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UNIVERSITY-INDUSTRY LINKAGES AND COMMERCIALIZATION OF RESEARCH FINDINGS: EVIDENCE FROM SOUTH-EAST NIGERIA, 2012-2021

Chinyeaka Justine Igbokwe-Ibeto and Felicia C. Anyanwu
Department of Public Administration, Nnamdi Azikiwe University, Awka
Department of Business Administration, Nnamdi Azikiwe University, Awka

Abstract: Synergies between tertiary institutions and industries plays a critical role in securing and leveraging resources for promoting innovation and technology transfer as well as ensuring that graduates have the required skills and knowledge to effectively contribute to national development. Within the framework of diffusion of information and new growth theories, this study examined the effect of linkages between university-industries linkage and commercialization of research findings in Nigeria with specific reference to South-East Nigeria 2012-2021. This study was guided by two research questions and hypotheses. The study adopted the survey research design. The study relied on primary and secondary data. The data collected were presented in frequency tables and simple percentage. Multiple Regression Analysis statistical tools were used with the aid of Statistical Package for the Social Sciences (SPSS) in testing the research hypotheses. Findings of the study show that, government policies had significant effect on the number of Intellectual Property Rights (IPRs) sold or bought; that funding mechanisms had significant effect on the number of research contracts awarded to the academic staff; that communication strategies had significant effect on the number of licensed inventions being marketed by universities in the system of innovation in South-East Nigeria. It therefore recommends that, government should strive to provide the enabling environment that paves way for effective university-industry linkages by way of aligning the nation's industrial policy with her education policy, that a sustainable research funding mechanism should be put in place while stakeholders in the university-industry linkages should embark on regular capacity-building on relevant skills, policy development, IPR management, marketing communications, and entrepreneurship among academic staff of universities in the South-East Nigeria.

Keywords: Governance, Partnerships, Innovations, Invention

Introduction

All over the world, synergies between tertiary institutions, industries and other players in the economy plays a critical role in securing and leveraging resources for promoting innovation and technology transfer as well as ensuring that graduates have the skills and knowledge required to effectively contribute to the national development (Munyoki, Kibera & Ogutu, 2017; Mouton, 2015). As a matter of fact, there has to be a very strong collaborative partnership between tertiary institutions, government and the industry which drives the economies of nations (Bogoro, 2015). In the industrialized countries, partnership between university and research institutes, on one hand, and industry and governments, on the other, is one of the most effective strategies for technology development and a useful tool for ensuring the effective and efficient application of science and technology to the resolution of societal problems. Such partnerships take many forms including the joint execution of research projects, the award of research contracts, the development of curriculum and the provision of continuing engineering education for practicing engineers and scientists.

However, in most African countries, partnership between universities and local industries is not a common phenomenon. Thus, the transformation of research results to products/technologies is usually left to the individual who, without the necessary institutional framework and experience, only allows the idea to collect dust in a little known journal. There are several reasons why the enabling institutional arrangements for such partnerships have not developed over the years. For example, a number of African countries in lack an enabling environment for reorienting and aligning universities and other tertiary institutions towards a more entrepreneurial role. Apart from perhaps, the Maghreb region and South Africa, most of sub-Saharan Africa lack high-tech industries and a true technology culture that arises from the constant pressure to update and deepen technology in order to survive in a competitive marketplace (Koehn, 2012).

Most Africa's industries are often small to medium-scale organisations producing for mainly for the local markets, while the relatively larger ones are subsidiaries of transnational companies which draw upon the in-house Research and Development (R&D) capabilities of their parent company. In Nigeria, the university system was initiated with the establishment of the first (University College Ibadan) university in 1948. The colonial government was essentially concerned with creating a pool of manpower required for the civil service. The immediate post-independence years witnessed the establishment of three (Ahmadu Bello University Zaria (ABU), University of Ife and University of Nigeria (UNN Nsukka) new universities one in each of the three regions that existed then. Since then till date, the number of educational and knowledge infrastructure has grown astronomically with 198 universities, over 152 polytechnics, over 85 colleges of education and over 300 research institutes and innovation agencies. It was generally recognized that the relatively few educated Nigerians lacked any knowledge of managerial and technical skills required for industrial production and development. The establishment of these institutions was thus part of the efforts to improve the local supply of skilled manpower (Adeoti, 2016a, Adeoti, 2014).

While universities in Nigeria increased in number and sizes, however, industrialization continues to be promoted under import substitution strategy. Increased in the number of tertiary institutions in the country has not resulted into significant increase in national industrial activities and economic prosperity due to little or no interaction among the actors, weak infrastructure and insignificant research fund appropriation, thereby limiting national economic, technological and industrial growth and development of the country.

The increasing role of knowledge in development suggests that universities, government and industry have to interact not only to create, but also to employ knowledge for development. While there are ample evidence of interaction between universities and industry in developed and newly industrializing countries, developing countries are replete with universities that function, for the most part, independent of industry; and industry that depends on foreign sources of knowledge to sustain production and possibly meet competitive challenges. According to experts, Nigeria currently stands at 66th position out of 73 countries in an assessment that ranked nations according to innovation capacity (Igbokwe-Ibeto, 2018). Indeed, R&D is expected to lead to home-grown industries. However, since 1964 till date, despite the huge endowment of the country such as abundant human and natural resources, the country remains a crippled giant in terms of socio-economic and political development (Igbokwe-Ibeto, 2019). Till date, the country does not have any globally branded product, multinational company, technical and managerial expertise, international intellectual property rights emanated from its indigenous knowledge and industrial efforts. This study therefore, seeks to examine the effect of university-industry linkages and commercialization of research findings with specific

reference to selected tertiary institutions in South-East Nigeria, 2012-2021

Research Questions

To investigate the effect of university-industry linkages and commercialization of research findings in some selected tertiary institutions in South-East Nigeria, 2012-2021, in this study, efforts will be made to beam our search light on the following three research questions which will serve as a guide to the survey in the quest for answers to the problem being investigated.

1. Could government policies on university-industry linkages have any effect on the number of licensed inventions being sold or bought in the system of innovation in South-East, Nigeria?
2. Does funding mechanisms for university-industry linkages have any effect on the number of research contracts awarded to academic staff in South-East, Nigeria?
3. Could communications strategies with outside world have any effect on the number of licensed inventions being marketed or sold by universities in South East, Nigeria?

Research Hypotheses

To determine the effect of university-industry linkages on commercialization of research findings in some selected tertiary institutions in South-East Nigeria, 2012-2021, the following three research hypotheses will be tested for the purpose of this research.

1. Government policies on university-industry linkages has no significant effect on the number of licensed inventions being sold or bought in the system of innovation in South-East, Nigeria 2012-2021.
2. Funding mechanisms for university industry linkages has no significant effect on the number of research contracts awarded to academic staff in South-East, Nigeria 2012-2021.
3. Communications strategies with the outside world by universities has no significant effect on the number of licensed inventions being marketed or sold by universities in South–East, Nigeria 2012-2021.

Conceptual and Theoretical Epistemology

It is customary especially in social and management sciences research to begin an academic interrogation by combing the conceptual and theoretical contours of the subject matter of investigation (Igbokwe-Ibeto, 2019). It is within this context we engage in this endeavor. According Asobie in (Igbokwe-Ibeto, Chukwuemeka & Okechukwu, 2014), a university can be defined as a self-governing community with an elected hierarchy, separated from the world of commerce, involved in a mission to learn and to teach at an advanced level, using mysterious ritual and dress to dramatize its uniqueness, and requiring from its members, deep loyalty and enduring support for each other and the university. Research findings according to Bentley (2018), refers to the outcome in the form of special knowledge that results from a research efforts, be it, basic research, applied research or development researcher carried out by higher institutions of learning, research institutes, or industrial firms. In the linear model of innovation, public research especially in the universities generates basic knowledge, which leads to inventions and inventions when commercialized, become innovations (Adeoti, 2016b). To Romer (2006), innovation can be defined as the application of basic knowledge acquired through science and technology research and investment to achieve physical production of goods and services.

However, it is imperative to note that knowledge might be acquired through learning, research or experience. But until this knowledge is applied in physical production of goods and services and translated to development, it cannot be considered to be innovation. From this simplistic view of the innovation process, the research activities in the universities and public research institutes are isolated from industry, meaning that research and development activities that contribute to the real technological change required for economic progress are located outside the ivory towers. However, several studies have proven that economies that are innovation-driven are characterized by evident strong university-

industry collaborations. Research is a means of demonstrating one's ability and capability in solving an identified problem and it is an important pointer to the national technological capability (Jones, Bailey & Lyytikainen, 2017). One of the major roles of research is in breeding industrialization which brings about jobs and wealth creation, arrests social menace, assists in curbing rural-urban migration and poverty reduction.

Research as an endavour comes in three forms: basic (theoretic or experimental) research, applied research, and development research. Basic research as identified by Frascat-Manual (2018), Yusuf, Saint and Nabeshima (2018) refers to experimental or theoretic work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts without any particular application in use. The main aim of this research is to gain deeper knowledge or understanding of the subject without specific application in mind. Basic research does not have specific immediate commercial objectives, although it may be performed in fields of present or potential commercial interest. The outcomes or results are not generally sold but are usually published in scientific journals or circulated to interested groups. Applied research, on the other hand, are undertaken as original investigation to acquire the knowledge. According to Siyanbola (2018), it is primarily directed towards a specific practical aim or objective to gain knowledge in meeting a specific and recognised need. In industry, applied research are undertaken to discover new scientific knowledge that has commercial objectives with respect to products, processes or services. This type of research gives operational forms to ideas and the knowledge or information obtained from it is often patented, but may also be kept from the public. The third type of research, the development research is the systematic use of the knowledge derived from research directed towards production of useful materials, devices, systems or methods including the design and development of prototypes and processes. This type of research is systematic in nature, inferring from knowledge gained through research and practical experience which is directed to producing new products, devices as well as installing new ones and improving the existing ones. The outcomes are intended primarily to produce particular products that will be able to meet customers' expectations in the market or a product that will enhance productivity. For example, in the US, the universities and colleges performed approximately 53.8percent basic research and the federal government estimated to have provided 58.90percent basic research funding most of the time. Industry, on its own part, accounts for 65.7percent of all applied research, while federal laboratories and universities accounted for the rest.

In social and management sciences research, no one theoretical window can adequately explain a social phenomenon. Nonetheless, this study needs a platform on which to anchor its subject of analysis (Igbokwe-Ibeto, Agbodike & Osakede, 2018). This is study is anchored the diffusion of information (DOI) theory. The DOI theory seeks to explain how, why, and at what rate new ideas and technology spread through cultures. This theory was developed by two rural sociologist Gabriel and Rogers (1962), who popularized the theory. They claim diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system.

Rogers explained the process of innovation diffusion as one which is dictated by uncertainty reduction behavior amongst potential adopters during the introduction of technological innovations. Innovation Diffusion Theory (IDT) consists of six major components: innovation, characteristics, individual user characteristics, adopter distribution over time, diffusion networks, innovativeness and adopter categories, and the individual adoption process. Arguably, the most popular of the six components of IDT centers on the characteristics of the innovation itself. After analyzing a variety of previous innovation diffusion studies, Rogers singled out the five

characteristics of innovations that consistently influence the adoption of new technologies.

The Interface between University-Industry, and Government Linkages

The University system interacts with the industrial system in strategic sectors that present opportunity for competitive advantage. If Nigerian universities are to contribute more actively to innovation, there is a need to support closer interactions among governments, universities, the industry, and other relevant actors. The various national policy frameworks are not in themselves sufficient, but provide a start as well as incentives and helps clarify the role of each stakeholder in advancing innovation. How can university-industry government collaboration serve as impetus for the creation of developmental universities? This is what this section seeks to address.

Institutional reform is a major component of current economic reform. Reforming the university system has been in focus and a subject of intense debate (NUC, 2016). First, it is important to point out that Nigeria's education and industrial policies are isolated from each other. For example, the Nigerian industrial policy addressed critical issues of competitiveness, policy, finance, technology advancement, incentives to industries, research and development without any significant relationship with the role of the educational system in providing the ingredients required for these elements to achieve the objectives of economic growth and development. The education policy concentrates on development of formal education to achieve the objectives of Education for All (EFA) without thorough analysis of what is required to make the educational and training system fulfill the role of generating knowledge for development in an innovation system framework. The starting point for creating developmental universities in Nigeria, therefore, requires a close integration of the education and industrial policies. To achieve this, either the education or the industrial policy could be the entry point. For the purpose of our discourse in this paper, we have chosen the industrial policy because it has more clearly defined specific objectives.

The aim of the Nigerian industrial policy is to place Nigeria among the ranks of industrially developed countries, while the specific objectives include: to encourage the private sector to play a pivotal role in the industrial development of the country; to increase industrial output and linkages for both domestic and export market; to increase value addition by creating a few niches of competitive advantage; to increase capacities for entrepreneurship and technical skills in order to create more direct and indirect employment opportunities; to increase competitiveness of made-in-Nigeria products; to facilitate inflow of foreign capital and technologies; and to encourage geographical dispersal of industries (FMI, 2013).

One important option for university-industry collaboration is the location of specialized universities in an industrial park or near an industrial cluster where businesses related to the specialization are thriving. This would be akin to establishing a university of computer and information technology in Ikeja, where there is an important ICT (computer village) cluster or the citing of the mechanical and automobile engineering department of a state of federal university of technology in Aba or Nnewi, which is known for a thriving industrial cluster, specialized in the manufacture of automobile spare parts, shoes, cloths or coal camp in Enugu known for fabrication of all auto spare parts.

University-industry and government collaboration could also stimulate the integration of financing mechanisms for research and development within the education and industrial system. R&D for most companies in Nigeria is known to be done by multinationals whose R&D centers are located outside Nigeria (Adeoti, 2016b). Local R&D is generally limited to adaptation and imitative types. Though, this may not immediately lead to attaining international competitiveness, if encouraged with the right mix of incentives, it has the potential of improving the chance of Nigerian firms becoming real innovators.

University research themes or projects should be identified in collaboration with industry and there should be active participation of government as major financier of such collaboration, while industry is committed to employing the useful outcomes of the R&D. This model would be particularly relevant to small and medium-sized enterprises, which have limited capacity for engaging in R&D.

Placing Nigeria among the largest economies as conceived in Vision 20-2020 will require a speeding up of the pace of Nigeria's industrialization. A close relationship between the universities and industrial firms is a necessary strategic input. If Nigeria would be among the most industrialized, then she has to learn to innovate and have some sectors of the economy employing technology at the frontier. The basic requirement of the universities would be to train scientists, engineers and other related skills with active involvement of firms that would later employ them. Involving firms in university training activities could be directly by the participation of factory scientists and engineers as resource persons for teaching specialized course modules, and by industrial training of students in firms operating in the field of the prospective career of the student. Indirect engagement could involve joint development of the relevant course contents or curricula by universities and firms, and periodic review of the course contents to suit industry or practitioners' demands.

Also, linking Nigerians in the diaspora through university industry-government network would be very useful. Juma (2017) presents some examples from which Nigeria could learn. He reported that significant experiments are under way around the world to make effective use of the diaspora. The Swiss government recently converted part of its consulate in Cambridge (Massachusetts, USA) into a focal point for interactions between Swiss experts in the USA and their counterparts at home. The Swiss House was created in recognition of the importance of the area as the world's leading knowledge center, especially in the life sciences. In addition to Harvard University and Massachusetts Institute of Technology (MIT), the Boston area is home to more than 50 other colleges and universities and a cluster of biotechnology activities.

To harness the potential of University research and education to industry, universities also need to be supported and funded in such a way as to allow them to build the administrative capacity for industry and community engagements. Therefore, well-trained, knowledgeable staff in areas ranging from industry liaison, community outreach, and technology transfer is important enablers and facilitators of industry connections. Academic staff cannot be expected to fulfill these roles in an effective way, without distracting them from core academic functions.

There is no shortcut to promoting strong university industry-government linkages without strengthening the academic and managerial capacity of universities. Nigerian universities need a larger base of continuing, long-range academic research programs in areas that interface with national, regional, and local economic and social contexts. University research cannot be expected to deliver prompt solutions to immediate problems. Rather, it is through sustained research and education efforts that expertise is built in disciplinary and interdisciplinary fields. Such expertise, if aligned with the knowledge needs and demands of national and local industry, can have a meaningful impact in economic activity. For effective collaboration to take place, careful implementation of policy instruments aimed at stimulating university industry-government linkages is essential. For the universities, there are several actions that could be taken to improve the development of partnerships with industry. For instance, universities have to better define and frame their potential contribution to national economic development for internal and external audiences; each other should be in promoting innovation and supporting regional economies.

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If the university is to make impact in the industry, some university research programs in relevant disciplines (e.g. agriculture, engineering, materials science, computer science) need to be oriented towards issues that impact local economies and industries. For that to happen, greater interaction with external stakeholders might be facilitated through events, associations, and networking initiatives. Yet, within universities, stimulating interactions across teams of researchers with complementary expertise should be encouraged, regardless of their disciplinary or departmental affiliations innovation in industry does not happen within disciplinary silos (Kross, Adeoti & Nabudere, 2012). Multidisciplinary teams of experts are better positioned to address complex problem by bringing together theories, knowledge, skills and methods from various fields and applying them to generate solutions. Interdisciplinary research programs that include industry partners should be encouraged in universities. Those programs might be housed in dedicated research centers, including business representatives in their Advisory Boards.

Industries should also work with their tertiary institutions counterparts to improve their research and training capacity. This can be done in multiple ways. For example, businesses may provide internship positions for students, and make their staff available for guest lectures, bringing their expertise to universities. More sustained forms of engagement can also be pursued. Individual firms, or even business associations, may work together with higher education to establish educational standards to inform the curriculum and educational experience of students in relevant fields. Such initiatives might contribute to addressing the perceived irrelevance of University education to the business sector. Finally, industry can also be a supportive partner in the creation, support, and staffing of research laboratories through gifts, donations, and research funding.

To achieve all the above lofty strategies, transformative, visionary and missionary leadership in the p = tertiary education sector is key. University management and administrators need to make university-industry partnerships a priority within their institutions. The goals and benefits of university-industry and government linkages need to be clearly communicated to researchers, as well as the principles guiding them for mutual benefit. Also, longer-term partnerships need management encouragement and support. Thus, academics need an enabling environment and a favorable reward structure for engaging with industry in a constructive manner.

Methodology

This study adopted survey research in which pre-tested and well validated questionnaire was used to collect data from respondents from the selected staff of selected five (5) universities and industries namely: Nnamdi Azikiwe University, Awka, Federal University of Technology Owerri, University of Nigeria Nuskka, Michael Okpara University of Agriculture Umudike, Innoson Industries Ltd Enugu, Nigeria Breweries Plc Enugu, International Breweries Onitsha, and Anambra Motor Manufacturing Company Limited (ANAMMCO) under investigation. In addition, secondary data were also collected from published and unpublished official documents obtained from these institutions and manufacturing industries. The population of the sample units was 4,361. From this population, a sample of 353 was drawn using Cochran's finite population correction technique. This special formula is given by:

$$n = \frac{n_o}{1+\frac{n_o - 1}{N}}$$

Where,

n = adjusted sample size

n_0 = correction factor $n_0 = \left[\frac{z^2 pq}{e^2}\right]$

N = Population size for the study

To determine the sample size for this study, we assume the following:

z = 1.96 (i.e 95% confidence level)

Estimated proportion of an attribute that is present in the population (estimated at 50% or 0.5)

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I-p (the proportion of an attribute that is not present in the population (100% - 50% or 0.5)

e = desired level of precision (estimated at 5% or 0.05).

To obtain n_o (finite population correction factor), we substitute in $\frac{Z^2pq}{e^2}$ as follows:

$n_o = \frac{1.96 \times 1.96 \times 0.5 \times 0.5}{0.05 \times 0.05}$

$= \frac{0.9604}{0.0025}$

$= 384.16 = 384$

Therefore, n_o (finite population correction factor) is 384.

N is already given as 4,281 above.

Substituting in the formula $n_o = \frac{n_o}{1+\frac{n_o - 1}{N}}$

above, we obtain:

$= \frac{384}{1+\frac{384 - 1}{4,281}} = \frac{384}{1.089465}$

$= 352.4666 = 353$ (rounded up).

Therefore, the sample size for the study was 353.

Having determined the sample size, the researcher proceeded by sharing the obtained data among the various units and departments in the selected organisations in South-East Nigeria. Based on this, the Rangan Kamaisan proportional allocation or distribution method was adopted to allocate the questionnaire to the units. This was to ensure that none of the units in the organization under survey is cheated. The formula is given thus:

$$ns = \frac{Np \times n}{n}$$

ns = Sample size allocated to each unit
Np = Population size of each unit
n = Total sample size
N = Total population size

Therefore, the sample allocation to the unit and departments are determined as follows:

1. Nnamdi Azikiwe University, Awka $\frac{445^X353}{4361} = \underline{36}$

2. Federal University of Technology, Owerri $\frac{645^X353}{4361} = \underline{52}$

2. University of Nigeria, Nsukka $\frac{435^X353}{4361} = \underline{35}$

4. Michael Okpara University of Agriculture $\frac{440^X353}{4361} = \underline{36}$

5. Nigeria Breweries Plc $\frac{650^X353}{4361} = \underline{53}$

6. Innoson Industries $\frac{590^X 353}{4361} = \underline{48}$

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7. ANAMMCO $\frac{500 \times 353}{4361} = \underline{40}$

8. International Breweries $\frac{655 \times 353}{4361} = \underline{53}$

Total **353**

Having determined the sample allocation size of unit and department, the researcher proceeded to determine the staffs that will participate in the study among the various units and departments in the selected organisations in South-East, Nigeria. Based on this, **N** small cards with numbers 1-53 as the case may be, were prepared for the sampling and were put in a box. Then, **n** cards using purposive sampling technique which favoured only target respondents in the sample units who were adjudged to possess good knowledge of the business education, management and entrepreneurship were used to randomly picked and those that selected **1** to the actual number required for each unit and department automatically became part of the sample.

Results of the Cronbach's Alpha test showed a reliability index of 0.82. Descriptive statistics comprising frequency units, tables and percentages was used in analyzing the data, while the four hypotheses of the study were tested using Multiple Regression Analysis, all with the aid of SPSS software. The questionnaire comprised 19 close-ended items set on the 5-point Likert-scale scale.

Preliminary Analysis of Results

Results of the analysis showed that out of the 353 questionnaire distributed, 333 or 94:4perecnt were returned well completed, 13 or 3.9percent were not returned at all, while 7 or 2.0percent were returned but rejected owing to inappropriate completion. It was the responses borne by the 333 well completed questionnaires that were extracted and coded into data that were used for both the subsequent analysis and test. In this section, the results of the Multiple Regression Analysis based on the model earlier specified above by the study are presented below.

As earlier stated, the hypotheses of the study are tested using Multiple Regression Analysis. The test was carried out using the primary data generated from the field survey. As part of the test procedure, the said data were fed into the SPSS software according to each of the four hypotheses. The results of the test are displayed in tables 1,2 and 3 below.

Table 1: Model Summary

Model 1	**R**	**R Square**	**Adjusted R Squared**	**Std Error of Estimate**	**Durbin Watsun stat.**
1	0.547	0.229	0.601	0.91487	2.614732

(a) **Dependent variable:** number of licensed inventions bought or sold, number of research contracts awarded, and number of licensed inventions marketed or sold.

(b) **Predictors (constants):** government policies, funding mechanisms, communication strategies

Source: Field Survey, 2021

Table 2: ANOVA Model

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Source of difference	**Sum of squares**	**Df**	**Mean square**	**f,**	**Sig**
Between Groups	8.111	3	2.7923	10	.000
Within Groups	37.306	347	0.270		
Total	45.415	350			

(a) **Dependent variable:** number of licensed inventions bought or sold, number of research contracts awarded, and number of licensed inventions marketed or sold.

(b) **Predictors (constants):** government policies, funding mechanisms, communication strategies

Source: Field Survey, 2021

Table 3: Co-Efficient

	Unstandardized		**Standardized**	**T**	**Sig**
	Coefficients		**Coefficients**		
	B	**STD Error**	**Beta**		
Constant	1.659	0.242		6.85	0.000
Government Polices	0.83	0.07	0.097	1.189	0.002
Funding Mechanisms	0.22	0.065	0.279		0.001
Communication Strategies	0.314	0.071	0.307	1.51	0.019

(a) **Dependent variables:** number of licensed inventions bought or sold, number of research contracts awarded, and number of licensed inventions marketed or sold.

(b) **Predictors (constants):** government policies, funding mechanisms, communication strategies

Source: Field Survey, 2021

The results of the Multiple Regression Analysis as displayed in tables 1 and 2 are interpreted below. Table 1 shows that the Adjusted R Squared has the value of r^2 = 0.602 which indicates that when all the variables are combined, the multiple linear regression model could explain for approximately 60percent of the variation in commercialization of research findings in Enugu State. In table 2, it is shown that the calculated F-value is 10.0, which shows that the regression model is very significant and well specified at the probability of 0.000. Table 3 shows that the four independent (predictors) variables have the following beta and probability values: government policies (B = 0.097; p = 0.002); funding mechanisms (B = 0.279; p = 0.001); human resource development (B = 0.203; p = 0.012); communication strategies (B = 0.314; p = 0.019). From table 3, we can easily construct the prediction equation of the relationship or model as follows:

Commercialization of research findings = 1.659 + 0.097 (government policies) + 0.279 (funding mechanisms) + 0.203 (communication strategies).

When interpreted, the equation tells us that when government policies go up by 0.097 or 10percent, commercialization of research findings goes up by 1 and when funding mechanisms go up by 0.279 or 28percent, commercialization of research findings goes up by 1. The table also shows that when human resource development goes up 0.203 or 20percent, commercialization of research findings goes up by 1; and when communication strategies go up by 0.307 or 31percent, commercialization research findings goes up by 1.

Test of Hypotheses

The three hypotheses were tested by using the primary data generated from the field survey. The test of the hypotheses was based on the results of the Multiple Regression Analysis as contained in Table 3 above.

Hypothesis I

H_0: Government policies on university-industry linkages has no significant effect on the number of licensed inventions being sold or bought in the system of innovation in South-East, Nigeria 2012-2021.

H_1: Government policies on university-industry linkages has no significant effect on the number of licensed inventions being sold or bought in the system of innovation in South-East, Nigeria 2012-2021.

Table 3 shows that the beta value is 0.097, while the probability is 0.002, which is less than the critical probability of 0.05.This means that there is very low probability that the statement overall model was insignificant was true.

Decision

The probability of the model (0.002) is less than the critical probability of 0.05 and the model found to be significant with a calculated F-value of 10.0. Based on the decision rule for Regression Analysis, the null hypothesis is hereby rejected and the alternate hypothesis accepted. We therefore, conclude that government policies have significant effect on the number of licensed inventions being sold or bought in the system of innovation in South-East, Nigeria 2012-2021.

Hypothesis II

H_0: Funding mechanisms for university industry linkages has no significant effect on the number of research contracts awarded to academic staff in South-East, Nigeria 2012-2021.

H_1: Funding mechanisms for university industry linkages has a significant effect on the number of research contracts awarded to academic staff in South-East, Nigeria 2012-2021.

Table 3 also shows that the beta value of the model is 0.279 as it pertains to funding mechanisms has probability of 0.001, which is less than the critical probability of 0.05.

Decision

Since the probability of the regression model as it pertains to funding mechanisms is 0.001 which is less the 0.05 critical probability threshold and the model significant at a calculated F-Value of 10.0, we should reject the null hypothesis and accept its alternate one going by the decision rule of the study. We, therefore, conclude that funding mechanisms have significant effect on the number of research contracts awarded to academic staff in South-East, Nigeria 2012-2021.

Hypothesis III

H_0: Communications strategies with the outside world by universities has no significant effect on the number of licensed inventions being marketed or sold by universities in South–East, Nigeria 2012-2021.

H_0: Communications strategies with the outside world by universities has a significant effect on the number of licensed inventions being marketed or sold by universities in South–East, Nigeria 2012-2021.

Table 3 also shows that the beta value of the model with regard to communication strategies is 0.307, while its probability is 0.019, which is less than the critical probability of 0.05.

Decision

Since the probability of communication strategies is 0.019, which is less than 0.05, we should reject the null hypothesis and accept its alternate one. We, therefore, conclude that communication strategies have significant effect on the number of licensed inventions being marketed or sold by universities in South-East, Nigeria 2012-2021.

Implications of the Findings: This study holds far-reaching great implications for the development of science and technology, the national system of innovation (NSI), the industrial sector, the tertiary institutions and, above all, economic development in Nigeria. By and large, this study has somewhat opened the eyes of leaders to the challenge of envisioning a new horizon of development that would focus on the role of knowledge as the basis for economic transformation of Nigeria. Before now, it was economic resources that drive the economy; today, the study have indeed arrived a new horizon, whereby it has become clear that it is knowledge that drives the economy.

The results of this study also first and foremost implies that the academia have to come out from their present lethargic concern and properly and clearly define their place and potential contribution to national development. Also, emphasis should be on quality assurance in all their processes, namely, curriculum of academic programmes, instructional delivery and learning transactions, instructional materials, and assessment and evaluation so as to guarantee quality of output i.e graduates, research findings, teaching, and community service. Indeed, another implication of this study is that the academia more than ever before need transformative, visionary and missionary leadership capable of prioritizing university-industry linkages, directing research efforts to local need, and forgoing grater inter-disciplinary research collaboration among researchers from diverse academic fields or disciplines in solving current national or local challenges confronting the country.

Conclusion

The main thrust of the study is to examine the effect of university-industry linkages on commercialization of research findings with specific reference to some selected institutions in South-East Nigeria, 2012-2021. The research was guided by three research questions and hypotheses. From the research findings, there is no gainsaying the fact that university industry partnership is a very crucial logical strategy for building technological capacity and promoting economic development of the country. The partnership will bring together generators and developers of knowledge (universities and research institutions) and those, who utilize that knowledge for economic development (industry). Therefore, it is a useful mechanism for utilizing national scientific and technological capacity for development

In review of relevant empirical literature and the subsequent testing of the three stated hypotheses, the study came to the conclusion that government policies on university-industry linkages has a significant effect on the number of licensed inventions being sold or bought in the system of innovation in South-East, Nigeria 2012-2021. That funding mechanisms for university industry linkages has a significant effect on the number of research contracts awarded to academic staff in South-East, Nigeria 2012-2021, while communications strategies with the outside world by universities also has a significant effect on the number of licensed inventions being marketed or sold by universities in South–East, Nigeria 2012-2021.

Recommendations

Based on the findings, this study recommends that: the scientist needs to take measured steps to address the concerns and misgivings of industry and also take cognizance of the peculiarities of local industries. It is clear from the analysis presented that there are specific needs and expectations from industry which scientists should do well to recognize and address. The concerns of industry as far as the partnership is concerned will include the cost of the invention, the economic value and whether it fits into their overall programmes. There is

need to build institutional expertise in intellectual property management; to support institutions to develop or strengthen existing strategic plans and develop realistic, implementable action plans for meeting stated goals.

Secondly, industry and institutions have several hurdles to overcome in order to forge an effective partnership. These constraints are in general derived from the scarcity of financial resources, the absence of relevant human resources in local industries, negative attitude towards local ideas and the nature (size and ownership) of the industries. These factors affect the ability to finance the cooperation and implement projects, the ability to interpret scientific research results for further development, the ability to carry out risk assessment, the demand and the size of the market for local technologies and the industrial partners' ability to take decisions relating to the partnership.

Thirdly, the need for increased funding and support should be made available for strengthening the capacity of Nigerian higher educational institutions to develop partnerships and linkages with industry and the broader productive sectors cannot be overemphasised. Advocacy for funding should target multiple levels, including national governments, private sector entities, and local and international development partners, among others. There is also need for sustained capacity-building in relevant skills and policy development. This could be achieved through support training, entrepreneur-in-residence programs, exchanges, and other means to develop entrepreneurial skills among academic staff should be prioritized by universities.

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