Nigerian economy after the discovery of petroleum in 1957 in the Olobiri, Niger

Delta region of Nigeria. Statistics show that on average, the energy sector in Nigeria accounts for over 40 % of the GDP in the 1990s. Although there was a slight decline in 2009 to 29.62 % due to the current unrest in the oil-producing regions in the country (Aminu *et al*., 2012)

The discovery of oil in commercial quantity has led to the neglect of the agricultural sector. The attention of governments and subsequent regimes has been on the energy sector because of the potentials and prospect the industry possesses. This trend has led to a drastic decline in the agricultural sector's contribution to GDP as asserted by Alene *et al*. (2009).

In light of the above, Nigeria's endowment in arable land and good agro-climatological conditions support vast agricultural production and by extension, economic growth and development. This study investigates the effect of oil dependence on agricultural development. The key focus of this paper is to examine if there exist causality among the variables of interest and the long-run relationship among variables considered for this study. This complements the already documented studies in the literature, as it examines the impact of openness to trade and its impact on the agricultural value chain. Previous studies focus more on the impact of agriculture value-added on aggregate economic growth (GDP). Thus, from a policy lens, this study aims to serve as a blueprint for policy and decision-makers in the agriculture and agro-business domain and to equip them with ample information for proper and decisive decision-making.

In the light of the above, the main objective of this study is a to assess the nexus between agriculture, trade openness and oil rents in Nigeria. Hence, the corresponding research question is: how are agriculture, trade, openness and oil rents linked in Nigeria within the remit of achieving the sustainable development agenda? The rest of the study is structured as follows. The conceptual framework and literature review are provided in Section 2 while Section 3 discusses the data and methodology. The empirical results are disclosed in Section 4 while the study concludes with Section 5.

2. Conceptual framework and review of existing literature

Research by agricultural and development experts have shown that the agricultural sector is the cure-all for economic growth and development by an extension (Wong, 2007; Oji-Okoro, 2011; Olajide *et al*., 2012). Empirically, the agricultural sector bestows immensely to the gross

domestic product (GDP) via an array of linkages (Johnston & Meller, 1961; Izuchukwu 2011; Olajide et al., 2012; Ahungwa *et al*., 2014; Sertoglu *et al*., 2017; Shabani & Shahnazi, 2019). According to Eric (2008), some of these linkages have been explained using the linkage theory; two and three gaps; booming sector; as well as the Dutch Disease, among others. How activities of the agricultural sector translate into economic prosperity is based on how efficiently and effectively the resources available to these countries are harnessed. Empirical evidence abounds which suggest that the agricultural sector is vital in most developing and developed nations of the world. Nevertheless, given the notable role of the agricultural sector, there was a decline in the sector's contribution to the economy in the 1980s (Wong, 2007; Bazemer & Headey, 2008; Izuchukwu 2011; Ahungwa *et al*., 2014; Sertoglu *et al*., 2017; Shabani & Shahnazi, 2019). The possible explanation for this phenomenon is the arrival of natural endowments such as oil, and natural gas.

Most African countries and developing nations of the world are endowed with huge deposits of oil (petroleum), natural gas, special stones, among others. Nations with these natural blessings are perceived as being favoured (Mohen, 2009; Gylfason, 2001, 2006; Mehlum *et al*., 2006; Torvik, 2009; Shao & Yang, 2014; Kim & Lin, 2015). However, there have been unsolved puzzles among development experts and economists. How could resource-rich nations like Nigeria not have been able to translate their endowments to the commonwealth of the nation? This puzzle has generated a series of debates among scholars. What is conceptualized as the "resource curse" is a phenomenon of how resource-rich nations grow sluggishly relative to their counterparts that are less endowed. This debate forms the basis for this study.

There has been no consensus among scholars on the relationship between oil dependency and agricultural development. This disparity among development experts and economists on whether nations with massive deposits of natural endowments like most sub-Saharan African countries serves as the determinant for economic growth. There have been divergences in the literature on the outcomes of this puzzle.

Sachs and Warner (2001a, 2001b) were among the pioneers to investigate whether natural resource endowment was a stimulus for economic growth and development. These scholars also queried the route through which development emerges. The study was carried out using cross-country data for developing nations for the 1970-1989 period. They found a negative relationship

exists between economic growth and natural endowment. In connection with this finding, many researchers have been motivated to study the nature of the relationship that exists between natural resource dependence and economic growth. In his study, Tornell (1999) justifies this dilemma where countries so rich in natural endowments like oil and gas are plagued with scarcity, poverty and all forms of social ills, good macro-economic policies have not been in the advantage of resource-rich economies. Furthermore, Tornell (1999) gives more explanation among which are misappropriation of resources, corruption, the red tape syndrome, bad political setting and also noted was the high interest accruing to such economies which crowds-out other sectors like manufacturing, agriculture and service sectors in such country. Mehlum *et al*. (2006) support the argument that failure is not far from countries that have based their economies on natural resources. Nili and Rastad (2007) lay emphasis on oil revealing the contrast between the oil-exporting countries and the rest of the world in the years 1975 to 2000, the finding has it that while oil-exporting countries experienced a fall of average per capita income of 29%, the rest of the world witnessed an increase by 34% during the specified period. As revealed by Apergis and Payne(2014), a negative relationship exists in the long run between oil rents and agriculture value added in oil-producing countries in Middle East and North Africa (MENA). Kazeem (2018) also attributes the rise in the poverty rate to the gross mismanagement of vast oil riches of the country as a result of the corruption and incompetence.

Also, Wright *et al*. (1999) and Wright & Czelusta (2004) in their empirical research asserted that there exists key attributes to the attainment of success in the resource endowed-development. The first quality is that resource-abundant nations as a matter of urgency are required to continuously stretch the know-how in the extraction process of natural resources. Secondly, there must be a synergy between the resources and other drivers of economic growth and development, especially agriculture and manufacturing. On the contrary, none of the aforementioned is obtainable in Nigeria.

On the other hand, several other scholars (Taiebnia, 2012; Dim & Ezenekwe, 2013; Aggrey, 2009) opined that the adverse and negative effect of oil reliance in nations with natural endowment can be explained by other factors, beyond the Dutch disease in the long run. Furthermore, Gylfason (2001) asserted that several other reasons are responsible among which are: no clear cut out definitions for property rights, poor canon and less competitive markets in

the regions blessed with natural endowments; minimal capital accumulation leading to low and unskilled workers available to harness the resources

Agriculture regarded as the mainstay of the Nigerian economy before the oil boom in the early sixties and seventies contribution overwhelming 70 to 80 % to the gross domestic product, employing over 60 to 70 % of the teeming population (Odularu, 2008; Sekumade, 2009; Umaru *et al*., 2012). The above researchers all investigated the subject keenly using different econometric approaches ranging from time series to cross-country panel approaches, but they all concluded that there is a positive and significant impact of agriculture on the development of the Nigerian economy.

3. Methodology

This research work uses annual data from World Bank development indicators (WDI) and the US Energy Information Administration (EIA) for over 30 years (1981-2017), using time series econometrics approaches. The choice of time series rather than others estimation techniques is to capture the effect of time, which is one of the strengths of the time series procedure. Causality will be examined by the Toda-Yamamoto estimation technique so that a causal variable can help policy makers make informed decisions. The recent and novel Bayer and Hanck combined co-integration test will be used to establish if there exists any long-run relationship between the variables considered for this study.

The empirical route of this study follows three (3) paths. First, the unit root test; to ascertain the stationarity properties of the variables under review and detect the maximal order of integration of the variables with both stationarity and non- stationarity unit tests with well know traditional Augmented Dickey Fuller (ADF), Phillips Perron (PP) in conjunction with Zivot Andrews (ZA) unit root that accounts for single structural break. This is necessary to avoid the trap of spurious analysis and by extension wrong policy implications. Second, investigation of long-run equilibrium (co-integration) relationship among outlined variables with the recent and novel combined Bayer and Hanck (2013) co-integration techniques. Lastly, to detect the direction of causality among the variables under review with the help of modified Wald test rather than the conventional Granger causality test. Toda-Yamamoto (1995) provides more robust and consistent results. This informed the choice of the Toda-Yamamoto Granger causality over the

conventional Granger causality method. Also, the impulse response function is applied to see the impact of a unit shock of each variable on another over the investigated period[2].

4. Results and Discussions

This section focuses on the interpretation and discussion of results. This section set off with basic descriptive statistics and correlation analysis and rest of estimations mentioned earlier.

"Insert Table 1 about here"

Table 1 above presents the descriptive statistics of trade openness, oil rent – GDP ratio and agricultural value added. Trade openness shows a mean value of 0.91, with a standard deviation of 0.46. The standard deviation measures the spread of individual sample points around the mean. The combined result of Jarque-Bera and Kurtosis shows the series in not normally distributed. For oil-rent-GDP ratio, it depicts a mean value of 12.02% and a standard deviation of 6.02. The variable is normally distributed as presented by Kurtosis and Jargue-Bera. Agriculture value added on the other hand gives a mean value of 7427.29 Million NGN[3] and a spread around the mean of about 4958.77 Million NGN. Agriculture value added is shown to be normally distributed. Furthermore, Table 2 reports the pairwise correlation analysis for the variables under review. We observe a weak relationship between oil rent and agricultural value added while a negative statistically significant relationship between trade openness and agriculture value added. On the other hand, between trade openness and oil rent a positive statistical relationship is seen over the sampled period. These results are insightful; however, correlation is not sufficient. Therefore, more econometrics techniques are conducted in the course of the study.

"Insert Figure 1 about here"

From the figure above, both trade openness and oil rent – GDP ratio enjoy a relative upward trend and reach their peak around 1993 and thereafter, started experiencing a relative downward trend, even till present time. These declines might not be unconnected to our autocratic political structure that dominated Nigeria's political space at the time. Around that time, General Sanni

[2]For brevity, estimation techniques and equations are available on the appendix section labelled endnotes. In addition, interested reader can consults lead papers for more insight.
[3]Naira-Nigerian currency

Abacha seized power, suppressed opposition and arrested the winner of the presidential election. This could have had implication on Nigeria's trade with other countries. Also, in 1995, Nigeria got sanctioned by the European Union (EU) and suspended from the Common Wealth because of the "acclaimed unjust killing" of Saro-Wiwa who campaigned and contested against oil industry damage to his home town in Ogboni Land. In 2004, violence in the Niger Delta affected adversely the oil industry in Nigeria. This period was dominated by piracy and kidnappings. The high volatility displayed in the oil rent – GDP ratio is not unconnected to the high volatile nature of international oil price. Nigeria relies heavily on crude oil and that make it susceptible to changes in international oil prices. Agricultural value added on the other hand has enjoyed a slow but steady rise from 1981 – 2001, thereafter, it improves greatly. This enormous improvement might be the consequences of various policy implementation of the government within these periods. Some of these policies include the National Special Programme on Food security (2002), Root and Tuber Expansion Programme (2003), Agricultural Transformation Agenda (2011).

"Insert Table 2 about here"

Table 3 above presents a battery of stationary and non-stationarity tests. All the unit root tests are necessary to ascertain the stationarity property conditions of the series under consideration. The results show the variables are non-stationary and integrated only at first difference as reported in Table 3.

"Insert Table 3 about here"

"Insert Table 4 about here"

Table 4reports the results of Bayer and Hanck and Johansen cointegration test results conducted to determine the existence of long run relationships among the variables. This test statistic uses both Trace statistics and the Max-Eigen statistics and the results show that no long run relationships exist among the variables. The decision criteria are the test statistics must be greater than the critical values for a long run relationship to exist among the variables. In conclusion,

both cointegration tests are in harmony on the long run equilibrium relations among the outlined variables.

"Insert Table 5 about here"

"Insert Table 6 about here"

Table 6 presents estimates of the T-Y Granger causality test for the variables under review. The result shows a unidirectional causality: oil rents Granger cause agriculture value-added, but not the other way around; agricultural value-added granger causes trade openness, but not the other way around; and trade openness granger causes oil rent, but not the other way around. These causality directions are indicative to agricultural policymakers as each variable contemporaneous terms as well as past realizations are good predictors of each other. For instance, it was observed earlier that agriculture value added causes trade openness. This implies that these variables are essential for sustainable development of the Nigerian economy.

"Insert Figure 2 about here"

Figure 2 shows the responses of each variable to a one standard deviation in another variable. From the result, a one standard positive deviation in oil rent exerts a positive shock on agriculture value added for one year, thereafter, exerts a negative shock between the second and the third years. The responses of agriculture value added to a one standard deviation in oil rent converge back to equilibrium in the third year. The response of agriculture value added to a one standard deviation shock in trade openness is neutral. This may be because Nigeria practices mono-cultural economy and focuses on crude oil, while other sectors are relatively abandoned. The increase in agriculture value added in the trend in figure 1 may have been over shadowed by increases in population, making agricultural products relatively not much for export.

The response of oil rent to a one standard deviation shock in agriculture value added started negative but improves over time within the first and second years. However, this improvement abated, and started having a negative effect between the second and third years. This effect reverts back to equilibrium between the third and the fourth years. Oil rent responds to shocks in trade openness negatively within the first and second years but adjusted positively within the

second and third years. The responses of oil rent to shocks in trade openness lasted only for three years.

Trade openness responds directly to a positive shock in agriculture value added, but this response last only within the first and second year because in the third year, the response reverts back to equilibrium. The same reaction is recorded for the response of trade openness to a one standard deviation shock in oil rent.

Residual Diagnostic test/ Post-estimation test

Table 7 presents the post-estimation and residual diagnostic tests. All tests as reported in Table 7 pass the statistical threshold and declare the VAR system is free from serial correlation issues, normally distributed and no problem of heteroscedasticity and well as all roots lie inside the unit circle. This implies that the fitted VAR system is not just parsimonious but suitable for policy guide.

"Insert Table 7 about here"

"Insert Figure 3 about here"

The findings have shown that governments should endeavor to put necessary facilities in place to ensure the smooth running of the agricultural sector because this will bring about a positive contribution to the sustainability agenda. Such facilities should go beyond the use of fertilizer to engaging three more factors that are worthwhile within the contemporary framework of sustainable development. These three points are substantiated in what follows.

First, soil fertility testing is fundamental before a type of fertilizer is recommended so that the blanket use of fertilizers should be avoided and by extension, fertilizers should be adopted contingent on soil characteristics. This is essentially because some elements that are not apparent in the soil may also be lacking in the recommended fertilizer. Some of the innovative approaches currently being employed for soil fertility testing include, *inter alia*, the Africa Soil Information Systems which is tailored to take samples and map information on soil nutrients and adapting these towards specific farmer fertilizer recommendations in view of boosting agricultural productivity. In summary, it is worthwhile to adapt the use of fertilizer to soil needs for agricultural productivity.

Second, another worthwhile element to engage is the consideration of synergic inputs which are fundamental in adapting measures surrounding the Green Revolution (i.e. immediately adopted in the post-independence era) to the sustainable development agenda especially as it pertains to less dependence on pesticides and fertilizers that are not environmentally-friendly. In essence, other sustainable mechanisms of increasing crop yield such as improved seeds, mechanization and irrigation could be considered for sustainable agricultural industrialization. For instance, as apparent in the literature, irrigation can be substantially more rewarding than fertilizer given that only approximately 1% of cropland in Nigeria is irrigated (Uduji et al., 2019a, 2019b; Aremu, 2020). In such a scenario, no quantity of fertilizer would substantially increase crop yield in the absence of water.

Third, agricultural extension agents should not be neglected in the equation because the corresponding agricultural agents are engaged with farmers to address challenges that farmers are confronted with when it comes to adapting their activities to new technology. Such agents are important in providing farmers with insights into the timing of fertilize usage. These extension workers are also important in providing farmers with new findings from agricultural research institutions and how such findings can be relevant in improving agricultural productivity. In essence, programs of the government that are designed to monitor the implementation of policies are largely coordinated by these agents who are fundamental in advising farmers on *inter alia*, tailored use of fertilizes, mass irrigation and improving crop yield by means of evolving information and communication technologies.

5. Conclusion

The growth of an economy is germane in the agenda of many nations. This position has been stressed by the physiocracy school of thought, particularly that of the developing and underdeveloped economies that strives mainly on her primary sector like agriculture (Bekun *et al*.2018). Nigeria, one of the developing countries, is plagued with the term called resource curse. The Nigerian economy is endowed with natural resources; paradoxically, the possession of these endowments has not resulted into spurring the growth of her economy. To this end, the present study explores nexuses between agriculture value added, oil rents and trade openness for the case of Nigeria in times where the quest for alternative growth paths to sustainable development has preoccupied both government administrators and policymakers. The present

study complements the existing body of literature by revisiting the nexus between the outlined variables with the adoption of recent time series data from 1981-2017 on an annual basis using current time series estimators. The study further establishes a long-run equilibrium relationship between the choice variables over the sample period, indicating the relevance of the variables for sustainable development in Nigeria. This is in line with the study of Bekun *et al*. (2018) and Osundina *et al*. (2019), as agriculture is regarded as panacea for long term economic growth and sustainability.

Empirical findings support the agricultural induced growth argument as revealed by the current study. Although correlation statistics reveal that a weak and statistically significant relationship exists between oil rents and agricultural value added, Table 6 for T-Y Granger causality shows the existence of one-way causality links running from agriculture to trade and from trade to oil rents. These are revealing given the dwindling oil market prices. The plausible logic to these outcomes is also resonated by the impulse response function analysis that outlines the positive impact of agricultural value added on trade openness over the study time horizon. It is worthwhile to note that gains from agriculture are gleaning most from trade surplus. This suggest that there is urgent need to improve the country's share of net exports as regards agricultural products and services especially cash crops that exhibit such traits. Similarly, the nexus between trade and oil rents is uni-directional from trade indicating that trade of Nigeria oil with the rest of the world will improve economic performance knowing the economy is reliant and a net exporter of oil. The gains from oil sales will be derived from foreign exchange. However, causation should be taken by government administrators given that over the recent years, there has been dawdling prices of oil products at the international market. Thus, the need for alternative growth catalysts from agriculture and service industries should be pursued.

In the light of the above findings, this study notifies policymakers that the agricultural sector should not be neglected because of its potential to boost the growth of the economy on the one hand and on the other, enhance social, economic and environmental sustainability. Improvement in this sector will encourage trade, increase the volume of goods made available to boost exports, thereby reducing the level of importation. Improvement in trade also has a ripple effect on the production and cost of crude oil. Therefore, the government should endeavor to put necessary

facilities in place to ensure the smooth running of the agricultural sector because this will bring about a positive contribution to the sustainability agenda.

Future studies can focus on assessing how the established findings and attendant policy implications are relevant to other African countries in particular and developing countries in general. In essence, country-specific research is worthwhile for more targeted policy implications while panel-oriented inquiries are also essential in providing tendencies that are relevant for cross-country common polices; essential in the achievement of SDGs that are more universal.

Notes

The Var Model is estimated in First Difference i.e.., We use Var-in-First Difference estimation Techniques – Justification:

I. All Variables Are Not Stationary i.e., Stationary at First Diff

II. The Variables Are Not Cointegrated.

Given Variable X And Y, Var-in-First Difference is Specified as follow;

$$\Delta Y = \alpha_0 + \sum_{i=1}^{K} \alpha_{1i} \Delta Y_{t-1} + \sum_{i=1}^{k} \alpha_{2i} \Delta X_{t-1} + \varepsilon_{1t}$$

$$\Delta X = \beta_0 + \sum_{i=1}^{k} \beta_{1i} \Delta Y_{t-1} + \sum_{i=1}^{k} \beta_{2i} \Delta X_{t-1} + \varepsilon_{2t}$$

Trade openness is computed as (export + import)/GDP

6. Declarations

Availability of data and materials

The data for this present study are sourced from the World Development Indicators (https://data.worldbank.org/). The current data specific data can be made available upon request but all available and downloadable at the mentioned database and weblink.

Unpublished material

We declare that this manuscript is not copyrighted, published or submitted elsewhere. All authors do approve the submission of this manuscript in your journal.

Competing interests

Authors state no conflict of interest

Research Funding

Authors state no funding involved.

Authors' contributions

The first author (F.F.A.) was responsible for the conceptual construction of the study's idea. Second author (O.A.O.) handled the literature section while third authors (F.V.B.) managed the data gathering, preliminary analysis and (S.A.) was responsible for supervision, proofreading and manuscript editing.

Ethical Approval: Authors mentioned in the manuscript have agreed for authorship read and approved the manuscript, and given consent for submission and publication of the manuscript.

Consent to Participate: Not Applicable

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Table 1: Descriptive statistics

	TO	ORG	AVA
Mean	0.907086	12.02843	7427.291
Median	0.850811	12.8276	4703.644
Maximum	2.368782	26.43017	17179.5
Minimum	0.258345	1.511362	2303.505
Std. Dev.	0.460479	6.025829	4958.767
Skewness	0.912192	0.145816	0.649675
Kurtosis	4.127394	2.430797	1.893251
Jarque-Bera	7.090736	0.630605	4.491192
Probability	0.028858**	0.729568	0.105864
Sum	33.5622	445.0519	274809.8
Sum Sq. Dev.	7.633458	1307.182	8.85E+08
Observations	37	37	37

Source: Author's computation
Note: TO represents trade openness, ORG means oil rent as percentage of GDP and AVA denotes agriculture value added. ** depicts 5% statistical rejection level.

Table 2: Correlation matrix

	LNAVA	LNORG	LNTO
LNAVA	1.0000		
t-Stat	-		
Prob	-		
LNORG	0.0597	1.0000	
t-Stat	0.3539	-	
Prob	0.7255	-	
LNTO	-0.7008	0.3833	1.0000
t-Stat	-5.8118	2.4549	-
Prob	0.0000***	0.0192**	-

***, **, *, represent significance level at 1%, 5% and 10% respectively
Note: TO represents trade openness, ORG means oil rent as percentage of GDP and AVA denotes agriculture value added.

Table 3: Unit Root Tests

Variables	ADF	PP	ERS	DF-GLS	KPSS	ZA
AVA	-2.0971	-2.1227	1.6582	-1.8674	0.1383***	-4.7681 (1) [2002]
ΔAVA	-5.7399*	-5.7399*	5.0025**	-5.9044*	0.0946	-7.8777*(1) [2002]
ORG	-2.0853	-2.4451	1.0151	-2.5463	0.1886**	-4.2707 (1) [1989]
ΔORG	-6.7170*	-13.1737*	4.7842*	-5.1148*	0.3210	-7.4969* (1) [1999]
TO	-2.0519	-1.9178	2.0100	-1.7925	0.1765**	-4.9497 (1) [1993]
ΔTO	-7.1936*	-7.3866*	5.6494*	-7.1257*	0.1290	-8.3055* (1) [2010]

Note: *, **, *** signify 1%, 5% and 10% significant rejection level respectively.Where, TO represents trade openness, ORG means oil rent as percentage of GDP and AVA denotes agriculture value added

Table 4: Bayer and Hanck (2013)/Johansen Cointegration Test

Fitted Model	EG-JOH	EG-JOH-BO-BDM	Cointegration Remark
LnAVA=f(LnORG, LnTO)	55.3035***	67.2868***	Yes

Series: AVA ORG TO
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.
r≤0	0.407746	28.05236*	29.79707	0.0784
r≤1	0.196618	9.718689	15.49471	0.3030
r≤2	0.057059	2.05632	3.841466	0.1516

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.
r≤0	0.407746	18.33367	21.13162	0.1179
r≤1	0.196618	7.662368	14.2646	0.4141
r≤2	0.057059	2.05632	3.841466	0.1516

Source: Author's computation
Note: *, **, *** signify 1%, 5% and 10% significant rejection level respectively.The Critical values of EG-JOH and EG-JOH-BO-BDM are 10.895 and 21.106 respectively

Table 5: Lag Criteria

VAR Lag Order Selection Criteria
Endogenous variables: AVA ORG TO

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-418.184	NA	54320154	26.32398	26.46139	26.36952
1	-336.651	142.6822*	585953.8*	21.79068*	22.34034*	21.97288*
2	-331.929	7.378764	779150.8	22.05803	23.01992	22.37687
3	-325.083	9.41288	930917.3	22.19268	23.5668	22.64816
4	-314.044	13.10817	891634.2	22.06527	23.85164	22.6574
5	-306.28	7.764321	1115382	22.1425	24.34111	22.87128

* indicates lag order selected by the criterion

Table 5 depicts the lag order criteria for the estimation of Vector-AutoRegressive (VAR) model. All lag order selection techniques chose 1 lag as the optimum lag to be adopted in the VAR model. Therefore, we adopted 1 lag in the VAR estimation in this paper

Table 6: Toda-Yamamoto Granger Causality Test Results

Dependent variable: AGRICVALUEADDED			
Excluded	Chi-sq	df	Prob.
TRADEOPENNESS	1.702927	2	0.4268
OILRENT	4.449937	2	0.1081
All	4.456621	4	0.3477
Dependent variable: TRADEOPENNESS			
Excluded	Chi-sq	df	Prob.
AGRICVALUEADDED	5.432098	2	0.0661
OILRENT	2.363747	2	0.3067
All	8.191338	4	0.0848
Dependent variable: OILRENT			
Excluded	Chi-sq	df	Prob.
AGRICVALUEADDED	0.137709	2	0.9335
TRADEOPENNESS	4.715189	2	0.0946
All	6.320801	4	0.1764

Source: Author's computation

Table 7: Residual Diagnostic test

Test	Coefficient	p-Value
Heteroscedasticity (ARCH)	1.3378	0.5777
Normality	0.6969	0.7058
Autocorrelation	11.5351	0.2408
Functional form (Ramsey RESET)	0.2316	0.6347

Author's compilation.

Figure 1: Trends of trade openness, oil rent GDP ratio and agriculture value added

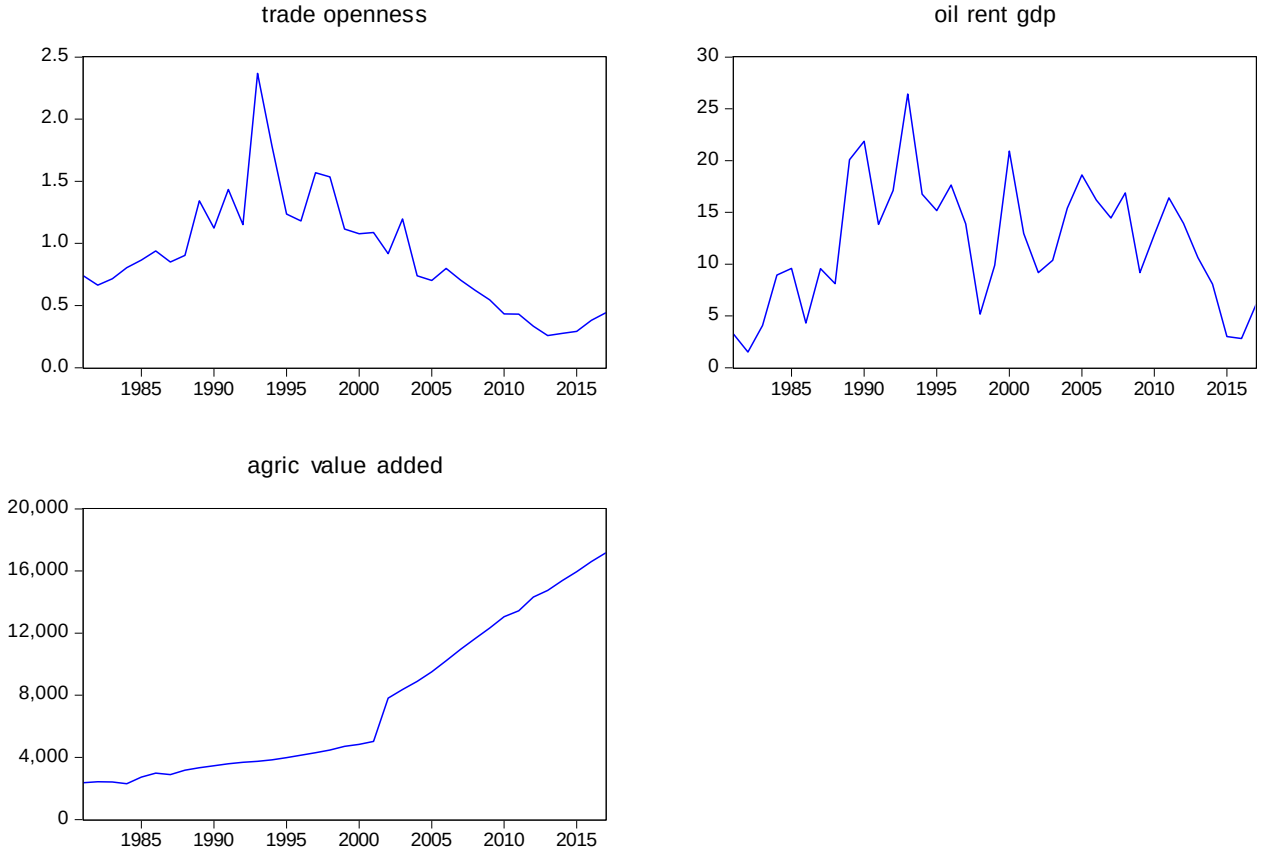
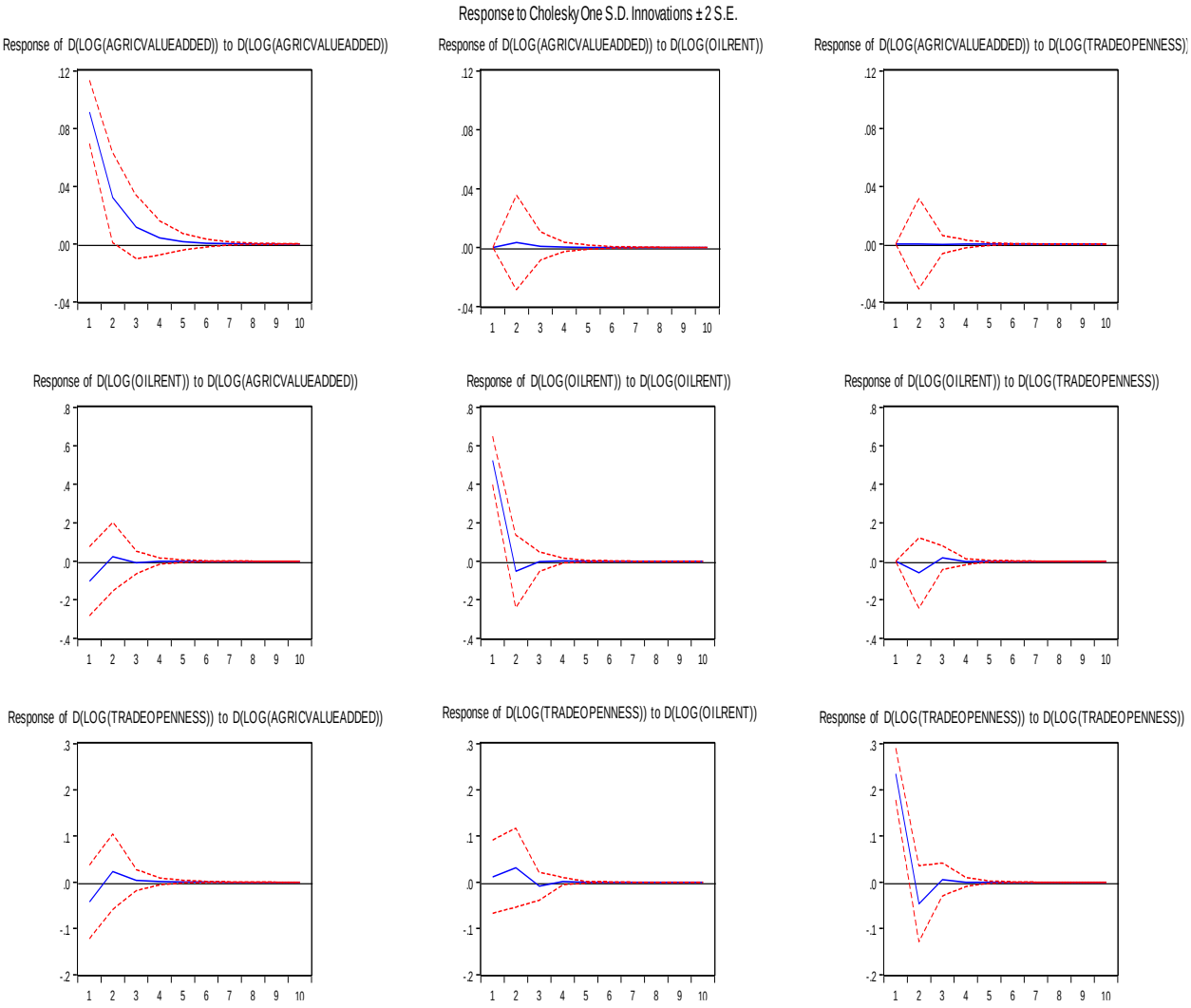


Figure 2: Impulse Response



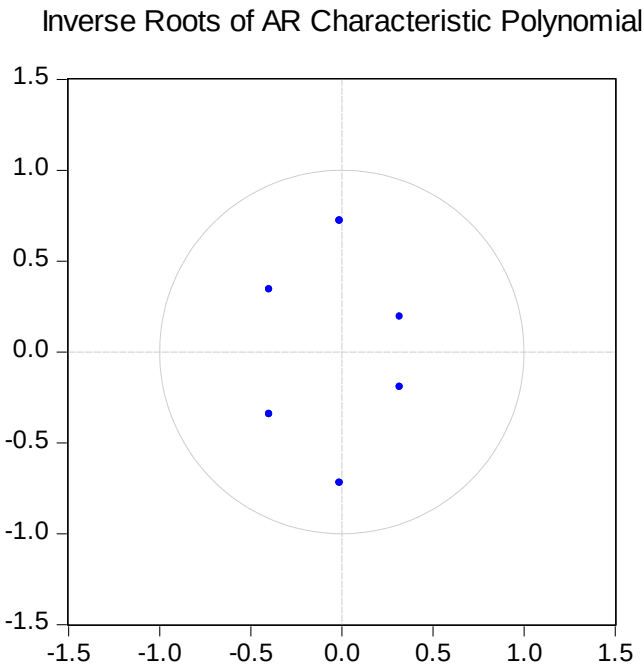


Figure 3: Parameter stability test

The parameters are stable – the points are confined within the circle