EFFECT OF HIGHER EDUCATIONAL INSTITUTION (HEI)-INDUSTRY LINKAGES ON COMMERCIALIZATION OF EDUCATION IN NIGERIA: EVIDENCE FROM ENUGU STATE, SOUTH-EAST NIGERIA

Helen Nnedinso Ozioko
Department of Political Science Education,
Federal College of Education, Ehamufu,
Enugu State.

Abstract

This study examined the effect of linkages between higher educational institutions (HEIs) and industries on commercialization of education in Nigeria with evidence from Enugu State, South-East Nigeria. The objectives of this study were to examine the effect of government policies on the number of licensed inventions sold or bought; to find out the effect of funding mechanisms on the number of research contracts awarded to academic staff; to investigate the effect of human resource development on the number of scientific conferences or training sponsored by government or industries; and to determine the number of licensed inventions being marketed by HEIs in Enugu State. The methodology adopted by this study was descriptive survey research in which well validated questionnaire that comprised 19 close-ended items that were set on the 5-point Likert-type scale was used to collect primary data from the five sample units. Results of the reliability test carried out on the said research instrument showed that it had a Cronbach's Alpha Index of 0.84. The said sample units included the HEI of Nigeria Nsukka (UNN), Enugu State HEI of Science & Technology (ESUT), Enugu, Institute of Management & Technology (IMT), Enugu, Enugu State Government (ENSG), and the Ama Plant of Nigerian Breweries Plc, Amaeke Ngwo. The population for the study was 4,361 out of which a sample of 353 respondents was drawn using Cochran's finite population correction technique. Target respondents for the survey were selected using purposive sampling technique, which allowed only the staff of the units sampled who possessed good knowledge of issues involved in HEI-Industry linkages the chance to participate in the survey carried out. Descriptive statistics comprising frequency counts, tables, and percentages was used to analyze the data that resulted from coding of the responses from responses, while Multiple Regression Analysis was used to test the hypotheses of the study. It was the findings of the study that government policies had significant effect on the number of license inventions sold or bought; that funding mechanisms had significant effect on the number of research contracts awarded to the academic staff; that human resource development had significant effect on the number of scientific conferences or training sponsored by the government or firms; and that communication strategies had significant effect on the number of licensed inventions being marketed by HEIs in the system of innovation in Enugu State. It was the recommendations of this study that government should strive to provide the enabling environment that paves way for effective HEI-Industry partnerships by way of formulation of sound policies or aligning of the nation's industrial policy with her education policy, strengthening of research governance and management and architecturing an effective sustainable national system of innovation (NSI). Finally, it was also the recommendations of this study that a sustainable funding mechanism that will target multiple levels, including government, private sector and productive sector be put in place; and that stakeholders in the HEI-Industry linkages should embark on regular capacity-building on relevant skills, policy development, IPR management, marketing communications, and entrepreneurship among academic staff of HEIs in Enugu State.

Keywords: higher educational institution (HEI), industry, linkages, partnerships, HEI, commercialization, research findings, invention, education, knowledge, private sector, government.

All over the world, HEIs are increasingly being positioned as strategic assets in innovation and economic competitiveness, and as problem-solvers for socio-economic issues affecting their countries. Synergies between higher educational institutions and industries (and other players in the productive sector) can play a critical role in securing and leveraging additional resources for higher education, promoting innovation and technology transfer, and ensuring that graduates have the skills and knowledge required to effectively contribute to the workforce (Barry, 2016; Mouton, 2014). As a matter of fact, there has to be a very strong collaborative partnership between Higher Educational Institutions, Government and the Industry, the "Triple Helix", the confluence which is a powerful one that drives the economies of nations (Bogoro, 2015:2).

In the developed or industrialized countries, partnership between HEIs 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 social problems. Such partnerships take many forms including the joint execution of research projects, the award of research contracts, the development of curricula and the provision of continuing engineering education for practicing engineers and scientists. Because of the awareness of the direct and indirect benefits associated with the partnerships, they occur readily with less external prodding. Furthermore, each of the partners has in place the policies and institutional arrangements to engage in such collaborative work and researchers with scientific ideas of economic value are assisted in forging links with industries/entrepreneurs and financial institutions (Bamiro, 2015).

However, in most African countries, partnership between local industries and universities is not very common. Hence, 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.

In Nigeria, the HEI system was initiated with the establishment of the first HEI 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 new universities one in each of the three regions that then existed. Since then till date, the number of educational and knowledge infrastructure has grown astronomically with over 125 universities,

over 100 polytechnics, over 98 colleges and over 300 research institutes and innovation agencies (Ogunwusi & Ibrahim, 2014). 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, 2016).

On one hand, universities in Nigeria increased in number (and some also increased in size) and on the other hand, industrialization was promoted under import substitution strategy. Both HEI development and industrialization progressed in the decades of 1960s and 1970s. Educational development and industrialization were both supported by the oil economy until the decline in the price of crude oil in the late 1970s. The deindustrialization that was glaring by mid 1980s and the crisis of decline in government support for the universities that began in late 1970s brought out the first set of indications that both the HEI system and the Import Substitution Industrialization (ISI) strategy were very weak and unable to sustain economic growth of the 1960s and early 1970s.

The increasing role of knowledge in development suggests that HEIs, 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 HEIs 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.

In this paper, we examined the effect tripartite linkages involving HEIs, industry, and government on commercialization of research findings towards increased economic growth and development in Nigeria. We obtained empirical evidence from selected HEIs, firms and government. These were represented by the Enugu State Government, HEI of Nigeria Nsukka (UNN), Enugu State HEI of Science & Technology (ESUT), and Institute of Management & Technology, and on the side of industry, the Ama Plant of the Nigerian Breweries Plc, 9th Mile Corner Ngwo, Innoson Industrial & Technical Co. Ltd, Enugu and Maldini Marbles Co. Ltd, Enugu.

Objectives of the Study

This study pursued the following specific objectives:

1. To find out the effect of government policies on HEI-Industry linkages on the number of licensed inventions being sold or bought in the system of innovation in Enugu State, Nigeria.

2. To investigate the effect of funding mechanisms on the number of research contracts awarded to academic staff in Enugu State, Nigeria.

3. To assess the effect of human resource development on the number of

scientific conference or training sponsored by government or industries in Enugu State, Nigeria.

4. To examine the effect of communications strategies on the number of licensed inventions being marketed or sold by HEIs in Enugu State, Nigeria.

Research Questions

1. What is the effect of government policies on HEI-Industry linkages on the number of licensed inventions being sold or bought in the system of innovation in Enugu State, Nigeria?
2. What is the effect of funding mechanisms on the number of research contracts awarded to academic staff in Enugu State, Nigeria?
3. What is the effect of human resource development on the number of scientific conference or training sponsored by government or industries in Enugu State, Nigeria?
4. What is the effect of communications strategies on the number of licensed inventions being marketed or sold by HEIs in Enugu State, Nigeria?

Research Hypotheses

i: Government policies on HEI–Industry linkages have no significant effect on the number of licensed inventions being sold or bought in the system of innovation in Enugu State, Nigeria.

ii: Funding mechanisms for HEI-industry linkages have no significant effect on the number of research contracts awarded to academic staff in Enugu State, Nigeria.

iii: Human resource development in key areas of HEI–Industry linkages has no significant effect on the number of scientific conferences or training sponsored by government or industries in Enugu State, Nigeria.

iv: Communications strategies with the outside world by HEIs have no significant effect on the number of licensed inventions being marketed or sold by HEIs in Enugu State, Nigeria.

Review of Related Literature

- **Commercialization of Education, Knowledge of Research Findings**

Commercialization of research results has become the· new catch-cry in most advanced economies as they embrace innovation as a key driver of economic policy. The transfer, exploitation and commercialization of public research results have become a critical area of science, technology and innovation. The knowledge and research generated by public research system is diffused through a variety of channels among which are the mobility of academic staff, scientific publications, conferences, contract research with industry and the licensing of HEI inventions. Effective commercialization of research results in any nation depends on rapid technological innovation, effective strategic management of knowledge and a clear focus in value-added goods, services and industries. According to Bently (2013), the world faces major issues such as climate change, limited natural resources and changing age demographics. Thus the need for transition

to a more sustainable economy is creating global market opportunities for entirely new solutions. Advancement in technology development has radically altered the economic system in the world. Nations and businesses that can achieve higher levels of performance in innovation will be well placed to be leaders of tom morrow. Thus, wealth is no longer being measured in terms of physical winch alone. It must be measured by the degree of access to, and timely use of knowledge and technology that leads to intensive value-added capabilities. Thus, commercialization of research findings is becoming an important aspect of economic development. However, while commercialization has led to substantial investments in public research in America, the perception in Europe is that the continent has failed to benefit from its substantial investments in public research. European governments have responded by introducing policies to promote commercialization such as introduction of HEI courses on entrepreneurship for future academics and a range of other programmes to encourage technology transfer by promoting formal contractual relationships between the business sector and public science (Appiah *et al.*, 2012). In India, the development and commercialization of new technologies have become very important in the research agenda. Even though India started development of its scientific infrastructure in a planned way immediately after independence, commercialization of technology attracted the attention of policy makers only in 1980 s. According to Kumar and Jain (2013), venture capital funds were established in the 1980's and a technology policy statement was also introduced in 1983 to provide risk-sharing funds as well as managerial expertise tor technology development and commercialization.

- **What do HEI-Industry Linkages Mean?**

HEI-industry linkages can take various forms and levels of partnerships from contract or sponsored research, to joint research, professional courses, consultancies to creating opportunities for student placements, staff exchange, and joint curriculum development. HEI-industry linkages are often conceived as a three-way interaction between universities, government, and firms as described in the *Triple Helix Theory* (Etzkowitz, 2008). Today universities are considered not only as centres of knowledge and learning, but as key institutions in national innovation systems (Nelson, 2006). In order to carry out their role within the innovation system, universities need to be well-linked to enterprises, other research institutes, and supported by government policies. The USA, for example, has enacted key legislation such as the 1980 Bayh-Dole Act to incentivize patenting, licensing, and technology transfer of HEI research. Through state intervention, Brazil has helped centre universities as technology incubators (Etzkowitz, 2008). At the HEI level, technology transfer departments, technology incubators, and science parks have been set up to encourage and manage entrepreneurial activities (Schiller, 2007).

- **Of What Importance are HEI-Industry Linkages to Africa and Nigeria**

African universities have often been criticized as ivory towers that churn out graduates and research that are irrelevant to the needs of employers and the social, economic, and technical challenges facing African economics. There is a growing perception that the knowledge and skills taught to students at African universities do not meet the requirements of industry and the wider economy. This mismatch, coupled with under-training in the critical skills of problem-solving, analytical thinking and communication is blamed, at least in is part, for the emerging high graduate unemployment and under-employment in many parts of Africa (Pauw, 2008). There is a need to bring together universities with productive sector representatives to update and upgrade curriculum to ensure students graduate with relevant skills for the workforce. In addition to the understanding that universities need to produce work-ready graduates with the requisite skills for the job market it is also increasingly recognized that universities should play a pivotal role m applying research and innovation to address socio-economic problems and promote innovation for economic growth by forging strategic partnerships with the productive sectors of the economy and national innovation systems.

In the broader literature, perceived benefits from HEI-industry collaboration include: providing new channels of alternative funding in an era of constrained funding; access to or acquisition of state-of-the art equipment; improved curriculum and training in technology-oriented programmes; enhanced employment prospects for students; supplemental income for academic staff; and clearer contribution of universities to the economy, among others (World Economic Forum, 2011: Martin, 2000). In the context of fiscal constraints, graduate unemployment, and the need for universities to demonstrate greater accountability to society and respond to national development imperatives, the topic of HEI-industry linkages is becoming increasingly prominent in the discourse on higher education in Africa in general and Nigeria in particular.

In terms of promoting entrepreneurialism and practical skills among staff and students, the majority of institutions report employing industry professionals as adjunct faculty staff, engaging guest speakers to provide business and entrepreneurial advice, and offer student attachments/co-op placements. Enhanced graduate employability as a result of improved curricula, skill development and internships, as well as, increased job satisfaction among academic staff were noted as positive externalities of promoting linkages with the productive sector. Many institutions, however, reportedly have no resources specifically dedicated to supporting entrepreneurial activities by staff. While industry professionals can bring value-added knowledge and hands-on experience to the classroom, it is also important to ensure

that such professionals are suitably qualified to teach at the HEI level.

New Strategies for Effective HEI-Industry Linkages in Nigeria

Like in most countries in sub-Saharan Africa, the reality in Nigeria is that the NSI is relatively weak (Muchie et al., 2016), and the developmental role of universities IS highly constrained. As the foregoing discourse suggests, the challenge of creating developmental universities in Nigeria is closely linked with the state of the NSI. The firm is at the centre of the NSI framework as the loci of innovative activities and the critical unit that determines the innovative outcomes of the interactions among agents in the NSL For universities to attain significant developmental roles, it, therefore, follows that their interactions with firms would be crucial. Firms in this respect should be viewed from its generic meaning of firm as a productive unit which can be a farm, manufacturing or commercial enterprise. Innovation is important for competitiveness in all types of enterprises. In dynamic economies, growth is powered by the NSI that functions to generate and employ innovation. The HEI system, as a sub-system of the NSI, plays fundamental roles especially as the principal agent for specialization. The HEI 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 policies framework are not in themselves sufficient, but provides a start as well as incentives and helps clarify the role of each stakeholder in advancing innovation.

In Nigeria, how can HEI-industry collaboration serve as impetus for the creation of developmental universities? Institutional reform is a major component of current economic reform. Reforming the HEI 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. The NSI approach that links various policy measures that are aimed at making innovations drive the economy is still relatively alien to Nigeria's policy process. 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 policy. 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.

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 HEI 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 HEIs and firms, and periodic review of the course contents to suit industry or practitioners' demands.

HEI-industry 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 are known to be done by multinationals whose R&D centres are located outside Nigeria (Adeoti, 2016b). Local R&D is generally limited to adaptation and imitative type. 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. HEI research themes or projects should be identified in collaboration with industry and there should be active participant 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.

Another enticing option for HEI-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 HEI of computer and information technology in Ikeja, where there is an important ICT cluster or the citing of the mechanical and automobile engineering department of a Federal University of Technology in Nnewi, which is known for a thriving industrial cluster, specialized in the manufacture of automobile spare parts.

There is no shortcut to promoting strong HEI-industry 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. HEI 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.

To harness the potential of HEI 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.

Fundamentally, 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.

Once universities can identify their place and potential contribution to national development, senior officials might engage with local industry from a clearer position on how to advance the HEI mission. The quality of HEI outputs (e.g. graduates, research findings, teaching) is a strong determinant in the success of HEI-industry linkages. Furthermore, better communication among universities and firms would be helpful. Universities have to be able to provide more evidence on the expertise and projects, which might increase industry awareness and interest to invest in partnerships.

Strong leadership is critical in higher education development. Senior administrators need to make industry-HEI partnerships a priority within their institutions. The goals and benefits of HEI-industry links need to be clearly communicated to researchers, as well as the principles guiding them for mutual benefit. Moreover, larger and longer-term partnerships need senior leadership encouragement and support. Academics need a favourable incentive and reward structure for engaging with industry in a constructive way.

If it is to have an impact in industry, some HEI 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.

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. 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.

Deciding to innovate locally is also a choice that industry needs to make. It might make better sense in the short term to resort to imported technologies or business solutions. In the long run, however, this preference has the cumulative effect of not creating endogenous capacity to innovate. Taking steps to create the competencies within firms and in partner institutions such as universities might seem costly, but the benefits of such investments need to be assessed within a long-term horizon that includes capacity building for sustained problem-solving and innovation.

As rightly observed by Juma (2016), there is growing recognition that Africa can only strengthen its economic performance through considerable investment and use of new knowledge. He stressed that a new economic vision for the region-expressed at the highest level of government-should focus on the role of knowledge as a basis for economic transformation: and doing so will entail placing policy emphasis on emerging opportunities such as renewing infrastructure building technical capabilities stimulating business development and increasing participation in the global economy. For these policy foci to yield desirable results the discourse in this paper emphasized that policies and strategies should aim at ensuring that the national system of innovation attains considerable strength that can foster a dynamic economy capable to sustainable growth. We have demonstrated that HEI-industry linkages are strategic in strengthening the national system of innovation and they are important catalysts for the creation of developmental universities in the countries of the South. For the illustrative example of Nigeria, we showed that the realization of the ambitious vision of Nigeria becoming one of the twenty largest economies by year 2020 would be greatly facilitated if HEI-industry collaboration is promoted through deliberate policy interventions aimed at creating developmental universities.

Methodology

This study adopted descriptive survey research in which pre-tested and well validated questionnaire was used to collect data from respondents who were selected from the selected staff of selected departments or units of the five (5) sample units, namely, ENSG, Ama plant of NBL, UNN, ESUT, and IMT, Enugu under investigation. 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.

The questionnaire comprised 19 close-ended items set on the 5-point

Likert-type scale. Results of the reliability test of the questionnaire showed it had Cronbach's Alpa index of 0.84. The respondents were selected using purposive sampling method, which allowed selection of only the senior management staff of the sample units who had good knowledge of issues concerning HEI-Industry linkages.

Descriptive statistics that consisted of frequency counts, tables and percentages was used to analyze the data collected. Inferential statistics known as Multiple Regression Analysis was used in testing the hypotheses of the study. Both the analysis and tests were done with the aid of SPSS software.

Results

Results of the analysis showed that out of the 353 questionnaire distributed, 333 (94:4%) were returned well completed, 13 (3.9%) were not returned at all, while 7 (2.0%) 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, number of scientific conferences or trainings sponsored, and number of licensed inventions marketed or sold.

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

Source: Field Survey, 2018; SPSS Output

Table 2: Anova Model

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, number of scientific conferences or trainings sponsored, and number of licensed inventions marketed or sold.

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

resource development, communication strategies

Source: Field Survey, 2018; SPSS Output

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
human resource development	-0128	0.05	0.203		0.002
communication strategies	0.314	0.071	0.307	1.51	0.019

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

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

Source: Field Survey, 2018; SPSS Output

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 60% 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 (human resource development + 0.307 (communication strategies).

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

Test of Hypotheses

The four 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.

Hypotheses No.1:

i: Government policies on HEI–Industry linkages have no significant effect on the number of licensed inventions being sold or bought in the system of innovation in Enugu State, Nigeria.

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 Enugu State, Nigeria.

Hypothesis No.2

ii: Funding mechanisms for HEI-industry linkages have no significant effect on the number of research contracts awarded to academic staff in Enugu State, Nigeria.

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 Enugu State, Nigeria.

Hypothesis No.3

iii: Human resource development in key areas of HEI-Industry linkages has no significant effect on the number of scientific conferences or training sponsored by government or industries in Enugu State, Nigeria.

Table 3 shows that the beta value of the model with regard to human resource development is 0.203, while its probability is 0.012 which is less than the critical probability of 0.05.

Decision

Given the fact that the probability of the model as it pertains to human resource development is 0.012, which is less than the critical probability of 0.05, we should

reject the null hypothesis and accept the alternate one. We have no other option, therefore, than to conclude that human recourse development has significant effect on the number of scientific conferences or training sponsored by government or industries in Enugu State, Nigeria.

Hypothesis No.4

iv: Communications strategies with the outside world by HEIs have no significant effect on the number of licensed inventions being marketed or sold by HEIs in Enugu State, Nigeria.

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 HEIs in Enugu State, Nigeria.

Conclusions and Recommendations

The literature demonstrates that strengthening HEI linkages with the productive sector in Africa, including Nigeria, is constrained by inter alia: low numbers of qualified faculty, including doctorate degree holders, brain drain, ageing faculty, and other issues associated with retention; low enrolment in maths, engineering, and other science-related disciplines against large enrolments in social sciences and humanities; inadequate research infrastructure at many universities and lack of access to up-to-date publications; funding constraints; and teaching rather than research-focused mandates. These constraints, however, should not be considered as a deterrent to strengthening working relationship with the productive sector, but should be taken into account in devising the best way forward.

There is no gainsaying the fact that HEI-industry partnership is a very crucial logical strategy for building technological capacity and promoting economic development of Nigeria. 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. Additionally, the partnership offers opportunities to all stakeholders. For the HEI and the scientist, it is an opportunity to generate income and strengthen their capacities. It also capacitates them to serve their communities and enhance their profile in society. Industry also benefits in many ways including access to scientific resources available in the universities and the improvements in their technologies and operating performance, which may rise from the partnership.

For this to ensue, however, certain factors are pertinent. First, 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. Others are increased funding, greater communication, and providing the enabling environment that supports HEI-Industry linkage on the part of government, the private sector and HEIs.

References

Appiah, N., Agyapong, A. and A. Asamoah (2012). Effects of commercialisation policy on the performance of CSIR-Forestry Reserach Institute of Ghana. *Ghana Journal of Forestry* 28(1): 51-63

Bamiro, O. A. (2014). The Nigerian HEI System and the Challenge of Building a World-class Science and Technology Institution. Convocation Lecture delivered at the Modibbo Adama HEI of Technology, Yola. August 14.

Bamiro, O. A. (2015). HEI-Industry Partnership in the Innovation Process: Cases from Nigeria and Ghana. *Proceedings of the Regional Conference on Innovation Systems and Innovation Clusters in Africa*, Dares- Salaam/Bagamowo, Tanzania. Feb 18-20, 2004 (pages 341-366)

Bently, N. (2013). Executive Summary. Innovation- the successful exploitation of ideas- is a key driver of economic growth for developed countries. Concept to Commercialization. 2011-2015. Technology Strategy Board.

Creso, M. Sa (2014). Perspective of Industry's Engagement with African Universities. *The Journal of Technology Transfer*, 27, 21-35.

DHESI A.S. and V. Chadha (2011). Factors Influencing Technology Transfer from R&D Institutions to Manufacturing: *Empirical Evidence from India in Science Technology & Development*, Vol (2), 225-237.

Frascati-Manual, A. (2012). Proposed Standard Practice for Surveys and Experimental Development. 6th Edition OECD. 30pp.

Geiger, R. & Sa, C. (2015). *Tapping the Riches of Science: Universities and the Promise of Economic Growth*. Cambridge: Harvard University Press.

Kirmar, V. and Jain, P.K. (2013). Commercialization of new technologies in India: An Empirical study of perceptions of technology Institutions, *Indian Institute of Technology*, India, pp 113-120

Laursen, K., Reichtein, T. &. Salter, A. (2011). Exploring the effect of geographical proximity and HEI quality on HEI-industry collaboration in the United Kingdom. *Regional Studies*, 45(4), 507-523.

Muchie, M., Gamrneltoft, and Lundvall, B. (eds.) (2016). Putting Africa First: The making of African innovation systems. Aalborg, Denmark: Aalborg University Press.

Nelson, R. R., David C. M., and Jan F. (2006). *The Oxford Handbook of Innovation.* Oxford: Oxford Handbooks Online, Oxford University Press. 27 October 2011 <http://dx.doi.org/10.I093/oxfordhb/9780 199286805 .00 1.000 I>

Pauw, K., Oosthuizen, M. and Van Der Westhuizen, C. (2008). Graduate Unemployment in the Face of Skills Shortages: A Labour Market Paradox. *South African Journal of Economics*, 76: 45-57

RAND Corporation (2011). Science and Technology Collaboration: Building Capacity in Developing Countries? RAND. Retrieved in September 2013 from http://www.rand.org/content/ dam/randypubs/rnonograp hJeports/200S /MR1357.0.pdf

Schiller, D. and Javier, R. D. (2007), HEI-industry linkages Potential and realization in developing countries: Thai experiences. *Tech Monitor*, Jan-Feb. 2007.

Siyanbola, W. O. (2016). Isn't there a better way? The case for a paradigm shift in R&D in Nigeria. Proceedings of the third Conference on Science and National Development. 17pp

The World Bank (2010). *Annual World Bank Conference on Development Economics.* The World Bank

The World Bank (2012). Africa's Pulse. The World Bank Retrieved in October 2013from http://siteresources.worldbanko rg/INTAFRICA/ResourcesAfri cas-Pulsebrochure_ VoI6.pdf

Welch, A. (2005). Challenge and change: The academic profession in uncertain times. *Higher Education Dynamics*, 7, 1-19.

World Economic Forum, the World Bank and the African Development Bank (2011), *The African Competitiveness Report 2011*. Geneva: World Economic Forum.