SCALING NEW HEIGHTS: SEARCHING FOR THE IMPACTS OF THE CONTRIBUTIONS OF R&D AND SERVICE SECTOR EMPLOYMENT ON THE NIGERIAN ECONOMY

[1]IBEINMO, FRIDAY COOKEY & [2]UZOMBA, PETER CHIKA
[1]Department of Economics, University of Africa, Toru-Orua.
[2]Department of Economics, Federal University Lokoja.

Abstract

In spite of the contributions of various components of the Nigerian economy; its real gross domestic products (RGDP) have not reasonably scaled new heights in terms of monetary outputs. The study therefore seeks to empirically establish how the contributions of Research and Development (R&D), and service sector employment have impacted on the Nigerian economy from 1990 to 2019. Methodologically, we source data from the statistical bulletin of Central Bank of Nigeria and adopt econometric method with restrictive emphasis on ARDL cointegrating approach as data analytical method. The findings reveal that the contribution of research and development (CORD) scales new height by impacting significantly on RGDP in the long run; while service sector employment (SVSE) does not. By implication, it means that continuous spending on R&D spurs innovative outcomes that equip human capital to make better contributions to RGDP. We conclude that the contribution of R&D provides the enablement for the growth of the Nigerian economy, and *remains the oil that lubricates the processes of economic progress of Nigeria. Hence, scaling up spending in R&D is recommended – as it presents an opportunity for Nigeria to move from resource-base to knowledge-based economy, and serves as a midwife for Nigerian economic rebirth.*

Keywords: R&D, Service Sector, Employment, Nigeria, RGDP, ARDL
JEL Classification: CO1, E24, H52, I2, J21, O32

Introduction

Quality of workforce is a contributory reason why some nations are rich, others poor; although, it was erroneously suspected, in the past, to be the quality and amount of physical capital. Nonetheless, in recent years, it has been discovered that some nations, industries, and firms do exhibit high level of workforce output even with low levels of physical capital (Shenglang,

2018); even more, from stockpile of outcomes from research and development (Peters & Taylor, 2015). This stresses the point why modern economies are quickly drifting from resource-based to knowledge-based; for the reason that, knowledge-based economy is the fundamental determinant of value creation that contributes to the development of a nation. By imitating this, evolving economies preoccupy themselves with formulation of policies that encourage increase in investment in R&D; and enforce proper deployment and utilization of the contribution of R&D for economic growth and development (Luisa & Ji, 2013).

Given the importance of human capital, any that is government desirous of economic growth and development invests heavily in R&D. It is for this reason that government makes tripartite investments in human capital – covering expenditures on education, health and R&D; with a primary objective to equip workforce for the production of goods and services. The last aspect of such investment centres more on knowledge creation and that forms the focus of this paper. By thinking in that direction, Surani, Gendron and Maredia (2017) argue that to increase economic growth and productivity through knowledge creation, countries often invest in R&D, and makes concerted dedication to science and technology. Kalu (2001) giving support to such an assertion posits that knowledge creation is needed to improve productivity and development by raising quality of the labour force and that of the population in general, and in this way the outlays yield a continuing return in future. No wonder, developed economies are transforming their production configuration into more knowledge-based; thus making the contributions of R&D more visible for economic competitiveness (World Bank, 2006). In advanced economies, the comparative utilization of R&D's contributions, like new production techniques, product design, market power, and intangibles incorporated in workforce and organization structure is rising continuously (Chun & Nadiri, 2016). As such R&D represents an important and growing component of total stock, as well as a critical determinant of firms' output and economic advancement (Gourio & Rudanko, 2014; Clausen & Hirth, 2016).

The Organization for Economic Co-operation and Development (OECD, 2011) reports that increasing expenditure on R&D by governments and other private establishments in the United States, Japan, and other parts of Europe,

has made tremendous impacts on output and, remains a major driver of economic growth. For example, it made a critical contribution of over 18% to real gross domestic products in OECD countries in 2017 (OECD, 2019). Being attracted by the contributions of R&D, Nigeria is making effort towards investing more in R&D. A case in point is the recent approval of ₦7.5b for research by the Tertiary Education Trust Fund (TETFund) – an agency of the Nigerian Federal Ministry of Education. Additionally, according to the statistics from the World Bank, (2019), Nigerian government has spent over N300b in R&D. In view of this development, it is naturally expected that R&D (through creative, inventive and innovative enterprises) would have equipped people to engage in more productive employment – so as to be able to contribute to the growth of the economy; as it has made in other countries; especially, in the OECDs. For instance, the contribution of R&D to RGDP from 2017 to 2019 increased approximately to 176% from 3.6%; similarly, service sector employment's contribution increased from 0.1% to 20%. In spite of these contributions, the Nigerian real GDP has not performed as expected. A thought provoking point is the fact that from 2018 to 2019, it increased from 9.39% - not in corresponding volumes with the contributions of R&D and service sector employment.

This unpleasant scenario seriously questions most theoretical and empirical works whose argument is that R&D is a very important contributor to economic growth (Guellec & Van Pottelsberghe, 2001; Greg, & Agboro, 2014; Gamayuni, 2015; Clausen, & Hirth, 2016); and investment in human capital instigates growth through innovation (Luisa, James, & Ji, 2013; Okoye, Offor, & Manukaji, 2019). By attempting to provide some empirical insight to this issue, Jaiyeoba (2015), Adeyemi and Ogunsola (2016), and Ehigiator (2017) who delved into assessing the impact of intangible assets on firms, service sectors and Nigerian economy have reported that intangible assets is significant to the growth of the Nigerian economy. Nonetheless, these studies made a disturbing presumption of assuming R&D into intangible assets, exclusion service sector employment and used data that ended in 2015. Noting this gap, out study departs from that stand point by decomposing and extracting the contribution of R&D from intangible assets, so as to enable us effectively determine its impact, as a single variable, on RGDP; also includes service sector employment being the transmitter of the contributions of R&D,

and extending the data point to 2019. This to the best of our knowledge has not received specific research attention as documented in the extant literature.

Arising from this paucity in literature, our study fills the gap by addressing this question: have the contributions of R&D and service sector employment scaled new heights by impacting significantly on the Nigerian economy? Responding to this question using autoregressive distributive lag (ARDL) cointegration approach forms the thesis of this study. In addition to the introduction in section one, the rest of the paper is organized in the sequence of; literature reviews – theoretical and empirical reviews - done in section two, section three considers methods of study, results and discussion presented in section four, and section five focuses on concluding remarks.

Literature Review

The growth of any economy is a function of a number of things, including the contributions from R&D and service sector employment. Economic literature has widely documented that increase in spending in R&D brings about enhanced growth. As it is the anticipation of the spending entity to receive some returns in form of new ideas to improve on existing products and produce new ones, initiate new ways of reducing costs, mitigating negative externalities, satisfying customers, sustaining and increasing market share, increasing sales; be more productive, profitable and competitive, and enjoy increasing return to and external economics of scale. Following this argument, this section of the paper dwells on conceptual clarification, theoretical review, empirical review, and summary of the literature reviewed.

Conceptual Clarification

The concept of R&D is bore out of making scientifically detailed and careful investigation into some subject or area of study with the aim of discovering and applying new knowledge, facts, skills or information that would move a country from a less desirable stage to a more desirable stage. In order to achieve this, R&D becomes an integral part of government's investment in human capital development – which is done in three folds; expenditure in education, health and R&D. Luisa, James & Ji (2013) define R&D as the effort made by public and private sectors to; brew new ideas, develop and

produce intermediate goods, discover methods to reduce costs and maximize output that would allow firms to be more productive and profitable. Also, they report that Romer conceptualizes R&D as any investment in human capital that contributes its spillovers to greater aggregate output of a nation. In the same study, it is reported that Griliches defines R&D as the effort made towards stocking knowledge for productive purposes.

Guellec and Van-Pottelsberghe (2001) see R&D as an investment effort made towards finding ways to improve on existing techniques and develop new ideas that will interplay seamlessly with productivity growth. Aghion and Howitt (2007) posit that R&D is a trusted and sure means of knowledge development that is non-rivalry, and enables a nation advance the course of economic growth by introducing better way of production operations. Thus, if technological progress is the key driving force for economic progress; then such progress should come from R&D which produces industrial innovations, creativity and inventions (Grossman & Helpman documented in Luisa, James & Ji, 2013). The review done so far clarifies and expounds the concept of R&D, and presents a balance synthesis that R&D is an enterprise that makes economies and firms breakeven through its sustaining contributions.

Employment is the avenue through which the benefits, otherwise contributions of R&D, are transmitted in an economy – whose anatomy captures service sector as a major component. In the scenario of economic nexus, a functional service sector depends on inputs from different outlets, including R&D. No wonder, Ghani and O'Connell (2014) see it as a sector that has the capacity to become an important driver of sustained growth in Africa if properly fed with the right kind of workforce. The service sector of any economy is that segment of an economy saddles with the responsibility of producing services, otherwise known as intangible goods. According to CBN classification of the Nigerian economy, the service sector is made up of those economic units that engage in the production of services in the country. They include the transport, information and communication, utilities, accommodation and food service, finance and insurance, real estate, professional, scientific and technical service, public administration, education, human health and social service, arts, entertainment and recreation, and other service units. It is one of the five main sectors of the Nigerian economy.

Service sector is that part of the Nigerian economy that provides complementary consumption; generate auxiliary outputs as inputs for the other sectors; and generally create more employment than any other sectors producing tangible goods (Oyejide & Bankole, 2001). The United Nations Conference on Trade and Development (UNCTAD, 2015) defines the service sector as an economic part responsible for contributing to growth and development of the other sectors in any country. The OECD (2008) says that the service sector employment is the engagement of employees in the provision of services that make tremendous contributions in order to keep an economy in a stable and healthy state. It is the act of employing or the state of being employed in the business of providing goods that are intangible in nature. Providing such services in a reasonable quantity is a matter of the quality of the employed workforce – whose capacity is built through the externalities or spillovers from the contributions of R&D.

Economic growth is loosely defined as the steady increase in the overall quantity of goods and services produced in a country. Such increase comes from the contributions of critical sectors of the economy – which mainly include the agricultural, industrial, construction, trade and service sectors. Simply put, an economy grows when there is significant increase in the quantity of goods and services produced by these sectors on a yearly basis. For Jhingan (2007), economic growth is the quantitative steady increase in a country's per capita or individual productivity or output or income that is brought about by the enlargement of its workforce, capital, consumption and the volume of trade. Chappelow (2019) sees economic growth as an improved production of economic goods and services in comparison from a period of time to another. It has two measurement points – nominal and real (adjusted for inflation), and could be construed as the aggregation of all national outputs produced by the factors of production within a country in a given year. It is a rise in the manufacturing of goods and services within a specific time frame (Kimberly, 2019), and it is ascribed as the stock-pile of physical and human capital as well as the expansion in the creation and production of new goods emerging from technological innovation, inventions and creativity provide by R&D. Therefore, if expenditure and commitment in R&D are raised, there will be increase in creative, inventive and innovative trajectories leading to opening of the economy through creation of job opportunities, and

acceleration of economic progress of a nation. This is framework upon which this study conceptualizes a possible nexus from the contributions of R&D, service sector employment and economic growth in Nigeria.

Theoretical Review

Our study relies on pure theory of public expenditure, and human capital theory. The pure theory of public expenditure was expounded in the 1950s by Samuelson. For Samuelson, according to Greg and Agboro (2014), public expenditure is made to achieve growth in labour; with a target to increase spending on education and allied enterprises. The theory preaches for growth in capital (K) and technological innovation through the activities of R&D; and, argues that government expenditure grows an economy through economic activities. In the context of our study, when government increases expenditure on R&D, both labour and capital, as factors of production, would be enhanced through creativity, inventions, and innovations. Hence, it is inferred that through such expenditure, new technologies are developed and improvement is made on the existing one(s) for effective and efficient production.

The second theory (human capital theory) argues that investment in human capital enables R&D produce a workforce that would improve on the output and productivity of labor. This is because such investment instills in a workforce, useful skills, knowledge and the right attitude that will raise the quality of the labour force and workers' expected future incomes by increasing their earnings for lifetime (Becker as cited in Mutamba 2016; and Kalu, 2001). The theory argues that a rise in the quality of workforce will result in tremendous economic growth. By implication, growth in the Nigerian RGDP requires a free release of the energy of workforce through qualitative outcome of R&D – which comes by through sincere government expenditure. Such expenditure should bring forth through R&D, a workforce that would serve as the key to the development of a people's ability to manage and induce change that will ultimately grow an economy by throwing up desired contributions. Intuitively, the theory offers a trajectory for a strong explanation and discourse around the connection between contributions of investment in education, and its attendant outcomes for economic growth.

The choice of the study variables is informed and inferred from the theoretical disposition demonstrated in the foregoing discourse – which clearly points to a positive relationship between investment in human capital and economic growth and development. With emphasis on expenditure on R&D, it is theoretically expected that, through the service sector employment, R&D should create the needed opportunities for the workforce to be fully equipped in the real sense creativity, inventions and innovations, and with useful knowledge and skills - so as to be able to make massive contributions for significant growth of the Nigerian economy. Arising from this therefore, the theoretical framework for our study is that investment in human capital through expenditure in R&D creates opportunities for a workforce to be well-equipped for employment, be more productive and makes contributions that would enable the Nigerian economy to scale new heights. Hence, the theoretical framework is symbolizes thus:
IHC→ERD→IWF→SSE→IPT→IRGDP.

Where: IHC - investment in human capital; ERD - expenditure in R&D; IWF – improved workforce; SSE – service sector employment; IPT – increase in productivity; IRGDP – increased RGDP.

Empirical Review

By looking at the nexus between R&D and economic growth, Adeyemi and Ogunsola (2016) investigate the impact of human capital development on economic growth in Nigeria, from 1990 to 2015, using ARDL approach. Their study reports a positive long-run relationship between government expenditure on R&D and economic growth. Marrano, Haskel and Wallis (2007) studying the United Kingdom using descriptive statistical methods, report that 15% of labour output growth is accounted for by intangible capital deepening in 1979-2005 and 20% in 1995-2003. Gamayuni (2015) examine the effect of intangible assets, financial performance and financial policies on the firm value of public companies in Indonesia, 2007–2009. By adopting OLS method, the study reports that returns from R&D have positive and significant effect on the firm value, while others failed in that test within the period of the study. Rahko (2014) looking at market value, R&D, patents, and organizational capital with Finnish evidence on 56,000 firms observations

between 1995 and 2008. Using Non Linear Square (NLS) regression method, the study reports that organizational capital, R&D, patents, and patent citations have positive and significant effects on market value.

Parcharidis and Varsakelis (2010) carry out research on R&D and emerging market: the case of the Athens Stock Exchange Greek firms, from 1996-2004 using OLS technique. They report that the Greek firms' R&D investment affects the market worth of the sampled firms. Hao, Manole and Van-Ark (2008) report that in Germany, France, Italy and Spain, from 1995 to 2003, intangible capital as an umbrella variable for intangible goods accounts for 31% of labour productivity growth in Germany, 37% in France, 59% in Italy and 64% in Spain. Subsequently, growth rose by 10% in Germany, 14% in France, 37% in Italy and 40% in Spain. Studying a sample of the 16 OECD member countries, Guellec and Van Pottelsberghe (2001) report positive and significant coefficient for business and public R&D expenditure but a slightly larger effect of foreign R&D on multifactor productivity growth. Griffith, Redding and Van-Reenen (2004) report a two-fold effect of R&D on total factor productivity – first, the direct effect of R&D on total factor productivity and secondly, the potential of R&D to enhance the capacity of a country to absorb new technologies.

Looking at service sector employment (henceforth referred to as SSE) and economic growth (afterward called EG), Ekesiobi, Dimnwobi, Ifebi and Ibekilo (2016) studies the relationship between SSE and manufacturing output growth in Nigeria from 1986 to 2014 with cointigration approach. The study details that SSE has a positive but insignificant effect on manufacturing output growth in Nigeria. By lending support to this report, Ramakrishna (2010) comparing the contributions of SSE, agricultural and industrial outputs to EG in India using data spanning from 1980 to 2016 with regression technique of OLS, reports that SSE in India contributes more to EG than agricultural and industrial sectors. By doing a sectoral analysis on the contributions of SSE, manufacturing and agricultural outputs to EG in Kenya, Barungi, Ogunleye & Zamba (2015) report that SSE contributes about 57%, while manufacturing and agriculture, respectively contribute about 9% and 21% to the nation's gross domestic product; and SSE share to GDP moves positively with EG. The submission by Francois and Hoekman (2010) in a panel data analysis of SSE

performance and productivity growth in sub-Saharan Africa countries from 1980 to 2005, submits that a positive relationship exists between the two; hence SSE is considered an essential driver of EG. Their conclusion earns support from the study of Park and Papadopoulou (2012) who report that service sector is a key provider of jobs that lead to economic growth in that region.

Summary of Literature Reviewed

There is a glaring consensus in the definitions of R&D – as an enterprise that makes significant contributions to the growth of an economy through its critical components such as creativity, inventions and innovations. Also, SSE is equally unanimously conceptualized as the act of engagement of workforce for the production of services that lead to economic growth. Distinctively, our study construes EG as steady increase in the production of goods and service occasioned by the contributions of R&D and SSE. On the theoretical review, it is evident that existing studies utilize a configuration of Romers' endogenous growth theory, Schumpeter theory of growth and human capital theory to look at issues bordering on the relationship between human capital development and EG. However, our study distances itself from the usual, by combining pure theory of public expenditure and human capital theory in the examination of the impact of the contributions of R&D and SSE on the Nigerian economy. Lastly, it is evident that the empirical studies reviewed report mixed results on the relationship between R&D, SSE and EG – suggesting that the debate surrounding this subject matter is inconclusive. On the account of this, we are motivated to re-examine the situation by empirically searching how the Nigerian RGDP has scaled new heights through the contributions of R&D and SSE from 1990 to 2019 using ARDL approach to cointegration as method for data analysis.

Method of Study

Data, Sources and Model Specification

Our study adopts a blueprint of ex-post facto research design and sources secondary data from the statistical bulletin of Central Bank of Nigeria and World Bank. The specification and estimation of the equation follows an implicit assumption and theoretical prescription that R&D and SSE contribute

to the growth the Nigerian economy. This is lucidly captured in the following functional relationship as modeled below:

$RGDP = f(CORD, SVSE)$ 1

Where: RGDP = Real Gross Domestic Product, a proxy for economic growth, CORD = Contribution of R&D, and SVSE = Service Sector Employment.

From equation 1, we proceed to estimate Autoregressive Distributed Lag (ARDL) bound cointegration equation as follows:

$$\Delta In(RGDP')_1 = \beta_0 + \beta_1 In(RGDP)_{t-1} + \beta_2 ln(CORD)_{t-1} + \beta_3 In(SVSE)_{t-1} + \sum_{i=1}^{p} \theta_{1i} \Delta(RGDP)_{t-i} + \sum_{i=1}^{r} \theta_{2i} \Delta(CORD)_{t-0} + \sum_{i=1}^{s} \theta_{3i} \Delta(SVSE)_{t-0} + \mu_t \quad 2$$

$$\Delta In(CORD')_1 = \beta_0 + \beta_1 In(CORD)_{t-1} + \beta_2 ln(RGDP)_{t-1} + \beta_3 In(SVSE)_{t-1} + \sum_{i=1}^{p} \theta_{1i} \Delta(CORD)_{t-i} + \sum_{i=1}^{r} \theta_{2i} \Delta(RGDP)_{t-0} + \sum_{i=1}^{s} \theta_{3i} \Delta(SVSE)_{t-0} + \mu_t \quad 3$$

$$\Delta In(SVSE')_1 = \beta_0 + \beta_1 In(SVSE)_{t-1} + \beta_2 ln(RGDP)_{t-1} + \beta_3 In(CORD)_{t-1} + \sum_{i=1}^{p} \theta_{1i} \Delta(SVSE)_{t-i} + \sum_{i=1}^{r} \theta_{2i} \Delta(RGDP)_{t-0} + \sum_{i=1}^{s} \theta_{3i} \Delta(CORD)_{t-0} + \mu_t \quad 4$$

Where: *β_0 is the slope of the ARDL regression line; $\beta_1 - \beta_3$; $\theta_1 - \theta_3$ are coefficients of parameters to be estimated; Δ = denotes the first difference operator; $RGDP'_{t-1}$, $CORD'_{t-1}$, $SVSE'_{t-1}$ are vectors of the equations allowed to be purely 1(0), 1(I) or cointegraeted; p, r, and s are maximum lags associated with the exogenous variables; ln = natural log; t – I = the lagged values; μ_t = vector of the uncorrelated random error term with zero mean and constant variance.*

The cointegrating *vectorized* equations are formally r*eparameterize* into error correction mechanism (ECM) equations as specified below:

$$\Delta(LNRGDP)_t = \Psi 0 + \sum_{i=1}^{p} \Psi 1i \Delta(LNRGDP)_{t-I} + \sum_{i=0}^{r} \Psi 2i \Delta(LNCORD)_{t-i} + \sum_{i=0}^{s} \Psi 3i \Delta(LNSVSE)_{t-I} + \text{þ}1ECT_{t-1} + e_t \quad 5$$

$$\Delta(LNCORD)_t = \Psi 0 + \sum_{i=1}^{p} \Psi 1i \Delta(LNCORD)_{t-I} + \sum_{i=0}^{r} \Psi 2i \Delta(LNRGDP)_{t-i} + \sum_{i=0}^{s} \Psi 3i \Delta(LNSVSE)_{t-I} + \text{þ}1ECT_{t-1} + e_t \quad 6$$

$$\Delta(LNSVSE)_t = \Psi 0 + \sum_{i=1}^{p} \Psi 1i \Delta(LNSVSE)_{t-I} + \sum_{i=0}^{r} \Psi 2i \Delta(LNRGDP)_{t-i} + \sum_{i=0}^{s} \Psi 3i \Delta(LNCORD)_{t-I} + \text{þ}1ECT_{t-1} + e_t \quad 7$$

Where: *All other parameters retain their earlier definitions, while ECT is the error correction term – which defines the speed of adjustment in the coefficients of þ_1. It is used to capture the significant of the ECM. In other*

words, it explains how much of the disequilibrium in the short run periods that can be corrected in order to restore equilibrium in the model. t-1 = is the lagged length for the ECT, Ψ1i, Ψ2i and Ψ3i are the coefficients lagged values of exogenous variables, Δ = difference operator for short run equation, p is the lag length for the dependent variable, r and s are lag length for the independent variables, e_t *= stochastic term*

Data Analysis Techniques and Justification

As methods for data analysis, we make use of ARDL bound cointegration technique. The choice of this method is informed by a leading argument that when one cointegrating vector exists, Johansen and Juselius (1990) cointegration procedure cannot be applied; hence, it becomes imperative to explore Autoregressive Distributed Lag (ARDL) approach to cointegration or bound procedure for a long run relationship as proposed by Pesaran, Smith and Shin (2001) and Pesaran, *et. al.*, (1996b); irrespective of whether the underlying variables are I(0), I(1) or a combination of both (Nkoro & Uko, 2016). This justification is hinged on an implicit assumption that this approach gives realistic and efficient estimates, enables the identification of cointegrating *vectorised* equation(s), and provides the basis to *reparameterize* the equation(s) into error correction mechanism. Additionally, descriptive statistical, correlation matrix, Philip-Perron (PP) unit root, Granger causality and residual diagnostic techniques are as well used for efficient and robust analysis.

Results and Discussion

Table 1: Results of Descriptive Statistics and Correlational Matrix

Descriptive Statistics				**Correlation Matrix**			
	LNRGDP	**LNCORD**	**LNSVSE**		**LNRGDP**	**LNCORD**	**LNSVSE**
Mean	38479.63	63.39321	43.92107	LNRGDP	1	0.5676	0.8754
Maximum	69023.93	435.0400	51.83000	LNCORD	0.5676	1	0.5987
Minimum	19199.06	0.160000	37.74000	LNSVSE	0.8754	0.5987	1
Std. Dev.	18342.63	91.75565	5.102426				
Skewness	0.492932	2.640922	0.281775				
Kurtosis	1.693350	10.87271	1.501767				
Jarque-Bera	3.125806	104.8571	2.989339				
Probability	0.209527	0.000000	0.224323				
Observations	28	28	28				

Source: *Computed by the Authors with E-Views, 2020.*

As presented in Table 1, the results of descriptive statistical tests show that LNRGDP, LNCORD, LNSVSE have mean values of 38479.63, 63.39321 and 43.92107; maximum values of 69023.93, 435.0400, and 51.83000; minimum values of 19199.06, 0.160000 and 37.74000; skewness values of 0.492932, 0.492932 and 0.281775. The values of kurtosis, Jarque-Bera and probability are 1.693350, 3.125806, and 0.209527 for LNRGDP; 10.87271, and 104.8571 and 0.000000 for LNCORD; and, 1.501767, 2.989339 and 0.224323 for LNSVSE respectively. The results of symmetry in the distribution show that the data are moderately skewed given the 0.5 and 1 threshold; have heavier tails (leptokurtic distribution), and normally distributed. The correlational matrix result reveals that LNCORD and LNRGDP are 0.5676 (57%) correlated, but LNSVSE and LNRGDP are 0.8754 (88%) correlated. This result shows that both contributions of research and development (CORD) and service sector employment (SVSE) are positively and strongly related with RGDP; but it is instructive to mention that SVSE is more correlated with RGDP.

Table 2: Philip-Perron (PP) Unit Root Stationary Test

Variables	PP Stat. at Levels	1% Crit. Value	5% Crit. Value	PP Stat. at first Diff.	1% Crit. Value	5% Crit. Value	Order of Integration
In(RGDP)	-1.444991	-3.679322	-2.967767	-5.193606*	-3.689194	-2.971853	I(1)
In(CORD)	-1.058034	-3.679322	-2.967767	-10.54423*	-3.689194	-2.971853	I(1)
In(SVSE)	-5.957958*	-3.679322	-2.967767	-10.54423	-3.689194	-2.971853	I(0)

*Note: *(**) indicates (1%) and (5%) Significant Levels*
Source: *Computed by the Authors with E-Views, 20200.*

The PP unit root test result reveals that the variables area stationary and integrated of order one [I(1)]; except for SVSE, that attains *stationarity* status and becomes integrated of order zero [I(0)] at 1% and 5% levels. This satisfies the condition for the application of ARDL cointegrating technique – which requires the underlying variables to be stationary at I(0), I(1) or a combination of both, but NOT integrated of order two [I(2)].

Table 3: Result of ARDL Bound Test

Equations (Dependent Variables)	Statistical Values		Critical Value Bounds at 5%		Decision on Cointegration	Decision on Next Action
	F-values	t-values	I(0)/Lower Bound	I(1) /Upper Bound		
LNRGDP	0.901164	-0.711762	3.79	4.85	No, accept Ho	Do nothing!
LNCORD	7.774111	-3.886173	3.79	4.85	Yes, reject Ho	Estimate ECM
LNSVSE	0.436623	- 0.714651	3.79	4.85	No, accept Ho	Do nothing!

Note: *ARDL =Autoregressive Distributive Lag; SROLS = Short Run Ordinary Least Squares. Ho = Null Hypothesis. ECM = Error Correction Model*
Source: *An Extract from ARDL Bound Test Result Computed by the Authors with E-Views, 2020.*

Basically, this study addresses the question of whether or not the contributions of R&D and service sector employment have impacted on the Nigerian economy by conducting autoregressive distributive lag (ARDL) test. From Table 3, it is evident that the result of the test from LNRGDP and LNSVSE equations has F-values of 0.901164 and 0.436623 respectively. These values are less than both the lower and upper bounds. As a confirmation, the absolute value of t-stat (0.711762) is less than both the values of "I(0)" bounds "I(1)" bounds. However, the result of LNCORD equation reveals that F-stat (7.774111) is greater than "I(0)" bounds and "I(1)" bounds implying that the underlying variable has a single long run relationship equation; thus suggesting the identification of a cointegrating vector ($\Delta(LNCORD)_t$). It is noteworthy to point out that this result satisfies the condition for the application of ARDL cointegrating approach and gives us the confidence to *reparameterize* the LNCORD equation into error correction mechanism as reported in the table below.

Table 4: Results of *Reparameterized* Error Correction Mechanism Test for LNCORD Equation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-5.333795	34.07219	-0.156544	0.8778
D(LNCORD(-1))	1.024651	0.636881	1.608857	0.1300
D(LNCORD(-2))	0.197486	0.359575	0.549222	0.5915
D(LNCORD(-3))	0.207760	0.245183	0.847367	0.4110
D(LNRGDP(-1))	-0.004535	0.002182	-2.078115	0.0566
D(LNRGDP(-2))	0.014199	0.020094	0.706616	0.4914
D(LNRGDP(-3))	0.001289	0.023976	0.053763	0.9579
D(LNSVSE(-1))	-9.178862	38.82289	-0.236429	0.8165
D(LNSVSE(-2))	-25.34714	33.75829	-0.750842	0.4652
D(LNSVSE(-3))	-0.488769	31.31566	-0.015608	0.9878
ECM(-1)	1.804988	0.756596	-2.385670	0.0317
R-squared	0.575328			

Note: *Lag Length Structure: 3; Lag Order Selection Criterion: LR = Sequential modified LR test statistic (each test at 5% level); FPE = Final Prediction Error; AIC = Akaike Information Criterion; and HQ = Hannan-Quinn Information Criterion indicate 3; while SC = Schwarz Information Criterion indicates 1, as the lag order selection criteria. We based the lag length at 3 given that majority of the selection criteria are within that region.*
Source: *An Extract from ECM Result Output Computed by the Authors with E-Views, 2020.*

As a response to the request made in Table 4, ECM is analyzed using 3 as the lag length structure, which was selected by LR, FPE, AIC, and HQ as lag order selection criteria. The result reveals that the coefficients of lags of CORD appear with positive sign – indicating that the contributions of R&D make positive impact on RGDP, but not significant as shown in the probability values, in the previous last three years from the end date of this study. Within the maximum lag length period of 3, RGDP appears with a negative sign in the first lag, but maintains positive sign in the lag periods of 2 and 3, though without being significant at any lag period. The service sector employment (LNSVSE) equation shows that within the first, second and third lag periods, SVSE appears with a negative sign and remains not significant as reveal by the probability values. The result of the coefficient of the ECM(-1) (1.804988) is positively signed showing that instead of divergent relationship, there is

evidence of a convergence between the contributions of R&D and RGDP. This is also found to be significant at the prob. value of 0.0317, and tells us that there is long-run relationship between the variables as well as implicit existence of Granger –causality; hence pairwise Granger causality test is conducted and reported below:

Table 5: Results of Estimated ARDL Pairwise Granger Causality Test

Null Hypothesis:	**Obs.**	**F-Statistic**	**Prob.**	**Decision**	**Nature of Causality**
LNCORD does not Granger Cause LNRGDP	28	0.55232	0.5831	Accept Ho	Unidirectional, from RGDP to CORD
LNRGDP does not Granger Cause LNCORD		4.75699	0.0187	Reject Ho	
LNSVSE does not Granger Cause LNRGDP	28	0.55430	0.5820	Accept Ho	Zero Directional, from both RGDP and SVSE
LNRGDP does not Granger Cause LNSVSE		1.01086	0.3795	Accept Ho	

Source: *An Extract from ARDL Granger Result Output Computed by the Authors.*

It is revealed that there is a unidirectional Granger causality from RGDP to CORD, because of the significant status of the result; but none is found from CORD to RGDP. Zero directional causality is found between SVSE and RGDP – because their respective probability values are greater than 5% level, howbeit. The result implies that CORD cannot Granger cause RGDP within the period of the study, but RGDP can Granger cause CORD. Simply put, CORD could not be used to forecast RGDP, but RGPD could be used to make forecast on CORD. It is also reported in the table that neither SVSE nor RGDP could Granger cause each other; thus, a zero directional causality is found between both variables. This is not surprising because the ARDL bound test could not establish a long run relationship between SVSE and RGDP as evidenced in Table 3.

Table 6: Results of Residual Diagnostic Tests

Equation (Dependent Variables)	Historgram Normality Result at 5% (0.05)			Serial Correlation Result at 5% (0.05)		Heteroscedasticity Result at 5% (0.05)	
	Prob. Value	Jarque-Bera Value	Decision	F.Stat Value	Decision	F.Stat Value	Decision
LNRDGP	0.0000	227.6694	ND	1.415979	NSC	1.587659	Reject Ho
LNCORD	0.9007	0.209163	ND	0.985385	NSC	3.256256	Reject Ho
LNSVSE	0.8976	0.216102	ND	4.359716	NCS	2.561816	Reject Ho

Note: *ND = Normally Distributed; NSC means Not Serially Correlated*
Source: *An Extract from ARDL Residual Diagnostic Tests Computed by the Authors.*

For the purpose of testing for the robustness of our results, residual diagnostic tests are conducted. In the three equations (LNRGDP, LNCORD, and LNSVSE) it is evident that the values of Jarque-Bera are greater than 5% level – which suggests that the errors in the data used for the analysis are normally distributed. To this end, we have a good reason to infer that the error or residuals in the distribution cannot affect the result of our study because of their wide variance. To be convincingly sure, we proceed to conduct serial correlation test at 5% level, using Breusch-Godfrey technique. The result of the test calls for retention of the null hypothesis, which states that there is no serial autocorrelation in the distribution. This is on the account that the F-stat values are greater than 5% level of significance. This result, once again gives us the reason to conclude that the data used for the analysis vise-a-vise the subject matter are reliable; hence the result that ensued from the analysis have somewhat policy relevant implications. For the avoidance of doubt, we proceed to use Breusch-Pagan-Godfrey technique to conduct heteroscedasticity residual diagnostic test. The results show that all the values of F-statistics are greater than 5% level of significance; therefore the models are said to be homoskedastic.

Policy Implication

Using ARDL cointegrating approach we examine the impact of the contributions of R&D and service sector employment on the Nigerian economy. The result of that ensued from the analysis reveal that the contribution of R&D makes significant positive impact on the Nigerian economy within the period of this study. This provides the enabling reason that led to *reparameterization* of the LNCORD equation into error correction mechanism. The result of the ECM test appears with a positive sign and also significant – indicating that there is a convergent relationship which can be best described as a directional relationship between the contribution of R&D and real gross domestic products. In other words, there is a behavioural assumption that both variables exhibit an equilibrium relationship both in short-run and long-run, because the deviation from long-run equilibrium could be corrected gradually through a series of partial short-run adjustments at 180.4988%. Simply put, the result unravels the fact that it would take approximately 180.5% speed of adjustment to correct the errors found in short run of the model. This high percentage speed of adjustment is supported by high maximum lag length of 3, which explains the length of time it would take economic actions from the contributions of R&D to significantly impact on RGDP, by smoothening out rough economic cycle, respond to and address appropriately, the issues that retard RGDP; all things being constant.

It could be discerned from the foregoing results that continuous investment in human capital with emphasis on expenditure on R&D, enables a nation to stockpile knowledge and skills, and brews new ideas that contributes to scaling up aggregate output. No wonder, Aghion and Howitt (2007) say that R&D is a trusted and sure means of knowledge development that is non-rivalry, and enables a nation advance the course of economic growth by introducing better way of production operations. The Granger causality result is a pointer to this claim. In line with this result, Olalekan (2014) reports that a positive relationship exists between human capital and economic growth in Nigeria; a long run relationship existed between education and economic growth in Nigeria (Oladeji, 2015). Still in support of our results, Coe and Helpman (1995) make a submission that a country's real gross domestic product depends on domestic and foreign R&D capital stocks.

Our result also finds a place of honour in the proposition of pure theory of public expenditure which argues that investment in education leads to the production of human capital through increase in employment of skilled labour; as a major component in the growth process. This is why the contribution of R&D is phenomenal to the underlying performance of the Nigerian economy, because they possess the quality of moving closer together over time. This happens because, theoretically, a well-equipped workforce makes possible, the convergence of the outcome of human capital and economic growth. A take-home therein is that education as the driver of technological progress and producer of the right impetus for economic progress of a nation cannot be argued less. This informs an assertion from Grossman and Helpman cited in Luisa, James & Ji (2013) that technological progress drives economic growth through R&D through industrial innovations, creativity and inventions (Grossman & Helpman cited in Luisa, James & Ji, 2013).

Unfortunately, our study could not establish a long run relationship between service sector employment and real gross domestic product in Nigeria as reported in Table 3. This means that the service sector employment has no capacity of improving the growth performance in Nigeria. This captures our surprise in the sense that the unprecedented high rate of unemployment that characterizes the Nigerian employment space most likely could be responsible for this. Further, it suggests that, even when the human capital is well formed, developed and equipped with right knowledge and skills, it does not find a place in the production space to utilize such endowment. This goes to support our claim that a zero directional relationship exists between service sector employment and real gross domestic products.

This result does not beat our expectation though, because in reality, the level of employment in the Nigerian service sector is obviously not sufficient to make significant impact on RGDP. Perhaps, such deficiency could be excused on the account that service sector is not part of the real sector of the Nigerian economy, and lacks the required capacities to employ as much as the agricultural, industrial and trade sectors do. The result could also be attributed to the nature of the Nigerian service sector – whose orientation is geared towards production of intangible goods that may have indirect impact on RGDP; just as we have in the education, health, transport, real estate, and utility sub-sectors. In support of our study, Okoye, Offor and Manukaji (2019)

report that service sector employees were found not to make significant impact on the performance of quoted companies in Nigeria.

Contrary to our result, Barungi, Ogunleye and Zamba (2015) report a dramatic growth in the service sector of Kenya. Their study say that the sector contributes about 57%, while manufacturing and agriculture, respectively contribute about 9% and 21% to the nation's gross domestic product. Similarly, Francois and Hoekman (2010) submit that service sector performance impacts on productivity growth and could be regarded as a key driver of economic development in sub-Saharan African countries. Based on a survey of Asian region economies, Park and Papadopoulou (2012) report that service sector is a key provider of jobs that lead to economic growth in that region. Lashmi and Kumar (2012) put forward an argument that the sector as compared to the primary and secondary sectors is regarded as the main driver of economic growth in both developed and developing countries in the 1990s and 2000s. It is obvious that the direction of impact of service sector on the Nigerian economy remains an inconclusive debate that would warrant further studies using different methods of study, data set, sample size and other control variables. This is said because the source of the inconclusiveness could be the; area of study, type and nature of data, study period or control variable, or combination of all.

Concluding Remarks

Investments in knowledge creation, through expenditure in research and development, plays key roles ranging from formation of human capital stock, production of skillful manpower, creation of opportunities (employment generation) to earn reasonable income, increase in aggregate demand, increase in national income, to ultimately, increase in economic growth and development. This value chain benefits from R&D motivated the search for the impact of the contributions of R&D and service sector employment on the Nigerian economy from 1990 to 2019. To justify this motivation, we employ ARDL cointegration approach as analytical technique. The results of analysis reveal among others that; the contributions of R&D scale new height by significantly impacting on RGDP in the long run; while the service sector employment to do same.

This finding is in line with a remarkable consensus that R&D drives productivity at the national level. Therefore, we conclude that for Nigeria economy to grow there is need to continuously harness the contributions of R&D because it gives the enablement for an economy to move from resource-based to knowledge-based. By implications, it means that the Nigerian economy grows more similar with the contribution of R&D over and across the years. Also, the development of knowledge-based economy through spending in research and development is a key that unlocks the economic progress of a nation. This position wraps up our argument that the contribution of R&D and its attendant outcome is the fulcrum that shoulders the competitiveness and progress that support sustainable economic growth and development of any nation. Following the conclusion, we recommend; firstly, that the Nigerian government should continue to step up its spending on research and development; budgetary attention to education should be scaled up to the international acceptable percentage of 26; and lastly, employment attention should be given to the service sector in public and private space.

Unlike other studies, this study makes a contribution to knowledge by using assessing the performance of the Nigerian economy through the use of novel Nigerian data on the contribution of R&D, rather than assuming it to be intangible asset, and moderating its hebaviour with service sector employment as a means of transmitting the contribution of R&D to the larger economy. It also documents the impacts of R&D and service sector employment on the Nigerian economy using more recent data outlays covering a period of 40 years.

References

Adeyemi, P. A & Ogunsola, A. J. (2016). The impact of human capital development on economic growth in Nigeria: ARDL Approach. *IOSR Journal of Humanities and Social Science, 7(2),* 37 -52.

Aghion, P. & Howitt, P. (2007). A model of growth through creative destruction. *Econometrica,* 323-351.

Barungi, B., Ogunleye, E. & Zamba, C. (2015). Nigeria, African economic outlook, *African Development Bank, Country Office, Nigeria.*

Chun, H. & Nadiri, M. I. (2016). Intangible investment and changing sources of growth in Korea. *Japanese Economic Review* 67 (7), 50–76.https://doi.org/10.1111/jere.12079

Clausen, S. & Hirth, S., (2016). Measuring the value of Intangibles. *Journal of Corporate Finance 40(4), 110–127. https://doi.org/10.1016/j.jcorpfin.2016.07.012*

Ehigiator, B. O. (2017). The service sector in Nigeria: an escalator for new economic growth Lund University, School of Economics and Management.

Ekesiobi, C. S, Dimnwobi, S. K, Ifebi, O. E, & Ibekiol, B. N. (2015). Public sector education investment and manufacturing output in Nigeria: empirics and policy options. *Public Policy and Administration Research,* .6(7), 456 - 470.

Gamayuni, R. R. (2015). The effect of intangible asset, financial performance and financial policies on the firm value. *Int. J. Sci. Tech. Res. 4(9), 202–212.*

Gourio, F., & Rudanko, L., (2014). Customer capital. Review of economic studies *81, 1102–1136. https://doi.org/10.1093/restud/rdu007*

Greg, E. E. & Agboro, D. E. (2014). The determinants of public expenditure on educational infrastructural facilities and economic growth in Nigeria. *Journal of Business Management and Economics, 5(6), 152-161. Available online http://www.e3journals.org ISSN 2141-7482.*

Griffith, R., Redding, S & Van-Reenen, J. (2004). Mapping the two faces of R&D: productivity growth in a panel of OECD industries. *The review of economics and statistics, Cambridge, MA: MIT Press, 86(4), 883-895.*

Guellec, D. & Van-Pottelsberghe, B. (2001). R&D and productivity growth: panel data analysis of 16 OECD countries, *OECD Economic Studies* No. 33, 2001/II, OECD, Paris.

Hao, J., Manole, V. & Van-Ark, B. (2008). Intangible capital and growth – an international comparison, *Economics Program Working Paper Series*, EPWP No. 08-14, Conference Board Inc., New York, December.

Jaiyeoba, S. V. (2015). Human Capital Investment and Economic Growth in Nigeria. *African Research Review, 9(1), 30-46.*

Kalu, I. E. (2001). *Issues in Problems and Policies of Development.* Techno Consult Ltd Publishing Division, Lagos State.

Lashmi, P. & Kumar, S. (2012), Economic growth and impact of service's sector in India. *International Journal of Business Management and Economic Research*. 3(5), 627- 632.

Lichtenberg, F. R. (1993). R&D investment and international productivity differences, NBER Working Paper No. 4161, *National Bureau of Economic Research*, Cambridge, MA.

Luisa, B.; James, P. & Ji, G. (2013). The impact of research and development on economic growth and productivity in the US States. Pepperdine University, *School of Public Policy Working Papers.* Paper 48.

Marrano, G., Haskel, J & Wallis, G. (2007). What happened to the knowledge economy? ICT, intangible investment and Britain's productivity record revisited, *Department of Economics Working Pape*r No. 603, Queen Mary, University of London.

Mutamba, C. (2016). *An exploration and critique of the use of human capital theory in human resource development research.* Retrieved from https://www.researchgate.net/publication/296640161.

Nkoro, E. & Uko, A. K. (2016). Autoregressive distributed Lag (ARDL) cointegration technique: application and interpretation. *Journal of Statistical and Econometric Methods, 5(4), 63-91 ISSN: 1792-6602 (print), 1792-6939 (online) Scienpress Ltd, 2016 A*

OECD (2011).Valuation issues in transfer pricing of intangibles.39 *Intertax, 39(3), 126-131.*

OECD (2019). Productivity growth and finance: the role of intangible assets - A Sector Level Analysis Economics Department Working Papers No. 1547 *www.oecd.org/eco/workingpapers*

Okoye, P. V. C., Offor, N. & Manukaji, I. J. (2019). Effect of intangible assets on performance of quoted companies in Nigeria. *International Journal of Innovative Finance and Economics Research,7(3):58-66, Seahi Publications, www.seahipaj.org*ISSN: 2360-896X

Oladeji, A. O. (2015). Impact of human capital development on economic growth in Nigeria. *International Journal of Recent Research in Commerce Economics and Management, 2(2), 151- 164.*

Olalekan, O. (2014). Human capital and economic growth in Nigeria. *International Journal of Innovation and Scientific Research, 11(2), 291–294.*

Parcharidis, E. G. & Varsakelis, N. C. (2010). R&D and Tobin's in an emerging financial market: The case of the Athens Stock Exchange. Manag. Dec. Econ. 31, 353–361.

Park, Y. & Papadopoulou, T. (2012). Impact of the cost overruns R&D on transport infrastructure projects in Asia: their significance and relationship with project size". Built Environment Project and Asset Management, 2(2), 156 – 175. *https://doi.org/10.1108/20441241211280873*

Pesaran, M. H. Smith, R. J. & Shin, Y. (1996b). *Testing for the existence of a long run relationship.* DAE Working paper No.9622, Department of Applied Economics, University of Cambridge, (1996b).

Pesaran, M. H., Smith, R.J. & Shin, Y. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics, 16, (2001), 289-326.*

Peters, R.H. & Taylor, L.A. (2015) Intangible capital and the investment-q relation. *Journal of Financial Economics. 12(3), 251–272.*

Rahko, J. (2014), Market value of R&D, patents, and organizational capital: Finnish evidence. *Journal of Economics of Innovation and New Technology.* 23(4), 353–377, DOI: 10.1080/10438599.2013.864923.

Shenglang, Y. (2018). *Essays on intangible capital and economic development*, (Canberra): Australian National University, ZDB- ID 265279-7. Vol. #649.

Surani, S., Gendron, W. & Maredia, S. (2017). The economic impact of research and development. Econometrics 3161.

World Bank (2006), Where is the Wealth of Nations? Measuring Capital for the 21stCentury, World Bank, Washington, D.C. *https://databank.worldbank.org/reports.aspx.*