Agricultural Sector Linkage with Other Sectors of the Economy: Evidence from Nigeria

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Authors' contributions

This work was carried out in collaboration between both authors. Author IK designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author SEN managed the analyses of the study and the literature searches. Both authors read and approved the final manuscript.

Article Information

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ABSTRACT

Economic resource planners have continued to harness proven empirical link amongst various sectors of the economy for effective policy formulation and implementation of successful growth and development strategies. The Agricultural sector is one of the sectors that have consistently contributed to other sectors of the economy in terms of provision of raw materials, food and employment to the growing population; however, the need to understand the forward and backward linkages between the agricultural sector output and other sectors' output has prompted this study. This paper investigates the causal link between the Agricultural sector output and Industry, Construction, Trade and Services sectors output using quarterly times series data extracted from the annual statistical bulletin of the Central Bank of Nigeria from the first quarter 2010 to the fourth quarter 2018. The study departs from the traditional static Leontief Input-Output approach by employing dynamic modern techniques like the Granger Causality, Vector Autoregression, Impulse Response and Variance Decomposition analyses. The results indicate the existence of bi-directional causal chain effect linkages between agricultural sector output, services,

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construction and trade outputs while a unidirectional causal linkage is found running from industrial sector output to agriculture. All the sectors drive agricultural sector output and agriculture stimulates other sectors except the industrial sector. In specific terms, it takes approximately two to four quarters for most sectors to respond to the impact of shocks emanating from the other sectors the economy. For the agricultural sector to play its pivot role as the driver of other sectors the study suggests that should be remodeled in such a way that its outputs meet industrial sector requirement.

1. INTRODUCTION

The issue of economic diversification away from the oil and gas sector to the non-oil-agricultural sector has remained in the front burner amongst policy analysts and researchers in developing economies [1,2,3,4] this is because the role of agriculture cannot be over emphasized. It has a direct linkage with the achievement of the sustainable development goals SDGs [5,6,7,8] and serves as a catalyst for the development of other sectors of the economy through its contributions in terms of inputs, food security, employment, income and poverty alleviation [9, 10,11]. Again, development theories [12,13] have linked economic growth and development of nations to agriculture. This is buttressed by recent empirical studies [14,15,16,17,18,19,20, 21] on the pivot role of the agricultural sector in national development.

The interdependence of agricultural sector output and industry sector output was investigated by earlier studies [22]. However, recent studies [23, 24] have affirmed the position of Chang [22] which posits that the agricultural sector feeds the industry sector with necessary inputs.

Studies have also shown that the interdependence between the agricultural sector and other sectors of the economy is not static but changes as the economy experiences growth and development. In this vein, [25,26,27] examine the interdependence between agricultural sector output and tourism sub-sector of the service sector. The agricultural sector provides variety of foods which attracts tourists and promotes tourism. In another inter-sectoral analysis, it was documented that the health sector relies on the agricultural sector for better and healthy living through food security, income generation for improved health care demand and quality and safe food [28].

Furthermore, studies have attempted an empirical linkage amongst other sectors of the economy. For example, the industry sector which entails the conversion of raw materials extracted from the primary sector (Agriculture and mining & Quarry) into finished goods adds value to the output of the agricultural sector, generates employment, motivate infrastructural development, reduces importation, drives exportation and foreign exchange earnings and creates rooms for services and trade sectors to thrive [29,30,31,32,33,34,35,36,37]. These studies identified the industrial sector as the channel through which agricultural output impacts on service sector, construction, and trade outputs. In recent years, the service sector has emerged as the new engine of growth [38] thereby displacing the industry sector. This assertion is evident in developed and developing economies.

For instance, statistical evidence presented in Fig. 1 reveals that the service sector is the new engine of growth in Nigeria with an average quarterly contribution of 35.73 percent, while building and construction contributes the least with a meagre of 3.53 percent. Between the extreme lies agriculture, industry and services with a quarterly average contribution of 23.61 percent, 20.36 percent and 16.76 percent respectively (CBN, 2018). The respective performances of these sectors could in recent times be compared with the sectoral budget allocation from the federal government of Nigeria. Again, from available statistics show that the economy's service sector has the highest allocation from the government with ₦435.04 billion in 2010, ₦141.10 billion in 2013, N101.76 billion and ₦121.70 billion in 2016 and 2017 respectively. The building and construction sector is the second most attractive in terms of budgetary allocation with N57.09 billion in 2010, N92.19 billion in 2013, ₦98.67 billion and ₦119.40 billion in 2016 and 2017. The agricultural sector has consistently received the least attention from the government within the period with only ₦28.22 billion, ₦39.43 billion,

₦36.58 billion and ₦43.50 billion in 2010, 2013, 2016 and 2017 respectively(CBN, 2018). It should be noted that the industry and trade sectors are dominated by the private participants, thus, the government majorly plays regulatory roles and provides the required enabling environment with much budgetary allocation.

From the foregoing, it is crystal clear that the one of the major problems rocking the agricultural sector has been underfunding relative to other sectors of the economy. This results in its underperformance in terms of percentage share in GDP of about 24 percent. While poor financing of the sector poses serious challenge to its ability to drive other sectors, [39,40,41] identified other top constraints such as imperfect and costly information, gap between researchers and farmers, poor storage facility, poor transportation system, rapid urbanization, insecurity, climate change as noticeable problems that inhibit the sector. These challenges have overtime received attention from the government in terms of credit schemes, empowerment policies and agro-value chain strategies.

Thus, in an attempt to nip the challenges confronting the agricultural sector in the bud, the government introduced several programmes and strategies to empower farmers, encourage participation of youths in the agricultural space and ensure credit availability. Some of the programmes and strategies include; Green Revolution, Agricultural Development Programme (ADP), National Agricultural and Land Development Authority (NALDA), Seed Multiplication Programme, National Poverty Eradication Programme (NAPEP), The Youth Collaborative Community Agriculture Programme (YOCCAP) of the Youth Initiative for Sustainable Agriculture (YISA), Private Sector Driven Agricultural Mechanization Programme, (PSDAMP); Staple Crops Processing Zones (SCPZs); One Stop Agro-Centre (OSAC); Youth Employment in Agriculture Programme (YEAP); Growth Enhancement Support (GES) Scheme; Nigeria Incentive Based Risk sharing System for Agricultural Lending (NIRSAL); Commercial Agriculture Development Project (CADP); Fadama III; National Programme for Food Security (NPFS); Private Sector Driven Commodity Marketing Corporation [42]. From the credit supply perspective, the government established a number of agricultural credit schemes that include; The Nigerian Agricultural and Cooperative Bank (NACB) established in 1973 with the target of providing medium and long term credits to agro-sector to enhance productivity. The failure of NACB led to the establishment of the Nigerian Agricultural, Cooperative and Rural Development Bank (NACRDB) in 2000 which is an amalgam of NACB, the People Bank of Nigeria (PBN), and the Family Economic Advancement Programme (FEAP). Again, the Agricultural Credit Guarantee Scheme Fund (ACGSF) founded in 1977 is saddled with guaranteeing credits granted by banks to the agricultural sector. In 2009, to make agro-loan accessible at a single-digit interest rate, the Commercial Agricultural Credit Scheme (CACS) emerged from the CBN in collaboration with the Federal Ministry of Agriculture and Water Resources with the target of attracting commercial banks loans to the agricultural sector with an initial seven-year bond of ₦200 billion via the Debt Management Office. In furtherance to the course of repositioning the agricultural sector, the Nigerian Incentive-based Risk Sharing for Agricultural Lending (NIRSAL) was established in 2011. Its objective is agro-value-chain development for cotton, tomato, maize, rice, cassava, and soybean with financial and technical supports from the CBN. As submitted by Anetor et al. [15], 'NIRSAL, unlike another scheme, encourages lending to all value chain actors and all categories of producers such as small, medium and large scale'.

In spite of these huge financial, technical and moral attentions given to the agricultural sector, its performance leaves more to be desired. This obviously manifests in acute shortage of food, raw materials, employment, and the declining contribution of the sector to the nation's aggregate output. These have led the other sectors which are expected to feed on the agricultural sector to resorts to alternative sources for input and other agro-related supports. For instance, the industry sector relies heavily on foreign economies for raw material purchases which have obviously weakened the agro-industry interdependence. The optimal performance of the industry sector is further constrained by volatile exchange rate, this further weakens the trade and service sectors which hitherto results in structural inter-sectoral breaks in the economy with its attendant consequence of sectoral resource misallocation which is anti-development.

Against this backdrop, this study has three objectives. First, the study investigates the causal-chain effects amongst sectoral output changes to determine the mechanism that channels the effects from a change in agricultural
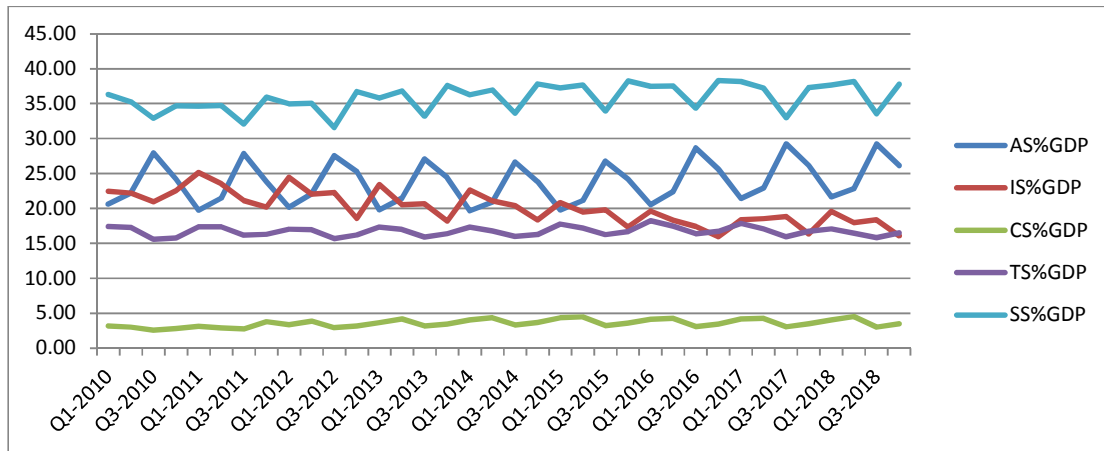
Fig. 1. Sectoral contributions to GDP
Source: Computed by Author using data from CBN Statistical Bulletin (2018)

sector output to industry sector, services, construction and trade sector outputs. Second, the study seeks to ascertain the existence of backward/reversal causal links from changes in other sectors output to the agricultural sector output. The third objective is to determine the dynamic effects of agricultural sector output on the outputs of other sectors. To attain these objectives, it is pertinent to answer the following research questions: Does agricultural sector output granger cause output of other sectors? Do other sectors output granger cause agricultural sector output? What duration does it take for a shock in the agricultural sector output to manifest on other sectors of the economy? Does the agricultural sector output have significant impact on other sectors output?

The remainder of this paper is organized as follows. Part 2 contains an overview of the different sectors of the Nigerian economy and Part 3 presents a review of relevant literature. Then, Part 4 addresses the methodology. Part 5 discusses the estimation results. Finally, Part 6 concludes the study with summary of empirical findings, principal conclusion and suggests directions for future research.

1.1 Sectors of the Nigerian Economy: An Overview

Nigeria is the largest in terms of population and economy and 14th largest country in terms of landmass in Africa, with an estimated population of over 190 million people and a landmass of 923,768 km^2 [58]. The country is blessed with enormous vegetation, dynamic topography, and viable agro-climatological conditions, and rich

arable farmland for agricultural purposes [58]. The structure of her economy is organized along five main sectors; Agriculture, Industry, Services, Construction and Trade. In the last decade, a new engine of growth has emerged in the economy which has dethroned the reign of the agricultural sector now referred to as the old engine of growth. The service sector leads the growth episodes with an average contribution of 35.74 percent to GDP, followed by agriculture with a contribution of 23.61 percent, while Industry, Trade and Construction respectively contributes 20.37 percent, 16.76 percent and 3.53 percent (CBN, 2018).

The Nigerian agricultural sector has four main sub-sectors whose contributions to the total agricultural output vary significantly towards a monopolistic structure. This is because, only the crop production sub-sector dominates the entire agricultural sector output with 89.74 percent contribution to the total agricultural output, while the other sub-sectors like the livestock, forestry and fishery contributes 7.12 percent, 1.04 percent and 2.10 percent respectively during the last decade (CBN, 2018) as presented in Fig. 2. Table 1 shows the annual sub-sectoral value of agricultural output. In 2010, total agricultural output stood at about ₦13.05 billion, out of which crop production sub-sector yielded about ₦11.68 billion, livestock production generated ₦0.98 billion, while forestry and fishery contributed ₦0.136 billion and ₦0.250 billion respectively. This observed unequal sub-sectoral contribution to the agricultural sector output has continued until 2018. From the statistical evidence available, the crop production sub-sector has continued to dominate with a ₦15.786 billion out

of a total sectoral output value of ₦17.544 billion, while the livestock, forestry and fishery sub-sectors are valued at ₦1.208 billion, ₦0.183 billion and ₦0.367 billion respectively.

Ironically, during the last decade, the fishery sub-sector has recorded the highest average growth episode of 4.98 percent, followed by the crop production sub-sector which grew at 3.84 percent, while forestry and livestock witnessed 3.79 percent and 2.70 percent growth rates respectively within the same period.

The industrial sector represents the old engine of growth in many developed economies as other sectors such as services have started leading world-growth episodes. The Nigerian industrial sector with its numerous components has in the last decade contributed about 20.37 percent to the national output. The Nigerian industrial sector exhibits a duopolistic characteristic with two sectors dominance. The crude oil/natural gas production and the food, beverage and tobacco manufacturing sub-sectors jointly accounts for 88.93 percent of the total value of industrial output, with the crude petroleum/natural gas sub-sector leading the path with a substantive 55 percent contribution to total industrial output (see Tables 2 and 3).

The other sub-sectors are significantly fragmented with solid minerals accounting for 1.54 percent; textile, apparel and footwear yielding 8.65 percent, 0.83 percent, 1.82 percent, and 3.38 percent are the respective contributions of the chemical/pharmaceuticals, oil refining and cement manufacturing to the overall industrial sector output. Again, the duopolistic structure of the Nigerian industrial sector is confirmed when sub-sectors are categorised into the crude/natural gas, solid minerals and manufacturing sub-sectors. This reveals a 99 percent joint contribution between the crude petroleum/natural gas and manufacturing.

The Nigerian service sector has emerged as the largest contributor to the nation's aggregate output in recent decades. Thus, it has become the new engine of growth as against the industrial sector which is now referred to as the old engine of growth [43,44,45]. The Nigerian service sector is about the broadest sector of the economy, it comprises of transportation, information and communication, utilities, finance and insurance, real estate, professional and technical services, business services, public administration, education, health and entertainment sub-sectors.

During the last decade, the service sector has the largest share in Nigerian GDP with a 35.74 percent contribution to the national output obviously stimulated by two sub-sectors. As presented in Fig. 4: the Information and Communication (ICT) and the Real Estate (RE) sub-sectors stand out as the drivers of the service sector growth in the country. Specifically, ICT contributes about 30.96 percent to the total service sector output while Real Estate follows with a 20.27 percent.
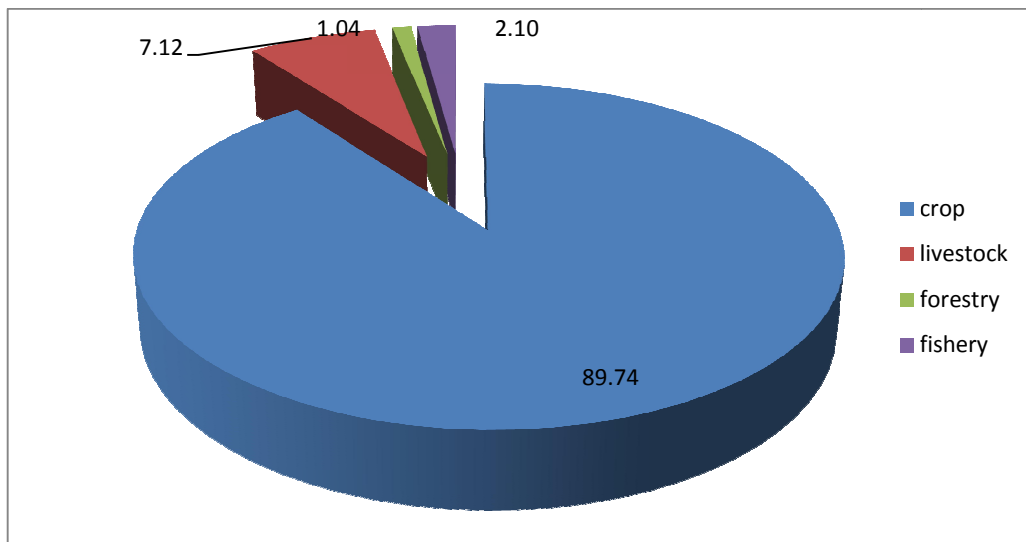

Fig. 2. Proportion of agricultural sub-sectors in total agricultural output

Table 1. Components of the agricultural sector (₦ billion)

Descriptor	2010	2011	2012	2013	2014	2015	2016	2017	2018
Crop Production	11,683,896.37	12,017,192	12,919,542.05	13,247,801.8	13,793,450.01	14,274,936.74	14,894,447.82	15,437,049.7	15,786,437.68
Livestock	979,564.06	999,404.03	972,762.79	1,030,937.33	1,086,847	1,151,323.39	1,185,118.45	1,204,205.25	1,208,128.04
Forestry	135,720.9	142,459.38	146,094.07	154,314.17	161,338.2	167,258.4	171,642.65	177,326.97	182,747.93
Fishing	249,711.47	270,323.35	291,306.7	317,469.91	338,754.13	358,701.61	356,128.42	360,913.36	366,834.08
(Total)	13,048,892.8	13,429,378.77	14,329,705.62	14,750,523.21	15,380,389.34	15,952,220.14	16,607,337.32	17,179,495.3	17,544,147.73

Source: CBN, 2018

Table 2. The Nigerian industrial sub-sector and their contributions to the total industry output (₦ billion)

	2010	2011	2012	2013	2014	2015	2016	2017	2018
Crude Petroleum & Natural Gas	8402676.4	8598636.62	8173255.83	7105283.39	7011814.77	6629963.75	5672207.01	5938047.69	6005955.73
Solid Minerals	51877.8	59418.28	71130.27	82868.12	95214.86	102543.81	87609.74	87732.32	96602.02
Solid Minerals>Coal Mining	3218.24	3874.7	4576.64	5496.76	6587.69	7272.06	7344.65	7238.01	6817.23
Solid Minerals>Metal Ores	2354.85	2706.96	2889.58	3326.63	3878.93	4160.92	5023.8	6097.14	7702.9
Solid Minerals>Quarrying & Other Mining	46304.72	52836.61	63664.05	74044.73	84748.24	91110.84	75241.3	74397.18	82081.89
Manufacturing>Oil Refining	255160.06	270998.55	223520.2	344710.74	311383.84	200883.04	205966.43	148916.4	143003.36
Manufacturing>Cement	221087.82	238202.04	270345.65	376446.4	488279.08	596173.71	564213.86	551775.5	576627.32
Manufacturing>Food, Beverage & Tobacco	2298522.9	2466513.33	2628306.89	2938606.11	3104004.91	2937062.39	2752898.95	2817563.62	2900145.02
Manufacturing>Textile, Apparel & Footwear	352543.83	571846.09	815285.86	1096388.65	1438342.86	1423019.64	1407504.32	1419074.44	1443029.85
Manufacturing>Wood & Wood Products	123384.09	130265.97	157343.7	171312.07	193065.36	205212.33	196929.27	197977.82	201348.53
Manufacturing>Pulp, Paper & Paper Products	24355.21	28516.19	30348.04	44017.16	50243.71	53671.22	51431.11	51490.58	53259.9
Manufacturing>Chemical & Pharmaceutical Products	25167.16	38941.47	61899.43	92636.15	127773.72	150992.61	152792.52	153994.52	154932.37
Manufacturing>Non Metallic Products	59548.4	99035.37	112063.1	148213.29	198958.94	227227.04	234495	239099.75	237958.11
Manufacturing>Plastic & Rubber Products	33859.54	76111.59	106425.78	138509.58	180371.28	212628.01	220268.06	222440.87	225867.53
Manufacturing>Electrical & Electronics	2506.54	4568.54	4525.31	4759.19	5067.19	5134.31	4716.99	4585.25	4757.1
Manufacturing>Basic Metal, Iron & Steel	44474.19	103031.77	124491.86	141109.72	163112.52	168192.22	169399.1	169684.97	168417.01
Manufacturing>Motor Vehicles & Assembly	21890.74	26293.06	35317.97	44401.46	55773.4	52678.92	37394.37	29346.35	28600.14
Manufacturing>Other Manufacturing	116141.22	161867.32	213785.64	285247.96	367840.94	353743.19	304222.49	282946.71	282644.02
(Total)	12033195.92	12874246.2	13028045.52	13014509.97	13791247.36	13319126.19	12062049.2	12314676.8	12523148.05

Source: CBN, 2018

Table 3. Contributions of industrial sub-sectors to total industrial output (percent)

	2010	2011	2012	2013	2014	2015	2016	2017	2018
Crude%	69.40	66.33	62.19	54.00	50.20	49.09	46.30	47.51	47.32
SM%	0.43	0.46	0.55	0.64	0.69	0.77	0.73	0.71	0.77
Coal%	0.03	0.03	0.04	0.04	0.05	0.05	0.06	0.06	0.05
Metal %	0.02	0.02	0.02	0.03	0.03	0.03	0.04	0.05	0.06
Quarry%	0.38	0.41	0.49	0.57	0.61	0.68	0.62	0.60	0.66
oil Refining%	2.12	2.10	1.72	2.65	2.26	1.51	1.71	1.21	1.14
Cement%	1.84	1.85	2.08	2.89	3.54	4.48	4.68	4.48	4.60
FBT%	19.10	19.16	20.17	22.54	22.51	22.05	22.82	22.88	23.16
TPF%	2.93	4.44	6.26	8.42	10.43	10.68	11.67	11.52	11.52
Wood%	1.03	1.01	1.21	1.32	1.40	1.54	1.63	1.61	1.61
PPP%	0.20	0.22	0.23	0.34	0.36	0.40	0.43	0.42	0.43
CP%	0.21	0.30	0.48	0.71	0.93	1.13	1.27	1.25	1.24
MN%	0.49	0.77	0.86	1.14	1.44	1.71	1.94	1.94	1.90
PR%	0.28	0.59	0.82	1.06	1.31	1.60	1.83	1.81	1.80
EE%	0.02	0.04	0.03	0.04	0.04	0.04	0.04	0.04	0.04
Basic Metals	0.37	0.80	0.96	1.08	1.18	1.26	1.40	1.38	1.34
Motor V%	0.18	0.20	0.27	0.34	0.40	0.40	0.31	0.24	0.23
Others	0.97	1.26	1.64	2.19	2.67	2.66	2.52	2.30	2.26

Source: Computed by Author using CBN Data (2018)

The sectors of the Nigerian economy cannot be fully discussed without a reference to two other key sectors; Construction and Trade. The importance of construction [46,44,47,48] and Trade [49,50] in economic growth, development and their contributions to other sectors cannot be underscored. These sectors are both sensitive to changes in fiscal and monetary policies as well as fluctuations in the output of other sectors. Fig. 5 shows that the construction (CONS) and the Trade sector (TRAD) jointly account for about 21 percent of the total size of the Nigerian economy. B&C sector is the least productive sector in the country with an average annual contribution of 3.53 percent, while TRAD accounts for 16.76 percent of GDP between 2010 and 2018 (CBN, 2018).

From the overview of the sectors of the economy, similarity exists in the pattern of contribution between the service and industry in a duopolistic manner. However, the agricultural sector is encapsulated in monopoly behaviour with only the crop production sub-sector accounting for over 89 percent of the total sectoral output. The next part of this paper further unveils intersectoral dependence from the empirical angle across the globe to establish a firmer grasp of phenomenon of the study.
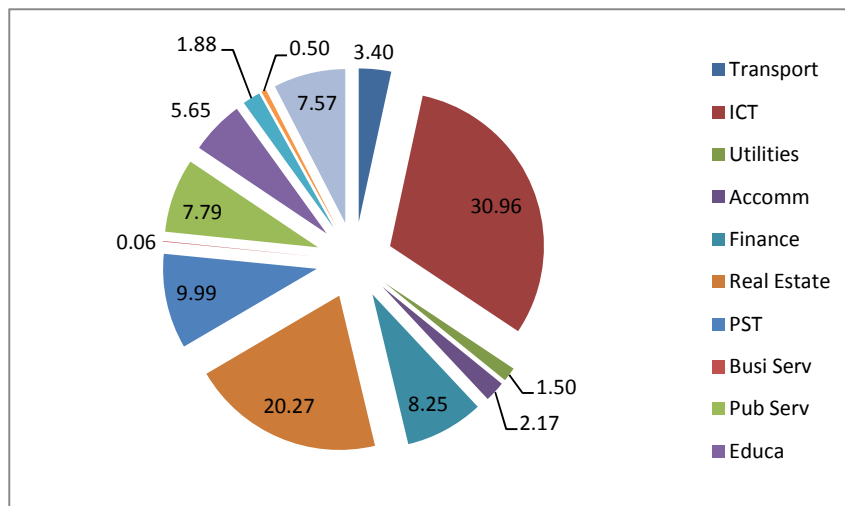

Fig. 3. Proportion of service sub-sectors in total service sector output (2010-2018)

Table 4. The Nigerian services sub-sector and their contributions to the total service output (₦ billion)

	2010	2011	2012	2013	2014	2015	2016	2017	2018
Services>Transport	694771.81	736243.24	711076.25	738078.52	770690.9	805455.74	808597.29	839846.73	956641.3
Services>Transport>Road Transport	619136.87	637003.74	601854.84	616125.64	639304.76	667810.59	679305.23	712168.24	815236.5
Services>Transport>Rail Transport & Pipelines	107.77	121.81	146.86	159.65	171.79	176.38	175.26	176.66	181.71
Services>Transport>Water Transport	4225.75	3814.06	3750.51	3919.2	4261.76	4621.74	4686.64	4745.2	4881.37
Services>Transport>Air Transport	32673.9	51889.95	54099.7	59139.71	60867.23	63120.21	60054.09	61155.63	73813.44
Services>Transport>Transport Services	22646.26	26960.76	33392.3	39136.21	44692.91	47111.52	46584.26	46684.47	47598.18
Services>Transport>Post & Courier Services	15981.27	16452.94	17832.02	19598.11	21392.43	22615.28	17791.83	14916.54	14930.14
Services>Information & Communication	5955059.68	6083046.65	6268513.42	6783070.35	7257062.03	7708113.84	7858698.28	7776896.97	8527659
Services>Information & Communication>Tele. & Inform. Services	4931991.14	4992420.11	5176559.4	5420654.36	5677875.46	5933089.01	6053663.29	5930246.08	6602077
Services>Information & Communication>Publishing	8775.89	12116.7	12631.74	14230.59	16051.42	17703.15	18127.89	18542.43	19661.4
Services>Information & Communication>Motion Pictures, Sound Recording & Music	479194.44	481559.47	491893.6	610870.38	735768.14	765640.63	734432.87	730211.66	727005.8
Services>Information & Communication>Broadcasting	535098.2	596950.39	587428.67	737315.02	827367.02	991681.06	1052474.24	1097896.81	1178915
Services>Utilities	222264.51	294545.98	332942.14	395577.89	382441.31	367314.75	335245.15	377611.92	405072.4
Services>Utilities>Electricity, Gas, Steam & Air Conditioner	179472.19	250387.13	286970.94	328764.37	300206.38	272431.57	231569.73	269620.91	289292.3
Services>Utilities>Water Supply, Sewage & Waste Mang.	42792.33	44158.84	45971.2	66813.54	82234.93	94883.16	103675.43	107991.01	115780.1
Services>Accomodation & Food Services	245760.58	268417.08	310950.38	540627.4	639714.72	654215.32	619419.23	609465.66	620190.7
Service>Finance & Insurance	1908805.12	1394696.6	1687905.9	1833645.5	1982669.74	2123896.83	2027512.3	2053001.83	2094677
Service>Finance & Insurance>Financial Institutions	1648736.84	1129561.89	1461704.33	1592125.49	1723775.91	1851828.27	1748753.68	1782325.91	1807434
Service>Finance & Insurance>Insurance	260068.28	265134.71	226201.58	241520.02	258893.85	272068.53	278758.59	270675.92	287242.3
Services>Real Estate	4127988.2	4145866.07	4379936.81	4904636.98	5155727.95	5264695.89	4903604.64	4694391.27	4471862
Services>Professional, Scientific & Technical Serv.	1711698	2031465.69	2190072.53	2265110.18	2390438.11	2516073.97	2536292.03	2529675.19	2544136
Services>Administrative & Support Services Business Services	13140.13	13824.98	13370.39	13720.21	13982.48	14473.97	14374.74	14466.49	14440.87
Services>Public Administration	1998470.87	2307377.38	1838732.42	1828842.45	1874943.16	1644782.78	1569517.75	1563619.54	1531582

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Services>Education	826671.62	1087670.16	1105896.4	1278414	1391953.37	1498707.08	1518933.09	1507982.79	1507561
Services>Human Health & Social Services	330963.66	374115.55	390300.74	427717.45	472633.66	484336.5	475690.01	474237.25	472701.6
Services>Arts, Entertainment & Recreation	30934.93	76814.53	97834.04	112444.88	129182.67	141329.25	146579.96	152629.9	156484
Services>Other Services	900022.87	934598.47	1401467.4	1551526.76	1825448.63	2151384.05	2257471.35	2310545.71	2360641
(Total)	18966552.02	19748682.42	20728998.81	22673412.58	24286888.77	25374779.96	25071935.82	24904371.3	25663648.05

Source: CBN, 2018
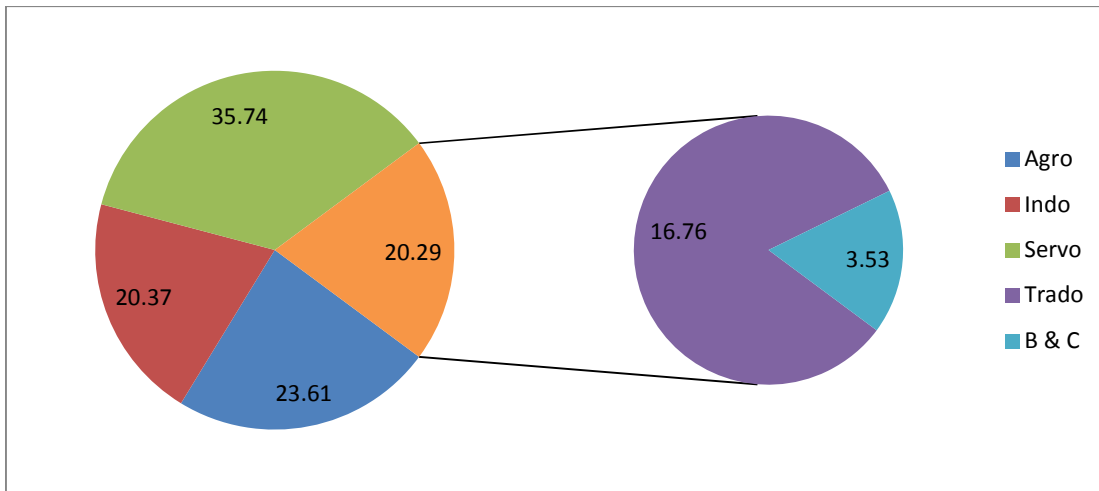
Fig. 4. The proportion of construction and trade sector in GDP (2010-2018)

2. LITERATURE REVIEW

Leontief [51] invented the first analytical framework for inter-sectoral dependence using the input-output technique. On the basis of this technique, Hirschman [52] became the first researcher to conceptualise the term 'linkage' in his essay titled '*The Strategy of Economic Development'*. The study argued in favour of 'unbalanced' growth against a 'balanced' development of all interdependent sectors simultaneously. This implies that economic resource planners and allocators should prioritise the development of the sectors that have the capability to drive and sustain the growth of other sectors of the economy. This sector is what Lean [44] identified at the hidden sector with a multiplier effect on the economy. This paper describes this sector as the lead sector. The pioneering work of Hirschman [30] emphatically reveals that policymakers should not only consider the explicit contribution of sectors to national output when making investment decisions, but should take into cognizance the implicit or indirect impulses either large or small that it imparts on investment, output and growth in other sectors. This exposition prompted a flurry of studies on sectoral linkages, interrelatedness and causal-chain effects.

Following the Leontief approach, Saikia [53] investigates the linkages amongst agriculture, industry and services in the Indian economy in the pre-reform and post reform eras using input-output analytical technique. The empirical results reveal an industry to agricultural interdependency during the pre-reform era and a reversal in direction during the post-reform era as agriculture to industry interdependence was found. Again, a weak interdependence was found between services and agriculture, while a strong and growing interdependence exists between the services and industrial sector. The study submitted that policy reformation has adequately addressed the intersectoral linkages in India as the agricultural sector feeds the industry and other sectors in line with theories of development. Chan et al. [54] examine the intersectoral nexus between the real estate sector and other sectors of the Chinese economy using the input-output method. The result reveals strong linkages between the real estate and other sectors of the economy through real and financial channels. The study concludes that any shock in the real estate sector has great implications on the overall stability of the Chinese economy. In a similar study, Andreosso-O'Callaghan and Yue [55] examine inter-sectoral dependencies in the Chinese economy. The study employs four versions of the static analysis; Chenery and Watanabe techniques, Rasmussen methodology, Dietzenbachar and Vdl approach and the pure linkage analysis. The results obtained were similar and dissimilar in certain categories. The study documents a significant positive relationship between manufacturing growth and inter-sectoral interdependence in the Chinese economy. The main gap in this study is the multiplicity of contrasting methodologies. This essentially makes the analysis conflicting and confusing. It therefore presents no policy direction for fruitful economic development plans for other countries of the world. Furthermore,

Freytag and Fricke [56] examine the intersectoral linkages in the Nigerian and Kenyan financial services sub-sectors using the input-output technique for data series collected in 2007, 2009 and 2011 with the objective of ascertaining if backward and forward linkages existed. The empirical result found that there is a strong forward and backward linkages in the Nigerian financial services sector, while a weak forward and backward linkages were found for the Kenyan financial services sub-system. The study principally concluded that the strong bi-directional linkages in Nigeria could be attributed to the underdeveloped nature of the financial sector. In review, the input-output model is only suitable for intersectoral analysis in a static economy and determines linkages at a particular point in time. However, all economies are dynamic and experiences structural changes which affect intersectoral linkages. To adequately incorporate the structural dynamism in intersectoral linkages analysis, dynamic econometric approaches such as the Vector Autoregression (VAR) and Granger Causality Test are required. This article employed these dynamic methods mentioned above to close the methodological gaps in literature.

Following the deficiencies in the input-output technique, Granger [57] postulated a dynamic method for intersectoral linkages analysis known as the Ganger Causality Test. This methodology captures the dynamism in the economy in the analysis of sectoral interdependence. Studies that have adopted this method abound in literature. Thus, Gemmell *et al.*, [58] investigate the dynamic relationship among agriculture, services and manufacturing in the Malaysian economy. Using time series data, the study adopts the Granger-Causality test and found a unidirectional causality from manufacturing and services to Agriculture. Gen-xing et al. [24] investigate the inter-sectoral relationship between agriculture, industrialization and Urbanization in the Chinese economy using the granger causality test on quarterly time series data spanning 15 years, from 1995 to 2009. The study submits that a unidirectional causality running from agriculture to urbanization and industrialization. This implies that industrialization does not granger cause the Chinese agricultural sector. The principal conclusion is that majority of the industrial inputs in the Chinese economy are imported from other nations. While analysing the linkages between manufacturing and other sectors of the Nigerian economy, Salami and Kelikume [59] employ the granger causality test.

The empirical result indicates a weak interdependence between the manufacturing sector and other sectors of the Nigerian economy. This implies that neither does agriculture granger cause manufacturing nor manufacturing granger causes agriculture in Nigeria. In a similar analysis for the Nigerian economy, Sertoglu et al. [60] reports that the agricultural output causes long run growth economic growth using the vector error correction and causality analysis. Lending more voice to the discussion, Subramaniam [61] employs a panel econometric inter-sectoral linkages analysis for Poland and Romania. The study incorporates the agriculture, manufacturing, services and trade sectors. The preliminary co-integrating vectors reveal that the analysed sectors have long run association for both economies, which implies an interdependent inter-sectoral growth. In addition, empirical result confirms that the industrial sector drives agricultural sector, while for the emerging service sector, a mixed result was reported for Poland. In the Romanian economy, the result shows that the industrial sector inhibits agriculture sector while the service sector stimulates agriculture. The study concludes that in the short-run, the service sector propels the growth episode in Poland because of its positive effects on all the other sectors examined. Conversely, industrial sector led-growth hampers other sectors growth in the Polish economy. However, in the Romanian economy, agriculture sector growth has a positive but insignificant impact on industrial sector growth the study submitted.

Degu [62] examined the relationship among agriculture, service and the industrial sectors of the Ethiopian economy using the Johansen co integration, vector autoregression, and impulse response and variance decomposition techniques. The result revealed a long-run relationship from agriculture and service to industry. The Granger causality test indicated bi-directional causality between agriculture and industry and between industry and service sectors. The result of the impulse response analysis showed that the agricultural sector played a significant role in the development of other sectors in Ethiopia. Other studies on intersectoral nexus include Njoya and Nititas [63] that assessed the linkages between agriculture and tourism sectors in Senegal, while Gani and Scrimgeour [64] investigated the interdependence between agriculture, trade and the industry sector for Fiji. However, Enyedi and

Volgyes [65] investigate the inter-dependence between agriculture and rural industrialization and found that a unidirectional causality exists that runs from agriculture to rural Industrialization and not otherwise amongst selected European economies.

This study corroborates the findings of Gen-xing et al. [24] and disagrees with Gemmell et al. [58] and Salami and Kelikume [59]. In review, though these studies employed the dynamic causality methodologies, none have examined the linkages amongst the five standard sectors of the economy; agriculture, industry, services, trade and construction simultaneously. This gap further justifies this article.

3. METHODOLOGY

This study distinguishes itself from previous empirical analyses on inter-sectoral linkages by adopting the vector autoregression (VAR) technique and the Granger Causality test which are dynamic in approach and superior to the conventional input-output approach that is static in application. Though previous studies [21,56] used the Leontief approach in analyzing inter-sectoral linkages, our study rather follows the approach employed by [65,59,60,61] to estimate a multivariate autoregressive model and used an unrestricted vector autoregressive model (VAR) to evaluate the agricultural sector linkage with other sectors of the Nigerian economy.

3.1 Data and Variable Definitions

Quarterly time series data sourced from the Central Bank of Nigeria statistical bulletin spanning 36 periods from first quarter 2010 to fourth quarter 2018 were utilized for empirical analyses. The variables for which data were collected included; the value of agricultural output (AGRI), the value of industrial output (INDU), the value of service sector output (SERV), the value of trade sector output (TRAD) and the value of construction sector output (CONS). The data were expressed in the same unit, (₦ billion) from their contributions to the national output.

3.2 Model Specification

The general VAR model is expressed as follows:

$$y_{1t} = \phi_1 + \phi_{11}y_{1t-1} + \phi_{12}y_{2t-1} + \Omega_{11}y_{1t-2} + \Omega_{12}y_{2t-2} + \epsilon_{1t} \tag{1}$$

$$y_{2t} = \Omega_1 + \phi_{21}y_{1t-1} + \phi_{22}y_{2t-1} + \Omega_{21}y_{1t-2} + \Omega_{12}y_{2t-2} + \epsilon_{2t} \tag{2}$$

The compact form of the above VAR equations is expressed in the equation below.

$$y_t = \Omega + \phi_1 y_{t-1} + \phi_2 y_{t-2} + \mu_t \tag{3}$$

Where

Ω *depicts an n* x 1 Column vector
$\phi_{j's}$ are the n x n square metrics
μ_t is an n x 1 column vector of serially uncorrelated vector of innovations variable which is independently, identically and normally distributed with zero mean and constant variance $\{\mu_t \sim iidn(0, \sigma^2)\}$.

If y_t is a column vector (n x 1) matrix which encompasses all the logged variables in the model, the VAR model establishes a link between the current y_t, its lags (y_{t-i}) and the white noise variable (μ_t).

Furthermore, the Granger causality test is employed to estimate equations 4 to 11 in an attempt to determine sectoral linkages between AGRI and other sectors of the economy.

$$logINDU_t = \Omega_0 + \sum_{t-1}^{n}\Omega_1 logINDU_{t-1} + \sum_{t-1}^{n}\Omega_2 logAGRI_{t-1} + \mu_t \tag{4}$$

$$logAGRI_t = \phi_0 + \sum_{t-1}^{n}\phi_1 logAGRI_{t-1} + \sum_{t-1}^{n}\phi_2 logINDU_{t-1} + \mathcal{E}_t \tag{5}$$

$$logSERV_t = \Omega_0 + \sum_{t-1}^{n}\Omega_1 logSERV_{t-1} + \sum_{t-1}^{n}\Omega_2 logAGRI_{t-1} + \mu_t \tag{6}$$

$$logAGRI_t = \phi_0 + \sum_{t-1}^{n}\phi_1 logAGRI_{t-1} + \sum_{t-1}^{n}\phi_2 logSERV_{t-1} + \mathcal{E}_t \tag{7}$$

$$logTRAD_t = \Omega_0 + \sum_{t-1}^{n}\Omega_1 logTRAD_{t-1} + \sum_{t-1}^{n}\Omega_2 logAGRI_{t-1} + \mu_t \tag{8}$$

$$logAGRI_t = \phi_0 + \sum_{t-1}^{n}\phi_1 logAGRI_{t-1} + \sum_{t-1}^{n}\phi_2 logTRAD_{t-1} + \mathcal{E}_t \tag{9}$$

$$logCONS_t = \Omega_0 + \sum_{t-1}^{n}\Omega_1 logCONS_{t-1} + \sum_{t-1}^{n}\Omega_2 logAGRI_{t-1} + \mu_t \tag{10}$$

$$logAGRI_t = \phi_0 + \sum_{t-1}^{n}\phi_1 logAGRI_{t-1} + \sum_{t-1}^{n}\phi_2 logCONS_{t-1} + \mathcal{E}_t \tag{11}$$

From equations 4 through 11, the following hypotheses hold.

Null hypotheses:

$H_0 = \sum_{t-1}^{n} \Omega_i = 0$, and $\sum_{t-1}^{n} \phi_i = 0$ (12)

The H_0 states that there is no causality between AGRI and other sectors of the Nigerian economy.

Alternative hypotheses

$H_1 = \sum_{t-1}^{n} \Omega_i \neq 0$, and $\sum_{t-1}^{n} \phi_i \neq 0$ (13)

While H_1 states otherwise, that is, causality exists between AGRI and other sectors of the Nigerian economy.

From equations 4 to 11, if the estimates Ω_2 and ϕ_2 are statistically significant, a bi-directional causation is said exist. But if Ω_2 is statistically significant and ϕ_2 is not, then, we would say a uni-directional causal relationship exists running from AGRI to the respective variable under consideration. Again, if ϕ_2 is statistically significant and Ω_2 is not, then a uni-directional relationship that runs from the variable to AGRI is said to exist.

Note: Henceforth, log AGRI = agri, logINDU = indu, logSERV = serv, logCONS=cons, logTRAD=trad.

4. EMPIRICAL ANALYSES AND DISCUSSION OF RESULTS

4.1 Tests for Stationarity

Table 5 presents the summary of the unit root results from the Dickey Fuller tested (DF), Augmented Dickey Fuller (ADF) and the Phillips-Perron (PP) techniques. The study the null hypothesis which stipulated non-stationarity in data series at 1%, 5% and 10% significance levels, and the Mackinnon critical values for the tests are summarized in Table 6.

The DF tests results indicate that all the data series are non-stationary at levels as the null hypothesis is accepted at 5% level of significance. Furthermore, on the basis of the ADF results, other first-difference series but serv and trad are stationary at 5% level of significance. The PP tests results vehemently affirms the conclusion that all the series are stationary in their first difference at 1% significance level. This informed the use of only differenced data series for further analysis to avoid spuriousness in the empirical results.

Table 7 presents the lag selection criteria. The results obtained from the lag structure using eviews 10.0 reveals an optimum lag of four periods based on the Akaike information criterion. This position is affirmed by the Schwarz information criterion, Hannan-Quinn information criterion and the final prediction error criterion. The lag structure is utilized in the estimation of the parsimonious VAR model.

4.2 Tests for Sectoral Linkages

The study employs the Granger causality test to ascertain if a change in agricultural sector output precedes changes in other sectors outputs in the Nigerian economy since 2010. This approach departs from Salami and Kelikume's [59] study that examines the causal linkages between manufacturing sector output and other sectors output instead of the agricultural sector linkages with other sectors by anchoring growth in other sectors on the agricultural sector based on development theories [55,39,35].

Table 8 indicates the strong sectoral linkages of agriculture with other sectors of the Nigerian economy. Agriculture leads construction, services and trade by two quarters, but it doesn't lead the industrial sector. This implies that there is a forward linkage from agricultural sector to construction, service and trade sectors in Nigeria over varying time lag and a backward linkage with the industrial sector. That is, while the former set of sectors feed on the agricultural sector, the latter feeds the agricultural sector and not otherwise. Interestingly, the empirical granger causality results further demonstrate the presence of multiple links amongst other sectors, thus, the output from industrial, construction, trade and service sectors in turn feed back into the agricultural sector at different time frame.

4.3 Optimal lag Selection Criteria

The agricultural sector output is strongly affected by changes in all other sectors of the Nigerian economy. Changes in services, construction and trade show stronger and immediate influence on agricultural sector output. It takes the industrial sector a quarter longer to influence the agricultural sector.

Within the same discussion, the result further indicates a bi-directional causal-chain between agriculture and construction, agriculture and services, agriculture and construction. However, a unidirectional causality runs from industrial

Table 5. Unit root tests: Nigerian sectoral output data, seasonally adjusted (Q1:2010 – Q4:2018)

	DF test at levels		ADF test in first difference				PP test in first difference			
Series	No trend	With trend	No trend	Lag	With trend	Lag	No trend	Lag	With trend	Lag
indu	-0.97	-1.34	-5.85***	3	-5.74***	3	-14.48***	3	-18.09***	3
serv	-0.59	-0.25	-1.74	3	-2.29	3	-19.24***	3	-21.76***	2
trad	0.11	0.20	-1.36	3	-2.01	3	-8.97***	3	-9.84***	3
cons	-0.53	-0.89	-3.09**	3	-9.94***	3	-14.49***	3	-27.14***	3
agri	3.10	-0.47	-15.46***	3	-16.07***	3	-7.65***	3	-7.44***	3

Source: Author's computation using eviews 10. Note: *, **, *** respectively indicates the rejection of the null hypothesis of unit root at 10%, 5% and 1%

Table 6. Mackinnon critical values for rejection of hypothesis of unit root

Critical value	DF test at levels		ADF test in first difference		PP test in first difference	
	No trend	With trend	No trend	With trend	No trend	With trend
1% level	-2.64	-3.77	-3.65	-4.27	-3.64	-4.25
5% level	-1.95	-3.19	-2.95	-3.56	-2.95	-3.55
10% level	-1.61	-2.89	-2.62	-3.21	-2.61	-3.21

Source: Mackinnon (1996)

Table 7. VAR lag order selection criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	327.2984	NA	1.23e-15	-20.14365	-19.91463	-20.06773
1	410.9771	135.9779	3.21e-17	-23.81107	-22.43694	-23.35558
2	484.4807	96.47350	1.75e-18	-26.84254	-24.32331	-26.00749
3	562.9182	78.43749	8.78e-20	-30.18239	-26.51805	-28.96776
4	641.6619	54.13631*	6.84e-21*	-33.54137*	-28.73192*	-31.94717*

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

sector to agriculture and the reversal is not possible, this could be rationalized or justified by the fact that the Nigerian agricultural promotion strategies are not tailed towards industrial needs but only for consumption purposes. All other sectors exhibit forward and backward (lead-lag) linkages with varying response time as clearly presented in Table 8.

4.4 Vector Autoregression Estimates

The article leads previous studies by extending the sectoral linkages analysis towards the determination of the long run effects amongst the various sectors output for Nigeria. The VAR models are estimated using the eviews statistical software based on the optimum lag selection criteria identified in Table 7.

In the long run, the result shows that the agricultural sector lagged by one period has positive effects on all the output of all other sectors, the t-statistics affirms that the positive effects are insignificant. The lag of the agricultural sector output by two periods reveals that the agricultural sector output has an
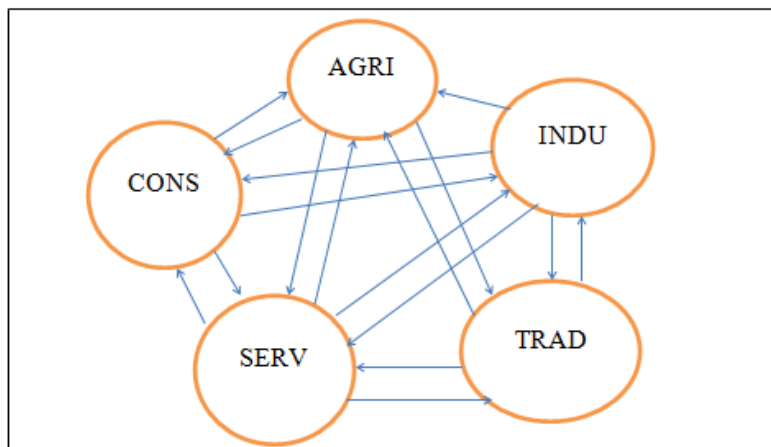

Fig. 5. Inter-sectoral linkages

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Table 8. Causality tests of agriculture on other sectors of the Nigerian economy

Direction of causality	Lag length	F-Statistic	Sign. level
Δagri => Δindu	4	1.05	
Δagri => Δserv	2	150.86	***
Δagri => Δcons	2	14.13	***
Δagri => Δtrad	2	26.72	***
Δindu => Δagri	3	9.57	***
Δindu => Δserv	2	4.19	**
Δindus => Δcons	3	3.42	**
Δindu => Δtrad	2	6.06	***
Δserv => Δagri	2	65.08	***
Δserv => Δindu	4	3.39	**
Δserv=> Δcons	2	13.86	***
Δserv => Δtrad	2	4.03	**
Δcons => Δagri	2	46.93	***
Δcons => Δindu	2	4.67	**
Δcons => Δserv	2	27.27	***
Δcons => Δtrad	2	38.96	***
Δtrad => Δagri	2	53.48	***
Δtrad=> Δindu	4	5.36	***
Δtrad => Δserv	2	6.39	**
Δtrad => Δcons	2	12.32	***

*Note: *** and ** denote rejection of the null hypothesis at 5% and 1% levels of significance respectively. Source: Author's computation using eviews 10.0.*
Δx => Δy implies sector x granger causes sector y

insignificant negative effects on all other sectors output except the trade sector. At the third and fourth lags of agricultural output, its effect on the trade sector became significant while its effects on other sectors remained unchanged. Furthermore, the lag of construction output by one period has a positive but insignificant effect on agricultural output, while two periods lag of construction output has a significant positive effect on the agricultural sector output. However, one and three periods lags in construction sector output drive industrial output. Again, the result indicates that one and third period lags in industrial output have positive but insignificant effect on the agricultural sector while a four period lag in industrial output stimulates the trade sector. The service sector output bears negative but insignificant effect on agricultural output except at its third lag when exert a positive effect. In all cases, the effects are not significant. However, a positive significant effect was only recorded with the trade sector at the third lag. The output from the trade sector bears positive effects on the agricultural sector output at all lag levels but none is significant. Thus, trade sector does not drive any other economic sector in Nigeria in the long run.

4.5 Impulse Response

The Impulse Response Function (**IRF**) presented in Fig. 6 shows that the standard deviation in the model is expressed in percentage for each sector. The horizontal axis of the IRF indicates the number of periods that have passed after the impulse has been given while the vertical axis reveals how the sectors responded to innovations. Since our focal sector is agriculture, the result in panel 1 shows that one percent innovation in other sectors of the economy produces a positive response of 0.0042, 0.0013, 0.0028, 0.0008, 0.0034 and 0.0018 percent in the agricultural sector output in the first, second, fifth, sixth, ninth and tenth period respectively. While negative responses of 0.0006, 0.0003, 0.0026 and 0.0005 are recorded in the third, fourth, seventh and eighth period respectively. The implication of this result is that innovations in the other sectors of the economy have not yielded strong positive impact on the agricultural sector in Nigeria.

4.6 Inverse Roots of AR

Fig. 7 shows the graphical illustration of AR inverse root of the VAR. The graph reveals that all roots of the polynomial except two are within the unit circle. The implication of this result is that the estimated VAR model is stable and stationary. As such the impulse response functions are reliable.

Table 9. Vector autoregression estimates

Standard errors in ( ) & t-statistics in [ ]					
	Δagri	Δcons	Δindu	Δserv	Δtrad
Δagri(-1)	0.248252	1.607959	0.270581	0.392937	-0.354077
	(0.17078)	(0.84135)	(0.50583)	(0.27792)	(0.19217)
	[1.45368]	[1.91117]	[0.53493]	[1.41385]	[-1.84249]
Δagri(-2)	-0.210123	-1.008539	-0.430568	-0.425340	0.421148
	(0.22369)	(1.10203)	(0.66255)	(0.36403)	(0.25171)
	[-0.93936]	[-0.91516]	[-0.64986]	[-1.16842]	[1.67311]
Δagri(-3)	0.134227	1.003563	0.504905	0.416831	-0.473023
	(0.20119)	(0.99120)	(0.59592)	(0.32742)	(0.22640)
	[0.66716]	[1.01247]	[0.84727]	[1.27308]	[-2.08933]
Δagri(-4)	0.709446	-0.317607	-0.614978	-0.075140	0.477725
	(0.20437)	(1.00688)	(0.60534)	(0.33260)	(0.22998)
	[3.47131]	[-0.31544]	[-1.01592]	[-0.22592]	[2.07724]
Δcons(-1)	0.004873	0.226250	0.537594	0.186024	-0.039836
	(0.04469)	(0.22017)	(0.13237)	(0.07273)	(0.05029)
	[0.10903]	[1.02760]	[4.06129]	[2.55775]	[-0.79213]
Δcons(-2)	0.133120	-0.357632	-0.123251	-0.101783	0.033263
	(0.05812)	(0.28632)	(0.17214)	(0.09458)	(0.06540)
	[2.29053]	[-1.24905]	[-0.71599]	[-1.07615]	[0.50862]
Δcons(-3)	-0.053969	0.477958	0.288369	0.116487	0.014193
	(0.04302)	(0.21195)	(0.12743)	(0.07001)	(0.04841)
	[-1.25448]	[2.25504]	[2.26303]	[1.66379]	[0.29318]
Δcons(-4)	0.108845	-0.123223	-0.351359	-0.023089	-0.006149
	(0.04315)	(0.21260)	(0.12782)	(0.07023)	(0.04856)
	[2.52229]	[-0.57960]	[-2.74892]	[-0.32878]	[-0.12663]
Δindu(-1)	0.017015	0.661655	0.210064	0.144966	0.055201
	(0.07274)	(0.35835)	(0.21544)	(0.11837)	(0.08185)
	[0.23392]	[1.84639]	[0.97503]	[1.22465]	[0.67441]
Δindu(-2)	-0.001413	-0.668553	-0.262387	-0.186519	0.097802
	(0.08392)	(0.41345)	(0.24857)	(0.13657)	(0.09444)
	[-0.01683]	[-1.61701]	[-1.05559]	[-1.36570]	[1.03564]
Δindu(-3)	0.041609	-0.088027	0.002598	-0.002820	-0.254659
	(0.09078)	(0.44725)	(0.26889)	(0.14774)	(0.10216)
	[0.45834]	[-0.19682]	[0.00966]	[-0.01909]	[-2.49284]
Δindu(-4)	-0.088890	0.568743	0.094551	0.243948	0.359207
	(0.07680)	(0.37835)	(0.22747)	(0.12498)	(0.08642)
	[-1.15747]	[1.50322]	[0.41567]	[1.95190]	[4.15657]
Δserv(-1)	-0.316774	-0.209602	0.351241	0.462842	-0.075545
	(0.19102)	(0.94111)	(0.56580)	(0.31087)	(0.21496)
	[-1.65829]	[-0.22272]	[0.62078]	[1.48884]	[-0.35144]
Δserv(-2)	-0.183147	1.650940	-0.015746	0.359386	0.460918
	(0.12068)	(0.59456)	(0.35745)	(0.19640)	(0.13580)
	[-1.51760]	[2.77676]	[-0.04405]	[1.82989]	[3.39403]
Δserv(-3)	0.107540	-1.342228	0.472180	-0.483792	0.289930
	(0.13555)	(0.66781)	(0.40149)	(0.22060)	(0.15253)
	[0.79336]	[-2.00990]	[1.17606]	[-2.19312]	[1.90075]
Δserv(-4)	-0.420099	-0.864661	1.615336	1.020966	0.350980
	(0.21415)	(1.05504)	(0.63430)	(0.34851)	(0.24098)
	[-1.96170]	[-0.81955]	[2.54664]	[2.92952]	[1.45645]
Δtrad(-1)	0.143615	0.924567	-0.669257	-0.161643	0.229756
	(0.21828)	(1.07538)	(0.64652)	(0.35523)	(0.24563)
	[0.65795]	[0.85976]	[-1.03516]	[-0.45504]	[0.93539]
Δtrad(-2)	0.056238	2.101528	-0.454483	0.071389	-0.209832
	(0.14162)	(0.69771)	(0.41947)	(0.23047)	(0.15936)

Standard errors in ( ) & t-statistics in [ ]					
	Δagri	**Δcons**	**Δindu**	**Δserv**	**Δtrad**
	[0.39711]	[3.01205]	[-1.08348]	[0.30975]	[-1.31669]
Δtrad(-3)	0.214081	-0.732532	-1.071979	-0.815753	-0.391099
	(0.20578)	(1.01382)	(0.60952)	(0.33489)	(0.23157)
	[1.04032]	[-0.72255]	[-1.75873]	[-2.43586]	[-1.68892]
Δtrad(-4)	0.277212	-1.219530	-1.199445	-0.294579	-0.134587
	(0.19120)	(0.94200)	(0.56634)	(0.31117)	(0.21516)
	[1.44982]	[-1.29462]	[-2.11790]	[-0.94669]	[-0.62552]
C	0.701124	-4.937632	5.874530	0.478270	0.153530
	(0.60166)	(2.96414)	(1.78207)	(0.97914)	(0.67704)
	[1.16532]	[-1.66579]	[3.29647]	[0.48846]	[0.22677]
R-squared	0.999128	0.971089	0.914339	0.993551	0.993740
Adj. R-squared	0.997541	0.918524	0.758593	0.981826	0.982358
Sum sq. resids	0.000203	0.004927	0.001781	0.000538	0.000257
S.E. equation	0.004296	0.021164	0.012724	0.006991	0.004834
F-statistic	629.8587	18.47409	5.870686	84.73600	87.31081
Log likelihood	146.0835	95.05442	111.3365	130.4999	142.3060
Akaike AIC	-7.817716	-4.628401	-5.646029	-6.843744	-7.581628
Schwarz SC	-6.855827	-3.666512	-4.684140	-5.881855	-6.619739
Mean dependent	3.584058	2.767741	3.506631	3.767085	3.435467
S.D. dependent	0.086633	0.074144	0.025896	0.051857	0.036395
Determinant resid covariance (dof adj.)	5.49E-22				
Determinant resid covariance	2.63E-24				
Log likelihood	641.6619				
Akaike information criterion	-33.54137				
Schwarz criterion	-28.73192				
Number of coefficients	105				

Source: Author's computation using eviews 10.0

Table 10. Variance decomposition of AS

Period	S.E.	AS	CS	IS	SS	TS
1	0.004296	100.0000	0.000000	0.000000	0.000000	0.000000
2	0.004863	83.74168	0.010121	5.112879	9.996292	1.139024
3	0.005583	64.77558	5.808349	6.072282	21.27950	2.064292
4	0.005934	57.57579	7.177408	10.25334	19.08175	5.911707
5	0.007133	54.84144	7.999550	9.474057	14.80292	12.88203
6	0.007965	44.92341	6.475895	12.33230	23.04192	13.22648
7	0.008564	48.04957	8.547753	10.66794	21.02588	11.70885
8	0.008847	45.39675	8.580751	11.40598	23.34354	11.27298
9	0.010037	46.76162	10.65283	10.72143	22.39709	9.467034
10	0.010774	43.49385	12.81816	10.99771	23.43427	9.256013

Source: Computed by author using eviews 10.0

4.7 Variance Decomposition (VD)

Table 10 presents the VD test which indicates the portion of the forecast error variance of each sector that is due to its innovation and innovations in other sectors. The own shocks of the agricultural sector constitute a significant source of variation in its forecast error in the time horizon, ranging from 100% to 43.49%. After 10 quarters, variation in the agriculture sector output is accounted for by changes in construction sector by (28.19%), industrial sector (10.99%), service sector (23.43%) and trade sector (9.26%). This result implies that the predominant source of external variation in agricultural sector output is accounted for by the construction sector, followed by the service sector and industry while the trade sector accounts for the least variation in agricultural sector output.

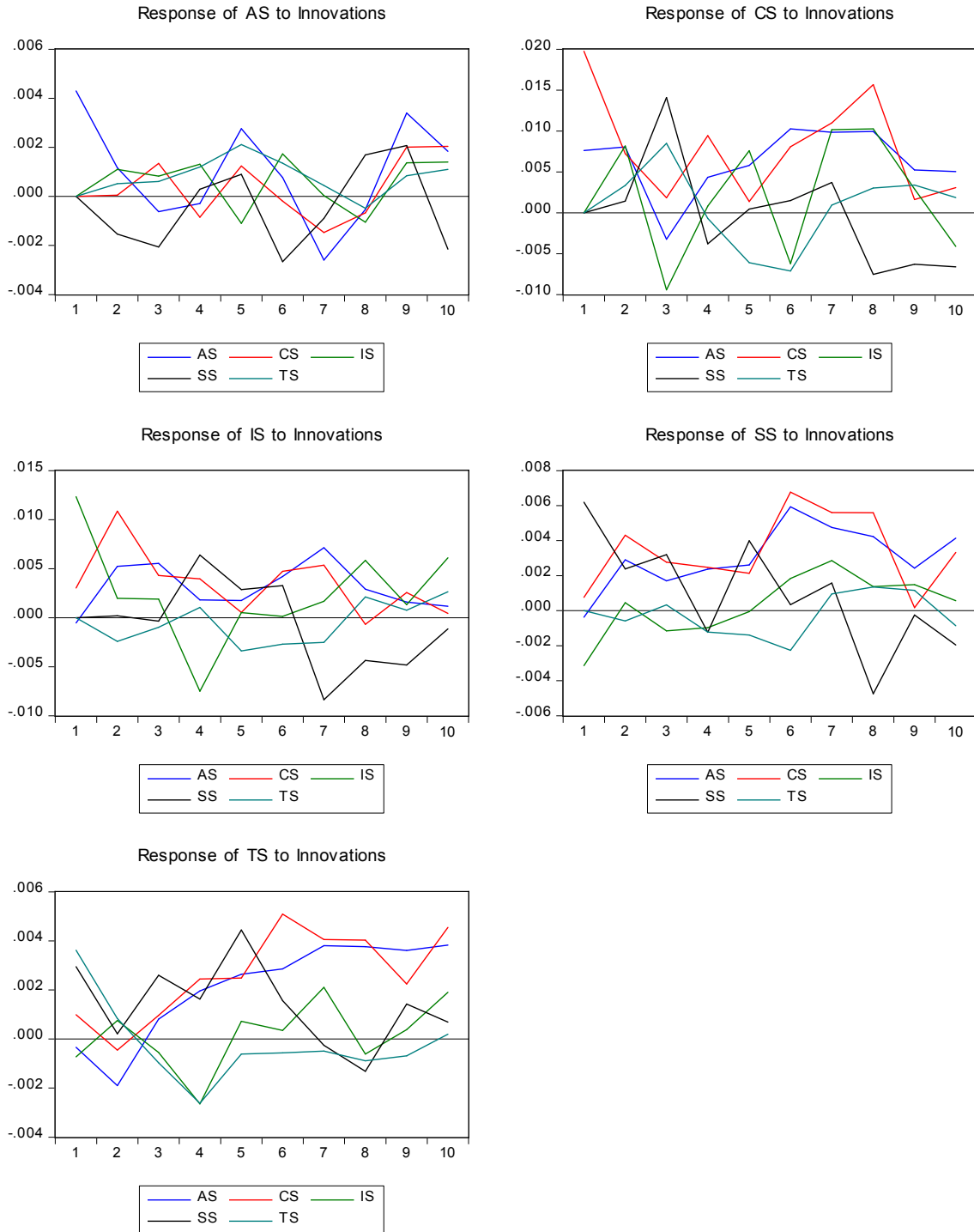Response to Cholesky One S.D. (d.f. adjusted) Innovations

Fig. 6. Impulse response graphs
Panels 2 to 5 are responses to innovations in other sectors by the construction, industrial, service and trade sectors respectively.
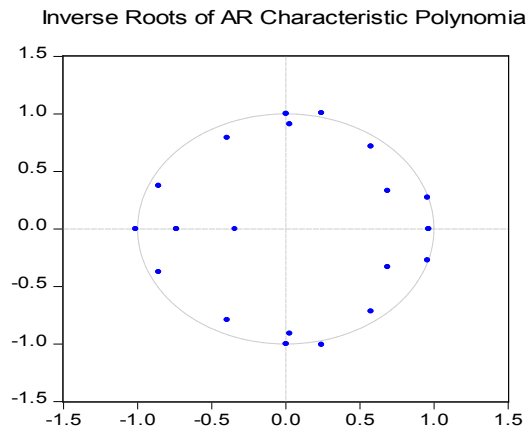
Inverse Roots of AR Characteristic Polynomial

Fig. 7. AR inverse root

5. CONCLUSIONS, POLICY IMPLICATIONS AND NEED FOR FUTURE RESEARCH

This article demonstrated a new approach for estimating the output linkages of agricultural sector and dynamic causal-chain effects on other sectors of the Nigerian economy. The new technique models the long run relationship between agricultural sector output changes and other economic sectors output as opposed to a static relationship produced by the conventional Leontief input-output technique. The dynamic econometric methodologies adopted in this article capture more specific cause-effect relationship between a pair of sectoral activities rhythms in the economy. It further states the chain effects or lead-lag or forward-backward flow of activities following a disequilibrium variation in one sector of the economy. This helps the policy makers who formulate and implement agricultural development strategies, policies and regulations to understand how the effects on agricultural output are being channeled through other sectors of the economy. Investors, industrialists and agro-business owners in Nigeria can gain tremendously from this study by tracking the level of agricultural sector output, as it enhances their awareness about the sectoral business performance. The estimated lag frame of the forward-backward linkages provides the agro-industrialists and other investors with adequate knowledge about the time horizon required to organize and select their best business strategies to The study indicates that some causal-effect nexus are bi-directional, this includes the agricultural sector output and construction, service and trade sectors output. The implication of the bi-

directional causation is that changes in economic conditions in construction, service and trade sectors through policies or technical know-how have reverses to affect agricultural output in Nigeria. It further implies that the agricultural sector is a receptor of shocks in other sectors and also causes output shock in other sectors except in the industrial sector. Therefore, the different sectors of the Nigerian economy have to develop some adaptable and flexible response abilities in order to adjust their productivity or output within the plausible. The study vehemently concludes that forward and backward linkages exist between agricultural output and other sectoral output except industrial output in Nigeria. The reports of this study that agricultural output does not precede industrial output but industrial output precedes agricultural output does not support the positions of [65-67,59]. The latter reported the absence of causality between agricultural output and industrial (manufacturing) output in Nigeria, while the former documented a unidirectional causality that runs from the agricultural sector to the industrial sector in Europe. However, this paper lends credence to the submission by Subramaniam [61] for the Polish and Romanian economies that in the former, industrial sector precedes agricultural sector while in the latter, service sector and agricultural sector have forward-backward linkages.

Future research efforts should be geared towards the extension of the study to cover sectoral linkages using other indicators of sectoral output, such as the growth rate in sectoral output as against the monetary value of sectoral output. Likewise, causal linkages between the agricultural sector output and the

overall economy in terms of aggregate demand level can be embarked upon using similar dynamic methodology.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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