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Intangible Assets and Economic Growth in Nigeria: An Empirical Investigation

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

This work examines the impact of intangible assets on economic growth in Nigeria, using time series data from 1990 to 2019. Relevant theoretical and empirical literatures were reviewed. Government expenditure on research and development, intellectual capital proxied by human capital stock, intellectual property and service sector employment were regressed as independent variables against the real GDP (proxy for economic growth) as the dependent variable. Secondary data were used for this work. The ARDL bound test was adopted in estimating the model. We discovered that government expenditure on R&D, intellectual capital and intellectual property do not have significant relationship with economic growth proxied by RGDP; meanwhile service sector employment had a significant relationship with economic growth in Nigeria. Also, government expenditure on R&D; and service sector employment were rightly signed; while intellectual capital and intellectual property were not rightly signed. This implies that when government increases its expenditure on R&D, it will result to economic growth, so also service sector employment in the long-run. Meanwhile, an increase in intellectual capital and intellectual property will reduce RGDP. We therefore propose that government should upgrade its spending on R&D so as to boost intellectual capital and property. The government should also create employment for the stock of human capital. Finally, government institutions such as producers' protection agencies should be empowered to protect intellectual properties in Nigeria.

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1. INTRODUCTION

Why are some nations rich and others poor? This is a big question that has bothered economists and policy analysts for decades. The most possible answer lies in quality of labour and its labour usage that outweighs the importance of physical capital in terms of productivity. Long ago, it was suspected that physical capital must have caused the distinction in the workforce output. However, it was discovered recently that some nations, industries and firms do exhibit very appreciable level of workforce output even with insignificant levels of physical capital [1]. But the advancement countries is on the account of distinctive labour force – which is the stockpiling of "intangible assets" [2]. This distinction is partly the demarcating reason why rich and poor countries exist, and at the time why nearly all evolving economies in the world are now preoccupy with how to formulate strategies that can enforce proper deployment and application of intangible assets to generate wealth, increase labour productivity, expand the economy reasonably and ultimately grow the economy.

Meritum cited in [3] maintain that the main feature of the success story of the rich countries is the essential role played by intangible assets as a fundamental determinant of value creation of business companies. This is why intangible assets have become the focal point of emerging economies; and remain a core reason why countries invest in knowledge creation – which requires expenditures in human capital growth and development. This falls in line with the thought of [2] who posit that the most treasured assets in both advanced and evolving nations are humans – and their quality in relation to what they can produce puts countries on the path of growth, and sustains those already on that path of growth to keep on growth faster than their counterparts. No wonder, [4] argue that in advanced economies, the comparative utilization of tangible capital is reducing while the comparative use of intangible capital, like production techniques, product design, market power, and intangibles incorporated in workforce and organization structure is rising continuously. However, in advancing or under-advanced countries, the reverse is the case [5].

The place of intangible assets in the quest to achieve macroeconomic objective of rapid economic growth by the less developed countries heightens the importance of the role humans play in the process – which make the development of humans a pivotal policy decision is capable of achieving this objective far less than anticipated. An inroad into this calls for ensuring that enough funding is made in human capital development projects – because such funds would see to the assemblage of knowledge, skills and intangible assets of individuals that can fit into the growth process and be able to contribute significantly to the economic growth of the home country [6]. In a similar opinion, [7], argue that providing adequate funds for human capital makes it possible for education, health and research and development (R&D) to contribute to increased output even more than the stock of material capital. No doubt, these activities contribute to improved productivity and development by raising the quality of the labour force and that of the population in general and in this way the outlays yield a continuing return in further – economic growth.

In particular, the return on investment in human capital include among other things improvement in intangible assets. This informs an argument by [8] that intangible assets are factors that are non-material in nature and without physical embodiment which impacts seriously on economic growth of a nation. Intangible assets are envisaged to produce future economic gains to the individuals – at the micro level and the country at macro level. They add to production and productivity of a company through organizations, brand name, social capital, property rights, and protection [9]. In the same way, [10] goes further to deepen the importance of intangible assets to economic growth by reporting that in the UK, for example, the endeavor of intangible assets to the growth of the economy has doubled between 1970 and 2004. At the expense of intangible assets more employments are generated, income rises; consequently, consumers have more purchasing power to acquire more goods and services that promptly stimulate and drive high-rise economic growth [11].

Premised on this, all countries wish and pursue positive and practical economic growth, and have made efforts to increase the allocation on research and development. From 2009 to 2019, R&D have recorded a tremendous increase from 230.52b to 298.45b, intellectual capital equally increased from 47b to 62b; intellectual property increased from 190b to 253b, and service sector employment has increased from ₦47b to ₦52b. Despite these increases, real GDP decreased from 49b to ₦23b within same period of consideration [12]. This situation points to the actuality that economic growth in Nigeria is in dire string in the face of reported increase in intangible assets. Also, it undermines an assertion that intellectual assets are very key and essential ingredients that contribute to economic prosperity of a nation, but received inconsequential or no recognition in the country's financial statements, thereby undermining their quota to the economic growth of the nation [3]. Based on this revealing evidence, this study is motivated to examine how government expenditure on research and development (R&D), intellectual capital, charges on intellectual properties and service sector employment have impacted on economic growth in Nigeria from 1990 to 2019. The rest of this paper covers the literature review, research methodology, presentation of empirical results and discussion, and concluding remarks.

2. LITERATURE REVIEW

2.1 Theoretical Review

Schumpeterian theory of growth is a model which explains that economic growth could be influenced by health as adopted by [13]. Schumpeterian theory is an endogenous growth theory that ascribes the fraction of growth in poor and rich nations to that of output and productivity growth and not rate of factors accumulation. The theory clearly differentiates intellectual capital from physical capital and also savings, which propels growth in innovation and physical capital which propels intellectual capital growth, which the earliest generation of endogenous growth theories lump together. Based on assumed creative destruction, the argument that a new innovation dovetails to a competitive advantage renders previous innovations obsolete.

This supports the argument by Romer, cited in [14] that as important as technological variation may be to the outcome of the deliberate activities of people and a nation, it cannot override the importance of human component in the economic growth path. This is because return on investment in technology is in no way near return on investment in human capital – measured in terms of intellectual assets [15]. They further argued, as in the sense of human capital theory, that education and training being building blocks of intellectual assets improve the output and productivity of labor and contribute to the nature and causes of wealth of a nation. Therefore the economy of a country whose intellectual assets increase is expected to grow to a reasonable extent. This is on the account that useful skills and knowledge that define the quality of a population help in improving earnings at both micro-and-macroeconomic levels {Becker cited [9]. It is on this note that the theoretical framework of this study suggests that increases in intellectual assets contributes to the growth of an economy of nations.

2.2 Empirical Literature

According to Ehimare et al.[16] researched the Nigerian government expenditure on human capital development. The magnitude of human capital development, which backs the proof of the magnitude of education and health of an economy, can affect the magnitude of economic activities in that country. Given the analytical methods employed, the outcome of the analysis revealed that existence of substantial depreciation in the potency of government expenditure from 1990 up till 2011.

According to Okoye et al.[3] examined the power of intangible assets on performance of quoted companies in Nigeria utilizing time series data from 2008 to 2017. Five firms from divergent sectors of the economy were sampled. The data utilized in this work were gotten from yearly reports and financial statements of account of hand-picked firms. Employing descriptive statistics, correlation analysis and OLS regression the analysis revealed that R&D cost (in other words investment in R&D) had a useful effect on return on capital employed of quoted companies in Nigeria.

According to Ajadi et al.[17] investigated human capital development in association to economic growth in Nigeria using a descriptive survey research was employed and multi–stage sampling technique with 200 respondents, and a questionnaire with 0.86 reliability index. The Pearson's Product Moment Correlation Coefficient was also utilized to analyze the data

collected. The outcome showed that education had a prognostic r-value of 0.76 on individual personal income and the class of work or job is interrelated to personal individual income (r=0.64). Similarly, [11] researched the effect of human capital development on economic growth in Nigeria with time series data covering 1980-2013 of life expectancy ratio, secondary school enrolment, gross capital formation, government expenditure on education, and economic growth. They adopted the ARDL cointegration approach in their research and it revealed a positive long-run relationship among life expectancy ratio, secondary school enrolment, gross capital formation, government expenditure on education, and economic growth. They therefore advised government should step-up its financial commitment to education rather than health sector.

According to Izedonme et al.[18] studied the inter-relationship between human resource accounting and organizational performance among publicly listed firms in Nigeria. Additionally, the study looked into the inter-relationship between intangible assets and organizational performance. Data employed were cross-sectional panel data. Return on capital employed (ROCE) proxied for organizational performance. Multiple regressions were employed to establish the inter-relationship between the variables. The study showed an insignificant inter-relationship between the independent variables (human resource accounting, intangible assets) and organizational performance. In a like manner, [19] researched the power of intangible asset, financial performance and financial blueprints on the worth of Public companies in Indonesia between 2007–2009 using OLS. The study unraveled that He discovers that intangible assets have positive and reasonable influence on financial performance (proxied as retune on assets - ROA) and firm's worth.

According to cookey et al. [20] scaling new heights in the search of the contributions of R&D and service sector employment to the Nigerian economy argued that 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. This paper therefore sought 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 using data from the statistical bulletin of Central Bank of Nigeria and adopting 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 [15] were aroused by the marginal performance of the Nigerian economy to ask this question; 'do returns on human capital improve Nigerian economy using evidence from intellectual capital and property. The logic of our method of study was drawn from Paul's Romer Growth and human capital theories and Autoregressive Distributive Lag (ARDL) and residual diagnostic were employed as methods for data analysis. The results reveal that RITC makes significant improvement on RGDP, but RIPR fails to do same. This implies that the two measures of human capital do not have the same effect on the Nigerian economy.

This study relied on the postulations of Schumpeter theory of growth, Paul Romers' New Endogenous Growth Theory and Human Capital Theory. Unlike other studies that made use of one theory or just a combination of two. Although, several empirical studies on the impact of intangible assets on economic growth were done in both foreign and local space, the few Nigerian empirical works [17,16,11,18] did not examine the combined impact of government expenditure on R&D, intellectual capital, intellectual property and service sector employment on economic growth of Nigeria from 1990 to 2019. Given this identified gap our study seeks to empirically interrogate the issues of what has been the performance of the real GDP as R&D increases through government expenditure? Has intellectual capital made any useful impact on real gross domestic product? To what level has the charges on intellectual property (patent, copyright, trademark etc.) contributed to real GDP? What has happened to real gross domestic product in the face of improvement in service sector employment? The absence of empirical responses to these questions, as evidenced in the extant literature creates a huge gap that begs for attention to be filled. Therefore, providing empirical work to these inquiries is the literature gap this research study has elected to fill by examining the impact of intangible assets (research and development (R&D), intellectual capital, intellectual property and service sector employment), on economic growth in Nigeria from1990 to 2019.

3. METHODOLOGY

This study relied basically on secondary data sourced from Central Bank of Nigeria (CBN) [21] Statistical Bulletin, 2020 edition for the real gross domestic product; and World Bank publications for the intangible asset variables. In line with Paul Romer's growth theory and human capital theory as well as the empirical model of [22], the present study's model is specified with some modifications. Their model used only R&D to regress on factor productivity, but the present study introduces more variables such as: intellectual capital proxied by human capital stock, charges on intellectual property (patents, trademarks, copyrights), and service sector employment in the model to model the relevant ARDL equations. This is captured in the following ARDL functional relationship as modeled below:

$$RGDP = f(RADV, INTC, INPR, SVSE) \quad 1$$

Where:

RGDP = Real gross domestic product, as proxy for economic growth
RADV = Government expenditure on research and development
INTC = Intellectual capital, proxied by human capital stock
INPR = Intellectual property proxied by charges on patents, trademarks, copyrights.
SVSE = Service sector employment.

The specification and testing for ordinary least squares would be necessary here if there is no cointegration in the ARDL Bounds equations. The equations would be specified thus:

The econometric form of the equation is written as:

$$RGDP_t = a_o + a_1RADV_t + a_2INTC_t + a_3INPR_t + a_4SVSE_t + U_t \quad 2$$

In order to keep the real values at par with the ratio values, a log transformation of the model is taken. This is because economic relationships are not only linear, but also nonlinear. So log transformation is necessary to determine the relation that will conform to theoretical expectations. The log form is expressed as:

$$logRGDP_t = a_o + a_1logRADV_t + a_2logINTC_t + a_3logINPR_t + a_4SVSE_t + U_t \quad 3$$

Apriori Expectation: $a_1 > 0$; $a_2 > 0$; $a_3 > 0$; $a_4 > 0$;

4. PRESENTATION OF EMPIRICAL RESULTS AND DISCUSSION

Table 1 result shows that the real gross domestic product (LNRGDP) had values above the mean value from 1990 to 2005, 2018 and 2019; with a median value that lays in-between 2003 and 2004 – which is about 18years out of the total period of 30 years. The variable has the maximum value in 2015, and its minimum value was in 1991. For government expenditure on research and development (LNRADV) the data for the variable fell below the mean value from 1990 to 2007, and 2011, as the median n value lies within the neighborhood of 2003 and 2005, with its maximum and minimum values recorded in 2010 and 1993 respectively. Further the data for intellectual capital (LNINTC) fell below the mean value from 1990 to 2007, and 2011, as the median value lies within the neighborhood of 2003 and 2005, with its maximum and minimum values recorded in 2010 and 1993 respectively. Going forward, the table also reports the descriptive statistical values for intellectual property charges (LNINPR) the mean value of fell below the mean from 1990 to 2007, as the median value lies in 2006, with its maximum and minimum values recorded in 2019 and 2003 respectively. Still on the same table, reports the descriptive statistical values was presented for service sector employment (LNSVSE) it is evident that the data for the variable was below the mean from 1990 to 2005, as the median value lies in 2005, with its maximum and minimum values recorded in 2019 and 1990 respectively.

The skewness, kurtosis, Jarque-Bera and probability values of the study variables reveal that the symmetry nature is high because the data are highly skewed as their values fall above 1. In determining the degree of *peakedness* of flatness of the data, their kurtosis values reveal that the data have heavier tails (leptokurtic distribution); in other words their kurtosis' values are greater than zero. Their Jarque-Bera test values reveal that the data, not the errors are normally distributed and there is goodness-of-fit, because their values are greater than 0.05; while, their probability values of the result suggest that the data could be used for further analysis. On this basis we proceed to stationarity test using Philip-Perron unit root estimator.

4.1 Presentation of Result of Unit Root Analysis

In order to ascertain that none of the variable is integrated of higher order, the Philip Perron (PP) unit root test was employed. The Table 2 above shows that service sector employment was stationary at levels [that is, I(0) at 5 percent significant level. However, the rest of the variables were stationary at first difference [that is, I(1)] at 1 percent and 5 percent significant levels. Therefore, the time series data used in this study are stationary.

Table 3 presents the result of the short run static ARDL regression for the study variables. The analysis was done with RGDP ARDL regression equation, RGDP as the dependent variable with 29 inclusive observations after adjustment and maximum dependent lags of 1 selected using Akaike Info Criterion (AIC). From the AIC ARDL values LNRGDP has lag 1, LNRADV has lag 0, LNINTC has lag 1, LNINPR has lag 0, and LNSVSE has lag 0. On the overall assessment of ARDL-RGDP model, the value of coefficient of determination – R squared has a value of 0.813171 and its counterpart statistics (adjusted R squares has a value of 0.762218. It is informative to observe that the value of R squared is indication that the model has the power to determine what happens on intangible assets causally and how it impacts on economic growth within the short run of the ARDL.

Table 1. Results of Descriptive Statistics Test for Study Variables

	LNRGDP	LNRADV	LNINTC	LNINPR	LNSVSE
Mean	38479.63	63.39321	43416376	1.15E+08	43.92107
Median	33365.00	28.25000	42275761	61172135	43.00500
Maximum	69023.93	435.0400	60698492	2.59E+08	51.83000
Minimum	19199.06	0.160000	30040723	11399110	37.74000
Std. Dev.	18342.63	91.75565	9177805.	97082398	5.102426
Skewness	0.492932	2.640922	0.294249	0.452556	0.281775
Kurtosis	1.693350	10.87271	1.933010	1.417177	1.501767
Jarque-Bera	3.125806	104.8571	1.732265	3.878646	2.989339
Probability	0.209527	0.000000	0.420575	0.143801	0.224323
Sum	1077430.	1775.010	1.22E+09	3.23E+09	1229.790
Sum Sq. Dev.	9.08E+09	227315.7	2.27E+15	2.54E+17	702.9383
Observations	28	28	28	28	28

Source: Computed by the Authors with E-Views Version 10.0, 2021

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
ln(RGDP)	-1.444991	-3.679322	-2.967767	-5.193606*	-3.689194	-2.971853	I(1)
ln(RADV)	-1.058034	-3.679322	-2.967767	-10.54423*	-3.689194	-2.971853	I(1)
ln(INTC)	1.752268	-3.679322	-2.967767	-3.902928*	-3.689194	-2.971853	I(1)
ln(INPR)	-1.398938	-3.679322	-2.967767	-6.404007*	-3.689194	-2.971853	I(1)
ln(SVSE)	-5.957958*	-3.679322	-2.967767				I(0)

Source: Computed by the Author from E-view Version 10.0, 2021.
*Note: *(**) indicates (1 percent) and (5 percent) Significant Levels*

Table 3. Result of RGDP Short Run Static ARDL Regression for the Study Variables

Variable	Coefficient	Standard Error	t-Statistic	Prob.
LNRGDP(-1)	0.748360	0.233124	3.210143	0.0040
LNRADV	15.14405	24.94501	0.607097	0.5500
LNINTC	-0.039630	0.030123	-1.315578	0.2019
LNINTC(-1)	0.039184	0.031070	1.261140	0.2205
LNINPR	4.88E-06	6.97E-05	0.070061	0.9448
LNSVSE	3106.124	2545.197	1.220387	0.2352
C	-64834.02	68848.78	-0.941687	0.3566
R-squared	0.813171	F-statistic	15.95914	
Adjusted R-squared	0.762218	Prob(F-statistic)	0.000001	

Note: p-values and any subsequent test do not account for model selection
Source: Computed by the Authors

More explicitly, we discovered from the table that government expenditure on R&D, intellectual capital and intellectual property do not have significant relationship with economic growth; meanwhile service sector employment had a significant relationship with economic growth in Nigeria. Also, government expenditure on R&D; and service sector employment were rightly signed; while intellectual capital and intellectual property were not rightly signed. This implies that when government increases its expenditure on R&D, it will result to economic growth, so also service sector employment in the long-run. Meanwhile, an increase in intellectual capital and intellectual property will reduce RGDP.

In numerical terms, this suggests that the model has the power to explain about 81 percent impact cause on economic growth products by the joint changes or variations that occur in intangible assets in both current time and one time period in the past within the period of the study. The remaining 19 percent is attributed to other factors that have the potency to cause impacts on economic growth but were not considered in the model.

In Table 4, the results of the second equation, which is natural log of government expenditure on research and development (LNRADV) the test reveal that F-value has the value of 3.927657, and t-value of -3.657396 (absolute value: 3.657396), with critical values of 2.86 and 4.01 for "I(0)" Bounds and "I(1)" Bounds respectively at 5% level of significance. This result reveals that the value of F-value (3.927657) is greater than the value of "I(0)" Bounds (2.86), but less than the value of "I(1)" Bounds (4.01), as such we reject the null hypothesis. Inspired by this result, it is inferred that government expenditure on research and development (R&D) has long run significant causal impact on economic growth in Nigeria from 1990 to 2019. The results of the test reveal that in the natural log of intellectual capital (LNINTC) equation or model, the F-value is 204.5669, and t-value of 8.119700, with critical values of 2.86 and 4.01 for "I(0)" Bounds and "I(1)" Bounds respectively at 5% level of significance. This result reveals that the value of F-value (204.5669) is greater than both values of "I(0)" Bounds (2.86) and "I(1)" Bounds (4.01), as such we reject the null hypothesis. This is confirmed and corroborated by the absolute value of t-stat (8.119700) which again is greater than both values of "I(0)" Bounds (2.86) and "I(1)" Bounds (4.01) testes at 5 percent level of significant. Therefore, there is level relationship or long-run relationship between intellectual capital and real gross domestic product in Nigeria for the period under review.

The results of the test reveal that in the natural log of charges on intellectual property (LNINPR) equation or model, the F-value has the value of 0.963163, t-value has the value of -2.016336, and critical values of 2.86 and 4.01 for "I(0)" Bounds and "I(1)" Bounds respectively at 5% level of significance. This result reveals that the value of F-value (0.963163) is less than both values of "I(0)" Bounds (2.86) and "I(1)" Bounds (4.01), as such we retain the null hypothesis. Therefore, INPR has no long run significant causal impact on real gross domestic product in Nigeria within the period of study. The results of the test reveal that in the natural log of service sector employment (LNSVSE) equation or model, the F-value has the value of 349.4361, t-value has the value of -39.88537, and critical values of 2.86 and 4.01 for "I(0)" Bounds and "I(1)" Bounds respectively at 5% level of significance. This result reveals that the value of F-value (349.4361) is greater than both values of "I(0)" Bounds (2.86) and "I(1)" Bounds (4.01), as such we cannot but reject the null hypothesis. Being confident about this result, it becomes intuitive to conclude that service sector employment (SVSE) has long run significant causal impact on economic growth in Nigeria within the period of study.

Arising from a table that reported the result of lag length structure selection criteria for cointegrated bounds test equations of LNRADV and LNINPR which was selected at 4, but cannot be presented due to space, the result of the estimated ARDL-ECM(-1) test for long run bounds test for cointegrated equations - LNRADV, and LNINPR is reported in Table 5. Selection of 4 as the lag length suggests the length of time it would take between economic actions of causal impact of government expenditure on research and development on economic growth and its outcome or consequence in Nigeria. The lag length defines the time it would take government expenditure on research and development to cause an impact on economic growth by smoothening out the economic cycle and respond appropriately to issues that would retard growth in the economy in relation to research and development, if properly implemented.

From the table, LNRADV equation has the coefficient values as 2.280755, value of standard deviation as 2.391252, the value of t-stat was reported as 0.953791, the probability value was

0.3942, the value for the R^2 was reported as 0.923063, while adjusted R^2 was reported as 0.538319. The result, the coefficient of the ECM (2.280755) indicates what would be the correction of the previous errors in the subsequent periods. The positive sign of the coefficient of ECM means that an increase in government expenditure on research and development would lead to economic growth in Nigeria. The coefficient value goes further to suggest that it would take about 228 percent speed of adjustment to correct the errors to short run of the model. The probability value of 0.3942 is greater than the 5 percent level of significance – revealing that the causal impact is not statistically significant. This supports why it would take such a long time period and speed of adjustment to correct the errors and return normalcy in the short run of the model. The value of R square still supports the fact (as found in the ARDL short run estimated equations) that the model has a high power of determination of changes that occur in economic growth as a result of changes that happen in government expenditure on research and development.

From the table, LNINPR equation has the coefficient values as 384807.7, value of standard deviation as 1144695, the value of t-stat was reported as 0.336166, the probability value was 0.7536, the value for the R^2 was reported as 0.705008, while adjusted R^2 was reported as -0.769954. The coefficient of the ECM (384807.7) indicates what would be the correction of the previous errors in the subsequent periods. The positive sign of the coefficient of ECM means that an increase in charges on intellectual properties (such as charges on patents, copyrights, trademarks, etc) would lead to economic growth in Nigeria within the time of the study. The coefficient value goes further to suggest that it would take about 384807.70 percent speed of adjustment to correct the errors from the long run to the short run of the model. The probability value of 0.7536 is greater than the 5 percent level of significance – revealing that the causal impact of charges on intellectual properties on real gross domestic products is not statistically significant. This supports why it would take such a long time period and speed of adjustment to correct the previous errors in the subsequent periods; and return normalcy in the short run of the model. The value of R square still supports the fact (as found in the ARDL short run estimated equations) that the model indicates that the model has about 71 percent power of determining changes that occur in real gross domestic products as a result of changes that happen in the charges on patents, copyrights, trademarks, etc).

The result of the study reveals that government expenditure on research and development (RADV) made causal impact on economic growth (RGDP) in Nigeria. There is level relationship or long-run relationship between government expenditure on research and development (RADV) and real gross domestic products (RGDP). This indicates that in the long run, increase in government expenditure on research and development has the potency of improving the growth in the production of goods and services in Nigeria. This goes to amplify the assertion of Romer that technological change is the outcome of the deliberate activities of people, such as in research and development. Table 5 reports that real gross domestic product (RGDP) does not have an effect from intellectual capital (INTC) or human capital stock. Intellectual capital, otherwise human capital stock, has made no causal impact on real gross domestic product in the Nigerian economy within the study time space. Also, the result in Table 6 reveals that there is level relationship or long-run relationship between intellectual capital (INTC) and real gross domestic product in Nigeria (RGDP).

The results of the study reveal that real gross domestic product (RGDP) does not have an effect from charges on intellectual properties such as patents, copyrights, trademarks etc, (INPR). This implies that charges on intellectual properties - patents, copyrights, trademarks, have made no causal impact on real gross domestic product in the Nigerian economy within the study time space. On the account of the test of the tenability of the null hypothesis it was revealed that there is no level relationship or no long-run relationship between charges on intellectual properties, in other words, income earned from patents, copyrights, trademarks (INPR) and real gross domestic product in Nigeria (RGDP). The finding under this revealed that RGDP does not derive an effect from service sector employment (SVSE). This means that service sector employment (SVSE) has made no causal impact on economic growth in the Nigerian economy within the study time space. On the ground of the null hypothesis, the result as presented in Table 6 revealed that there is level relationship or long-run relationship between service sector employment (SVSE) and economic growth in Nigeria (RGDP).

Table 4. Result of ARDL Bound Test for Long Run Equilibrium

Equations (Dependent Variables)	Statistical Values		Critical Value Bounds at 5%		Decision on Cointegration	Decision on Next Action
	F-values	t-values	I(0) Bound	I(1) Bound		
LNRGDP	0.519463	-0.984235	2.86	4.01	No, retain H_o	Estimate ARDL SROLS
LNRADV	3.927657	-3.657396	2.86	4.01	Yes, reject H_o	Estimate ECM
LNINTC	204.5669	8.119700	2.86	4.01	Yes, reject H_o	Estimate ECM
LNINPR	0.963163	-2.016336	2.86	4.01	No, retain H_o	Estimate ARDL SROLS
LNSVSE	349.4361	-39.88537	2.86	4.01	Yes, reject H_o	Estimate ARDL SROLS

Note: ARDL =Autoregressive Distributive Lag; SROLS = Short Run Ordinary Least Squares. Ho = Null Hypothesis. ECM = Error Correction Model
Source: Computed by the Authors, 2021

Table 5. Results of estimated ARDL-ECM(-1) test for long run bounds test for cointegrated equations – LNRADV and LNINPR

Equations (Dependent Variables)	ARDL-ECM (-1) Statistics Case 2: Restricted Constant and No Trend				R^2 (AdjustedR^2)	Lag Length Structure	Selection Criteria
	Co-efficient	Std-Error	t-Stats	Prob.			
LNRADV	2.280755	2.391252	0.953791	0.3942	0.923063 (0.538319)	4	LR, FPE, AIC, SC, HQ.
LNINPR	384807.7	1144695	0.336166	0.7536	0.705008 (-0.769954)	4	

Source: Computed by the Authors, 2021

Table 6. Result of Lag Length Structure Selection Criteria for Cointegrated Bounds Test Equations of LNRADV, and LNINPR

Equations (Dependent Variable)	Lag Length	LogL	Selection Criteria				
			LR	FPE	AIC	SC	HQ
LNRADV	4	-1045.541	38.35242*	4.28e+33*	88.50317*	93.58395*	89.96625*
LNINPR	4	-1045.541	38.35242*	4.28e+33*	88.50317*	93.58395*	89.96625*

** 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
Source: An Extract from VAR Lag Order Selection Criteria Output Computed by the Author with E-Views Version 10.0, 2020

5. CONCLUSION

Intangible assets through public and private scientific research and service sector employment have the capacity of improving the growth performance in Nigeria. This is because they are rightly signed and had a level relationship or long run equilibrium relationship with the real gross domestic product. Therefore, any increase in these variables will enhance economic growth performance in Nigeria. Whereas, intellectual capital (human capital stock); and intellectual property - charges on intellectual properties such as patents, copyrights, trademarks, etc, seems reducing economic growth performance in Nigeria. This is because they are not rightly signed. Although, intellectual capital had a level relationship or long run equilibrium relationship with the real gross domestic product, intellectual property did not. Therefore, any attempt to increase these variables will rather reduce economic growth performance in Nigeria.

Premised on the findings above, we recommend the following:

1. The government should continue to upgrade its spending on R&D by regular training and retraining of organizations and sponsorship of personnel to attend regular workshops. Our teachers in the primary and secondary schools should be constantly trained on best practices, sponsorship of research studies in higher institutions and educational programmes, locally and internationally, to boost performance through innovation and continuous review and improvement of productive processes that will eventually result in efficient service delivery and improved intellectual capital.
2. Special budgetary attention should be given to health and educations sectors, as proxies for R&D by increasing budgetary allocation to the two sectors and ensure proper implementation of programmes in these two sectors in order to increase returns.
3. Government and private sector should make special funding for research and development (R&D) to encourage innovations which are needed to facilitate Nigeria's sustained economic growth. This has become a clarion because spending on R&D was found to be contributory and significant to improved real GDP.
4. The government should expand the productive sector to absorb the teaming human capital stock in the country. The issue of graduate unemployment should be given proper and speedy attention. This would help intellectual capital and property to make more significant contribution to economic growth.
5. Government should step up enforcement of intellectual property right law, so as to encourage the creation of a wide variety of intellectual goods.
6. There should be increase in economic incentive to researchers and innovators as it will stimulate innovation and contribute to the technological progress in Nigeria.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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