Building a Sustainable and Innovation-Driven Economy in Nigeria: Academic Entrepreneurship Perspective

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Transitioning from resource-dependent society to a more advanced economy requires the development of highly sophisticated knowledge society. Evidences from developed and newly industrializing economies have consistently shown that knowledge generation and exploitation is critical to technological and socio-economic progress of nations. Unfortunately, latecomer economies, particularly in Africa, have paid little or no attention to innovation resulting in high unemployment and pervasive poverty. For that reasons, these economies need to deliberately invest in knowledge production and commercialisation to stimulate innovation and employment. This puts higher education and research institutions (HERIs) at the forefront of creating knowledge-based and innovation-driven economies, as they have the potential not only to produce top quality human capital and expand the frontiers of knowledge but also to continuously replenishing the market with innovative products, processes and services to satisfy societal needs. However, turning the knowledge outputs to products, processes and services demands that deliberate initiatives and strategies be put in place in these institutions to foster research commercialisation through academic entrepreneurship. Therefore, this paper examined faculties’ perception of university context in fostering academic entrepreneurship. Primary data was collected from two hundred and twenty-nine (229) faculties in thirteen selected universities across South-Western Nigeria. The standardized academic entrepreneurship perception scale was adapted to obtain the data. Data collected were analysed using frequencies, component factor analysis and binary logistic regression. The results showed that faculties’ positive perception of university characteristics (OR=1.78, CI 95%, p < 0.05) and innovation support system (OR=1.93, CI 99%, p < 0.01) were positively related and significant to academic entrepreneurship. However, faculties’ perception of strategic resources (OR=0.811, CI 95%, p > 0.52) did not show significant relationship to academic entrepreneurship. Other key results included poor perception on the reward system for innovation, as greater emphasis was placed on publication, rather than...
research commercialisation. The paper concludes that university administrators and government should create and strengthen positive ambience for innovation in Nigerian university system. Also, there is urgent need to initiate institutional re-configuration, individual re-orientation and adopt the triple-helix approach in R&D management to support Nigerian innovation system.

**Keywords:** Academic entrepreneurship, SDGs, Innovations, triple-helix, Intellectual property, Nigeria, Africa

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**INTRODUCTION**

In today’s globalized economy characterized by stiff competition and constant changes, knowledge and innovation are twin drivers of sustainable development. Innovation thrives in knowledge domain and knowledge provides critical inputs to innovation. Therefore, knowledge is a dominant mover in the innovation space. The ability to acquire, deploy and diffuse new knowledge is crucial to local, regional and national competitiveness. The difference between developed and developing countries lies in their ability to create positive ambience for new knowledge production, utilization, and exploitation (Kim, 2013). For instance, developed countries were able to transition from agrarian societies to highly industrialized ones in the 19th century through knowledge production and commercialisation. They master the deployment of scientific and technological breakthroughs to solve practical development problems. Even in the current dispensation of knowledge economy, they still play a leading role in economic renewals through knowledge applications. Also, the newly industrializing economies of Asia achieved diverse developmental objectives through catching-up, stage-skipping and quantum-leaping innovation strategies. The strategies involve heavy investment in knowledge production and innovation facilities, building technology and innovation capability and creating positive ambience for technopreneuship to thrive. The results are obvious today as they have become choice destinations for foreign direct investment. Today, the culture of innovation in both developed and newly industrializing economies is growing more rapidly. Most innovative companies globally and companies with top global brands come from these nations (Brand Finance, 2018; BCG, 2018). In fact, most firms that appear on the globalfinancebrand ranking report in 2018 are essentially companies with huge investment in knowledge generation and exploitation (Brand Finance, 2018). Out of 500 companies that featured in the report, there is none from Africa. Some of the firms from emerging economies that featured among the top ten brands include Samsung (S. Korea) and ICSB (China) which ranked 4th and 10th respectively. On the most innovative companies in 2018, only Samsung and Alibaba made the first ten with 5th and 10th positions respectively. The dominant strategies which mark-out those firms include dedicated resources, speed of opportunity exploitation, smart risk taking potential, investment in data and ability to secure top talents. Historically, China and S. Korea have deliberately and consistently invested heavily in building virile culture of innovation through critical investment in human capital, science and technology (S&T), innovation infrastructure and superhighways.
The latecomer’ economies of Africa are faced with diverse developmental challenges ranging from infrastructural decay, huge unemployment, poverty, low technology capability, to incessant conflicts and political instability. One main solution to these challenges is the promotion of socio-economic prosperity of her citizens. For this to happen, the economy has to be diversified away from resource dependence to enhanced value-addition in the key sectors. This brings the issue of knowledge generation, exploitation and innovation to the forefront of policy debate. Since positive relationship exists between knowledge creation and innovation which also correlate with economic growth/development (Myteka, 2000; Global Innovation Index, 2012; 2017; 2018), the emphasis now is on stimulating the culture of innovation not only in the real sector of the economy but also in the knowledge institutions. For instance, little success was recorded across Africa on the attainment of Millennium Development Goals (MDGs) because of late recognition of the need to drive the goals with requisite scientific, technological and innovative capabilities (AAS, 2018). How can hunger be banished without the application of scientific and technological solutions in agriculture? Therefore, to attain the sustainable development goals (SDGs), latecomer economies should of necessity deploy scientific, technological and innovative solutions. This places knowledge institutions at the centre of strategic economic planning by stimulating innovation culture among faculties and students. The argument for stimulating innovation culture in knowledge institutions hinges on the knowledge spill-over theory of entrepreneurship and entrepreneurial universities as advanced by Etzkowitz, (1998) and Acs et al. (2013). The latter postulated that knowledge institutions possess capabilities to create talents and tangible research results capable of transforming the society or economy. This is evident in the fact that most cutting-edge technologies and innovations transforming economic landscape today are developed by eminent researchers (faculty and students) from research laboratories, private or public. The Silicon Valley in the USA known as the ‘innovation machine’ has its origin in knowledge commercialisation from the surrounding universities and research institutes. The Valley is now home to thousands of high-tech firms including google and facebook adding thousands of jobs to California every year with huge socio-economic benefits. This proves that latecomer’s economies could be improved, if deliberate efforts are made to promote innovation culture in their system, including knowledge institutions. Most jobs of the future depend entirely on the knowledge inputs from the research organisations. For instance nanotechnology, biotechnology, robotics and Artificial intelligence emerged from the application of high-tech which requires top-notch scientific knowledge. These technologies are deployed in the management of natural resources for optimal productivity and innovations. For the latecomer economies to catch-up with development frontiers, there is a need to understand and imbibe the culture of innovation. This implies heavy investment in training and education, developing accessible and modern information infrastructure, using intensive research & development (R&D) to boost innovation, and focusing on economic incentives and a favorable institutional regime conducive to knowledge-oriented investments (Asongu, 2015). This paper delves into the system thinking approach and examines how the perceptions of the faculties about the entrepreneurial context of their universities affect/influence their
entrepreneurship potential. The argument is that where the context provides sufficient support for the occurrence of a phenomenon, it is a matter of time for it to become widespread. For instance, the Bayh-Dole Act in the USA changed the perception of researchers, to a greater extent that USA witnessed huge patent upsurge (AUTM, 1998). In addition, the need to fulfill the ‘third mission’ objective has mandated universities and research organisations to be more responsive to societal challenges beyond teaching and research engagements. Today, universities take pride in not only the successes of their alumni, but also in the number of patent disclosures, filed, granted, licensed and the spin-off created. To that extent, some African institutions need to embrace this development to transform its society in this era of Artificial Intelligence (AI) driven global competitiveness. In additions, this paper addresses the literature gap on the perceptions of African faculties on the entrepreneurial ambience of their universities. The paper is divided into five sections: introduction, background literature, research methods, key results and discussion and policy recommendations.

BACKGROUND LITERATURE

Recent explosion of entrepreneurial activities and the prominent role of knowledge in the ‘new economy’ have prompted a shift in expectations about the role of universities in the economy, particularly towards research commercialisation and contribution to job and wealth creation for development (Todorovic, McNaughton and Guild, 2005). To fulfill this role more effectively, Mowery and Shane (2002) and Siyanbola (2012; 2014) argued that universities need to become entrepreneurial, requiring a change in their approach to governance and administration. In addition, knowledge institutions are pressured to foster economic development of the region where they are located (fulfil the ‘third mission’ objective) through internal re-organisation and diverse strategies. Some of these strategies are: establishment of technology incubators, parks or science parks to foster spin-off firms, technology licensing to existing firms and direct commercialisation of research and development (R&D) outputs among others. These strategies are important because for university to be entrepreneurial, different skill sets are required and faculty members need re-orientation to that effect. Therefore, approach to university administration requires substantial change towards technology transfer activities and faculty members need to embrace new approach for successful technology commercialisation (Mowery and Shane, 2002). This gave rise to incidence of academic entrepreneurship in the developed and newly-industrialising economies. Academic entrepreneurship is a process of transferring knowledge between the university and the external environment, in order to produce economic and social value, both for external actors and for members of the academia, and in which at least a member of academia maintains a primary role (Cantaragiu, 2012). This definition strikes three important aspect of academic entrepreneurship, first, knowledge transfer activities are embedded, second, at least a faculty member is involved and lastly, economic activities are created and benefits accrued from them. De Silva, Uyarra and Oakey (2012) defined academic entrepreneurship more specifically as a process of translating knowledge outputs into
commercial products/process. Rizzo (2010) identified academic spin-offs as new firms whose business is to translate knowledge developed within universities into commercialisable products.

These strategies have been adopted in advanced and some developing economies to foster technology commercialisation and some of the renowned universities in these categories are: Massachusetts Institute of Technology (MIT, USA), University of Cambridge (UK), Hebrew University (Israel) and Gothenburg University in Sweden, Nile University in Cairo among others. Also, Etzkowitz (2001) established three reasons for strong interest towards supporting policies aimed at enabling knowledge transfer to firms around virtually all western universities. These are transfer of new knowledge into the market, the pursuit of revenue for universities and the positive externalities on the local area. In addition, universities and other research organisations constitute a major source of human capital development, knowledge production through research and development and new technologies that are useful for industrial purposes. Universities produce the necessary human and technical skills required for the new economic order in a knowledge economy through specialised training and directed efforts. Knowledge institutions through robust science programme contributes to the key functions of: i) knowledge production – developing and providing new knowledge; ii) knowledge transmission – educating and developing human resources; and iii) knowledge transfer – disseminating knowledge and providing inputs to problem solving. The high industry expenditure on R&D in America, Europe and newly-industrialising economies is an indication of increasing role of knowledge in production. Similarly, increased emphasis on the creation of skilled workers is necessary for building technological capabilities for learning new skills and applying them as key to absorbing and using new technologies. Properly-trained researchers and technicians are essential for producing and applying both scientific and technological knowledge.

The science system, especially universities, is central to educating and training the research workforce for knowledge-based economy. On knowledge transfer, the university system must balance not only its roles of knowledge production (research) and knowledge transmission (education and training) but also the third function of transferring knowledge to economic and social actors, especially enterprises, whose role is to exploit such knowledge (Adeoti, Odekunle and Adeyinka, 2010). This creates opportunities for universities to showcase their relevance and to stimulate new research directions. They provide a means both for the efficient transfer of economically useful knowledge and for advanced training in skills required by industry. Adeoti et al. (2010) opined that linkages between the knowledge institutions and industry are critical to the generation and use of technological knowledge. They regarded the interaction as products of developmental orientation of research activities as research is aimed at addressing community problems and in many instances research grants are won in competitive bids.

It was also submitted that university would not only generate new knowledge that improves the stock of knowledge but also produce change agents that carry knowledge into society and motivate society to employ and build on knowledge from ivory towers (Juma, 2006; Etzkowitz and Zhou, 2008).
Louis et al. (1989) explored the entrepreneurial activity of university scientists in the life science fields. They found the following five types of academic entrepreneurship stemming from university research:

i. Engaging in large scale science through externally funded research projects;

ii. Consulting or knowledge transfer resulting in supplemental income;

iii. Gaining industry support for research;

iv. Generating intellectual property (IP); and

v. New venture creation.

They argued that these five types of entrepreneurial activity were not readily compatible with the traditional role of the university scientist, with venture creation being the least compatible. Samsom and Gurdon (1993) and Siegel et al. (2003) also found venture creation to be at odds with the core objective of the university scientists. Studies have pointed at challenges and disharmony for university scientists that deviate from a research path (Glassman et al., 2003; Mendes and Kehoe, 2009). However, visions of research universities transforming into entrepreneurial universities have added to the image that university scientists are also more or less voluntarily transforming into increasingly entrepreneurial roles (Etzkowitz, 2003). The “entrepreneurial university” expanding beyond a research university in terms of outreach, collaboration and creating utility, has placed academic entrepreneurship in a new context since the work of Louis et al. (1989), if not in practice, then at least in regard to policy and debate (Slaughter and Leslie, 1997; Deem, 2001; Nelson, 2004 and Kirby, 2006).

Also, universities, since the Humboldtian model at the beginning of 19th century, have had the double role of performing higher education and research activities. But, in the last decades of the 20th century, they have started to be regarded also as providers of knowledge useful for exploitation in practical terms (Rolfo and Finardi, 2014). The increasing interest for the relationship existing between knowledge production in universities, industrial innovation and economic growth has led to changes in the traditional structure of Higher Education Institutions, strongly establishing such relations in the framework commonly addressed as ‘third mission’ (Gulbrandsen and Slipersaeter, 2007) encompassing technology and knowledge transfer and other related activities. The role of the university in the entrepreneurial society is broader than just to generate technology transfer in the form of patents, licenses, and university-sanctioned start-ups. Rather, the mandate of the university in the entrepreneurial society is to contribute and provide leadership for creating entrepreneurial thinking, actions, institutions, and what Audretsch et al. (2006) refer to as entrepreneurship capital.

Entrepreneurial universities can significantly contribute to increase the competitiveness of national economies, by providing an effective channel for technology transfer and a quick
application of innovative discoveries in the society (O’Shea et al., 2005; Rasmussen and Gulbrandsen, 2006; Rasmussen, 2011). Lundqvist and Williams (2013) explored changes in the role of the university scientists towards academic entrepreneurship through venture creation and advised that specific ventures be developed and legitimized while upholding entrepreneurial environment and entrepreneurship educations that play key roles for early ventures. The entrepreneurial environments act beyond being transactional technology transfer offices (TTOs) or “gateways” for innovations through their ability to legitimize and connect with internal and external university resources, including students as key drivers. In relation to the cases considered in their study, they further suggested that government and university-level initiatives helped legitimize, enhance and integrate resources already in existence. This indicates that entrepreneurial capabilities at universities fostering venture creation primarily are to be initiated and supported from within universities. Audretsch (2014) noted that part of the response to creating the entrepreneurial university was the development of academic fields and areas of research that were not just focused on “knowledge for its own sake”, which is the gold standard of scholarly inquiry under the model of the Humboldt University, but rather oriented towards knowledge for the sake of solving specific and compelling problems and challenges confronting society. Thus, relevance and applicability emerged as the key guiding values in these new, external oriented fields and areas of research, such as biochemistry, informatics and bioengineering. The core of the university remains the basic disciplines, fields and academic traditions comprising the Humboldt University.

Additional strand of academic activity is added around that core with the primary focus on and mandate for providing solutions and applications to major problems confronting society or particular aspects of society. However, just having applied research, education and fields with a focus on meeting particular needs, interests and demands in society did not prove to generate sufficient knowledge spillovers from the universities for commercialisation, innovation and economic growth. Thus, a third ring around the core of basic research and education at universities was created which consists of mechanisms to facilitate the spillover of knowledge from the research core and applied programmes generating that knowledge to society where that knowledge would be commercialised or at least applied (Audretsch, 2014).

In order to facilitate university entrepreneurship and technology transfer from the university, in an effort to penetrate a formidable knowledge filter (i.e. knowledge transfer barriers), the US Congress enacted the Bayh-Dole Act in 1980. The Bayh-Dole Act was passed into law by the Congress with the goal of promoting the commercialisation of university science (Link and Siegel, 2005; Link et al., 2007; Kenney and Patton, 2009). Studies have generally shown a positive assessment of the impact of the Bayh-Dole Act in the United State of America (Aldridge and Audretsch, 2011). More impressionistic reactions about the efficacy of the Bayh-Dole Act have been highly enthusiastic, together with amendments in 1984 and augmentation in 1986, it unlocked all the inventions and discoveries that had been made in laboratories through the United States with the help of taxpayers’ money. This single policy measure helped to reverse
America’s precipitous slide into industrial irrelevance more than anything else. Before Bayh-Dole, the fruits of research supported by government agencies had gone strictly to the federal government and nobody could exploit such research without tedious negotiations with a federal agency concerned. Worse still, companies found it nearly impossible to acquire exclusive rights to a government owned patent without which no firm were willing to invest millions more of their own money to turn a basic research idea into a marketable product.

This generated unprecedented increase in filing and securing patents by the universities. In addition to other legal, economic and political developments that also spurred patenting and licensing, the results seems nothing less than a major boom to national economic growth (Mowery, 2005). As noted earlier by Lundqvist and Williams-Middleton (2013), one of the key mechanisms or instruments created by universities to facilitate the spillover of knowledge by commercialising research undertaken at the universities is the university technology transfer offices (TTOs) (Lockett et al., 2005; O’Shea et al., 2008; Phan et al., 2005; Siegel et al., 2007). Other mechanisms created at universities to facilitate the spillovers emanating from university research include science parks, incubators, and proof of concept centers. To facilitate knowledge spillovers from university research even further, many communities, cities, regions and states have created a series of institutions with the mandate to absorb knowledge created at the university and enable commercialisation by firms. For instance, Georgia Research Alliance in Atlanta, the Indiana Venture City in Indianapolis and CONNECT in San Diego were conduit to facilitate the spillover of knowledge from the source where it was created, the university, and the organisation which commercialises it to generate innovative activity (Audretsch, 2007). Audretsch (2014) concluded that the role of the entrepreneurial university is to create new businesses, ventures and commercialisation where it previously did not exist, or at least to increase the amount of technology transfer from the university to private and not-profit firms and organisations. This brings about the much expected ‘third mission’ objective of the universities.

On the ‘third mission’ of universities, the call for increased relevance of the universities is with the advent of the comprehensive mass education facilities of the late twentieth century. The more precise tasks and obligations of the university have become a concern for broader segments of society. The result of this development has been that universities are facing a multitude of new demands from a host of stakeholders. Universities are asked to take on a progressively important role in economic and social development. Governments task the universities with providing education for larger and larger shares of age cohorts as well as with developing and transferring state-of-the-art technology to industry. Industry increasingly looks beyond generic engineering education and require universities to deliver new and specialised education as well as research activities in support of their particular needs (Audretsch, 2014). The concept of the third mission encapsulates much of the rising demands on the university. In one sense it is a residual, encompassing all university activity not covered by the first two missions: teaching and research. This makes it a rather nebulous concept and rather vaguely defined in national policy documents,
and the interpretation of the mission varies considerably between countries as well as between universities in the same country.

However, the common rationale for the third mission is for the university to take on a more visible role in stimulating and guiding the utilisation of knowledge for social, cultural, and economic development (Brundenius, 2010). The foregoing has shown that the demand for universities’ participation in solving societal problems had broadened the scope of operation to include knowledge transfers. To fulfil this additional objective, institutional rearrangement and individual researcher’s re-orientation are necessary to engender the culture of innovation and entrepreneurship in the university settings. Even with thinner budgetary allocation to universities, showing relevance in terms of knowledge transfer to the industry will encourage industrial firms’ participation in providing additional funding for research. The policy-makers and governments at all levels need to provide incentive platform to encourage universities fulfill the newly found mission as demonstrated in Bayh-Dole Act.

SUMMARY OF THE REVIEW

Given the wide array of literature on the entrepreneurial universities, academic entrepreneurship and third mission objective of the universities as discussed in section 2.0, it is important to emphasis that the perception of the faculties on the readiness of their institutions to embrace entrepreneurial activities could determine their interest and propensity. In countries that have already embraced the concepts, the target would be on improving the process to increase technology commercialisation for industrial renewals. However, in the developing countries where research funding is limited and awareness about university fostering innovation is low, great effort is required to propagate the idea. In Nigeria, the idea has been around for decades now, at least universities and some research institutions have established intellectual property and technology transfer offices since 2007 but the efficiency of these offices in fostering innovations in the knowledge institutions is yet to be ascertained. In addition, how many faculties are aware of these offices and their roles, including the extent to which they are being patronized? The literature also pointed to other facilities and incentives that could stimulate innovations in the knowledge institutions such as incubators, science parks, IP policy, innovation fund and, or venture capital. Therefore, the impression of the faculties on the ability of the university to create conducive ambience for innovation could go a long way to determine motivation and interest.

RESEARCH METHODS

Given the homogenous nature of faculties and department in Nigerian university system and ability to generate tangible research results, the study focused essentially on the departments of science, technology and engineering. Adelowo (2018) detailed methods adopted in the selection of universities and appropriate representative sample. Primary data collected from two hundred and twenty-nine (229) faculties in thirteen universities were analysed using descriptive and
inferential statistics. The perceptions of the faculty on the entrepreneurial context of their universities were captured using an adapted research instrument developed by the Stevens Institute of Technology USA (Christodoulatos, Lechler and Furnbach, 2012). The entrepreneurial perception of the universities by the constituents; faculty and students, does have effects on whether they would be interested or likely engage in such activities. The questionnaire considered the general characteristics of the institution as to whether it is favourably disposed to academic entrepreneurship or not. The perceptions of the faculties on the supports and preconditions, process and strategy for academic entrepreneurship were evaluated using fifteen questionnaire items. Some of these items included 1. education and research activities at my university are aimed at the integration of technological and market knowledge into curriculum, 2. collaborative research with industry and other universities for the creation of intellectual property are supported in my universities, 3. technical inventions based on research results are often commercialised in my university (see Table 4.2 for details). These items were measured using five points likert-rating scale from strongly disagree to strongly agree (1 to 5). The fifteen items were later subjected to data reduction strategy using Principal Component Analysis (PCA) to summarize the entire items. The PCA produced three major factors, which were re-named based on item loading (Henson and Roberts, 2006; Williams, Brown and Onsman, 2010). In total, the PCA analysis showed statistically significant Barlett’s Test of Sphericity of (940.213, df = 105, p<0.000), and the Keiser-Meyer-Olkin index of 0.86 which was regarded as ‘meritorious’ (using the thresholds proposed by Kaiser, 1974). The analysis identified three factors with Eigenvalues greater than 1.0, and accounting for 54.1% of the variance. The ‘elbow’ in the screen plot and ‘principle of parsimony’ (Handfield and Melnyk, 1998) suggested retaining the three factors. The first factor dimension is dominant, accounting for 36.38% of the variance, while others accounted for 10.16% and 7.56%. In addition, these factors followed theoretical richness as they represented faculties’ perception of entrepreneurial richness of the universities’ contexts. Factor one had eight strong items loading and was named perception of faculties on the university’s innovation support system. These items were: technical inventions based on research results are often commercialised in my university, sufficient funds are available for AE initiative, sufficient rewards and compensations are offered for AE initiative, AE and IP seminar/workshop are offered for students and faculty at my university, my university provides sufficient resources for spin off companies, a support network of industry partners, investor and regulators helps my university’ faculty students in their AE activities, an incentive system motivates faculty and students at my university to participate in AE initiative and there are well established/structured technology transfer and commercialisation processes within my university. Factor two had four items loading and was tagged ‘perception on university entrepreneurial characteristics’. These items were: education activities at my university are aimed at the integration of technological and market knowledge into curriculum, research activities at my university are focused on scientific breakthroughs and technological advances to create economic values, and collaborative research with industry and other universities for the creation of intellectual property are supported in my universities. The third and last factor had
two items loading which were: *my university has dedicated resources to quickly exploit evolving innovation opportunities and effective administrative functions exist to improve AE processes.* This was named as perception on university’s entrepreneurial resources.

For the purpose of regression analysis, the three extracted factors were used as independent variables while we age and qualifications of the faculties served as control variables. The dependent variable for the study was whether the faculty had intellectual property or not. The item was captured using binary variable of 1 for ‘Yes’ and 0 for ‘No’, hence the choice of binary logistic regression. Moreover, faculties provided information on the entrepreneurial activities of their departments and universities, in addition to the traditional teaching and research endeavours. The results of the analysis are presented and discussed in the next section of this paper.

RESULTS AND DISCUSSIONS

The results of the study is presented in three parts; the first part presents and discusses background information of the faculty surveyed; the second parts gives clear discussion of the perceptions of the faculties on the entrepreneurial contexts of their universities and the empirical data reduction strategy results; and the third part discusses the results of the binary logistic regression analysis.

Background Information of the faculty members

Majority of the faculties surveyed are male gender (77.2%) while only few of them are females (see Figure 4.1). This presents prevailing circumstances across Nigerian universities. The human capacity assessment conducted by the Federal Ministry of Education in 2010 reflected similar trend. The skewness towards male gender becomes more pronounced as the department of consideration tended to science, technology and engineering programme (Adelowo, 2018). Gender has been found to be a key factor determining entrepreneurial propensity among students of higher institutions (Wang and Wong, 2004; Siyanbola et al, 2008 and Adelowo et al., 2018). These empirical evidences have supported male gender being more entrepreneurial than their female counterpart (Corley and Gaughan, 2005; Link et al., 2007).
Age is another important factor that could have significant effect on entrepreneurial inclination of the respondents. About 70% of the faculties are between the ages of 31 and 50 years and younger faculties of between 21-30 years are about 15.3%, the same goes for older faculty members (Figure 4.2). It is generally believed in Nigerian settings that younger generations are more prone to risk taking and innovativeness than the older ones. In fact, results from Global Entrepreneurship Monitor (2018) showed high entrepreneurial activities among younger people in developing countries with similar trends observed in some developed economies. It is also very important to point out that certain economic parameters could influence the choice of starting a business, even as academics. For instance, where certain incentives are provided and there is access to innovation facilities, the chances are that most faculties would be interested in the commercialisation of their R&D results.
Figure 4.3 shows the distribution of faculty members by their highest academic qualifications. The results showed that majority of them possessed doctoral degrees in their various fields of endeavours while about 39% possessed master degrees. In Nigeria, the minimum academic qualification to qualify as academic is doctoral degree, however those with master degree with potentials to undertake doctoral programmes are also considered.

Entrepreneurial Perception of Universities’ Context by the Faculty Members

The perception of academics about the entrepreneurial nature of the university is an important factor in determining whether a faculty would be interested in pursuing commercialisation of their research outputs or not. This study considered how academics perceived their university characteristics, supports and preconditions as well as existing strategies in their university to pursue academic entrepreneurship. The results, as presented in Table 4.1, shows that most academics (83%) concurred that technological and market knowledge were integrated into their school curriculum indicating that greater attention is being paid to entrepreneurship. This might, partly, be due to the recent initiative of the NUC mandating all tertiary institutions in the country to include entrepreneurship education into the school programmes. A recent study showed that most universities in Nigeria have complied with this directive (Adelowo et al., 2015).

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<td>a. Educational activities at my university are aimed at the integration of technological and market knowledge into the curriculum</td>
<td>32.3</td>
<td>50.7</td>
<td>4.5</td>
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b. Research activities at my university are focused on scientific breakthroughs and technological advances to create economic value. 

About 84% of them agreed that research activities in their selected universities focused on scientific breakthroughs and technological advances to support economic value. In addition, collaborative researches with industry for the creation of intellectual property were fostered in these universities as claimed by 74% of the academics while 48.6% indicated that research

c. Collaborative research initiatives with industry and other universities (in areas of common research interest) for the creation of IP (Intellectual Property) are supported at my university.

d. Technical inventions based on research results are often commercialised in my university.

Support and Preconditions for Academic Entrepreneurship (AE)

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<td>a. Sufficient funds are available for AE initiatives</td>
<td>12.5</td>
<td>25.0</td>
<td>27.2</td>
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<td>b. Sufficient rewards and compensations are offered for AE initiatives</td>
<td>7.7</td>
<td>29.7</td>
<td>22.5</td>
<td>12.6</td>
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<td>c. AE and intellectual property seminars/workshops are offered for students and faculty at my university</td>
<td>9.5</td>
<td>40.5</td>
<td>19.4</td>
<td>7.24</td>
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<td>d. My university provides sufficient resources for start-up companies</td>
<td>4.1</td>
<td>23.6</td>
<td>28.2</td>
<td>16.4</td>
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<td>e. A supporting network of industry partners, investors and regulators helps my university’ faculty and students in their AE activities</td>
<td>6.7</td>
<td>32.3</td>
<td>21.5</td>
<td>10.3</td>
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<td>f. An incentive system motivates faculty and students at my university to participate in AE initiatives</td>
<td>10.3</td>
<td>33.2</td>
<td>22.0</td>
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Process for AE

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<td>a. There are well established/structured technology transfer and commercialisation processes within my university</td>
<td>8.9</td>
<td>37.4</td>
<td>19.6</td>
<td>3.3</td>
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<td>b. My university has dedicated resources to quickly exploit evolving innovation opportunities</td>
<td>9.8</td>
<td>38.3</td>
<td>19.6</td>
<td>7.0</td>
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<td>c. Effective administrative framework exists to improve AE processes</td>
<td>11.8</td>
<td>40.3</td>
<td>12.3</td>
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Strategy for Academic Entrepreneurship (AE)

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<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>a. My university has a strong emphasis on research for development and diffusion AE</td>
<td>20.5</td>
<td>48.1</td>
<td>11.4</td>
<td>4.8</td>
</tr>
<tr>
<td>b. My university has a well communicated strategy that aims to foster and exploit technology commercialisation e.g. research or technology fairs and exhibition</td>
<td>14.2</td>
<td>46.4</td>
<td>13.7</td>
<td>1.9</td>
</tr>
</tbody>
</table>

About 84% of them agreed that research activities in their selected universities focused on scientific breakthroughs and technological advances to support economic value. In addition, collaborative researches with industry for the creation of intellectual property were fostered in these universities as claimed by 74% of the academics while 48.6% indicated that research
commercialisation were carried out in their universities. The percentage of academics that perceived that their universities support academic entrepreneurship was generally low. The analysis shows that few academics perceived that there was sufficient funding for AE (37.5%), sufficient rewards or compensation for AE (37.4%), sufficient resources for start-ups (27.6%) and networking platforms for AE activities (39%). However, half of the academics (50%) perceived that sufficient AE and intellectual property seminars/workshops were offered for students and faculty members in their university. This results suggests the need for training and awareness-creation efforts in all these universities to demonstrate their readiness for academic entrepreneurship and to encourage faculty’s’ participation. Further, about 68.6% of the faculty members believed that their universities emphasised research for development and diffusion of AE within the system while 60.6% of them concurred that their universities had well-communicated strategy to foster technology commercialisation, including research and technology fairs and exhibition. These are avenues to attract industrialists, assess university research outputs/technologies for uptake. The avenue is widely used in the country, particularly among the technical departments and, or universities. The result also shows that about 46.2% of faculty members perceived that their universities had well-established technology transfer structure as parts of the process for promoting academic entrepreneurship. About 47% of them concurred that their universities had dedicated resources to exploit innovations and about 52% of them agreed that effective administrative framework exist for improving academic entrepreneurship process.

Moreover, university that engages in technology transfer activities, in addition to traditional teaching and research, could be termed to be entrepreneurial (Siegel and Zervos, 2002; Link and Siegel, 2007) and faculty members in such university tend to accept entrepreneurship as one of their ambitions. In this study, information on other engagements of the faculty members’ department and universities was examined. As presented in Figure 4.1 and 4.2, the result shows that 53% of the academics reported that their departments engaged in consultancy services which portray a good starting point for an entrepreneurial university. Other entrepreneurial engagements at the departmental levels included community service (47.1%), industrial linkage (38.3%), patenting (16.3%), technology licensing (13.2) and creation of spin-offs (11%). Community service in the university system in Nigeria has not really been properly defined as academics whose research activities provided solution to certain problems in the locality could be said to have fulfilled community service.

It could be observed from the analysis that the more the activities move towards core academic entrepreneurship, the fewer the responses from the faculty members. This suggests that start-ups, technology licensing, patenting and industrial linkage were not common practice at the departmental level in the selected universities as presented in Figure 4.4.

Similarly, Figure 4.5 shows the level of university entrepreneurial activities. Community service (52.9%) was reported to be in the forefront of university engagements in addition to teaching and research activities. About 38.3% of faculty members claimed that their university engaged in
consultancy. Other entrepreneurial activities of the universities were industry linkage (37.9%), patenting (24.2%), technology licensing (17.2%), and creation of spin-offs (16.7%).

**Figure 4.4: Departmental Entrepreneurial Activities**

**Figure 4.5: University Entrepreneurial Activities**

**Exploratory Factor Analysis of the Independent Variables**

The results of the PCA showed that three factors were dominant and were used as the independent variables for the binary logistic regression. The reliability test also showed great cronbach’s alpha of 86%. The entire process of naming the factors had earlier been discussed in section three of this paper.

**Table 4.2: Exploratory analysis of faculties’ perception of university’s entrepreneurial context**

<table>
<thead>
<tr>
<th>Factor Loading Patterns</th>
<th>Component</th>
</tr>
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<tbody>
<tr>
<td>Educational activities at my university are aimed at the integration of technological</td>
<td>.723</td>
</tr>
<tr>
<td>and market knowledge into the curriculum</td>
<td></td>
</tr>
<tr>
<td>Research activities at my university are focused on scientific breakthroughs and</td>
<td>.793</td>
</tr>
<tr>
<td>technological advances to create economic value</td>
<td></td>
</tr>
<tr>
<td>Collaborative research initiatives with industry and other universities (in areas of</td>
<td>.628</td>
</tr>
<tr>
<td>common research interest) for the creation of IP (Intellectual Property) are supported at</td>
<td></td>
</tr>
<tr>
<td>my university</td>
<td></td>
</tr>
<tr>
<td>Technical inventions based on research results are often commercialised in my university</td>
<td>.522</td>
</tr>
<tr>
<td>sufficient funds are available for AE initiative</td>
<td>.720</td>
</tr>
<tr>
<td>sufficient rewards and compensations are offered for AE initiative</td>
<td>.738</td>
</tr>
<tr>
<td>AE and IP seminar/workshop are offered for students and faculty at my university</td>
<td>.478</td>
</tr>
<tr>
<td>my university provides sufficient resources for spin off companies</td>
<td>.751</td>
</tr>
<tr>
<td>a support network of industry partners, investor and regulators helps my university'</td>
<td>.640</td>
</tr>
<tr>
<td>faculty student in their AE activities</td>
<td></td>
</tr>
<tr>
<td>an incentive system motivates faculty and students at my university to participate in AE</td>
<td>.658</td>
</tr>
<tr>
<td>initiative</td>
<td></td>
</tr>
<tr>
<td>there are well established/structured technology transfer and commercialisation</td>
<td></td>
</tr>
<tr>
<td>processes within my university</td>
<td>.564</td>
</tr>
<tr>
<td>my university has a strong emphasis on research and AE</td>
<td></td>
</tr>
<tr>
<td>my university has a well communicated strategy that aims to foster and exploit</td>
<td></td>
</tr>
</tbody>
</table>

Consultancy. Other entrepreneurial activities of the universities were industry linkage (37.9%), patenting (24.2%), technology licensing (17.2%), and creation of spin-offs (16.7%).
The binary logistic regression analysis presents the likelihood of faculties’ perception of entrepreneurial context of university to influence their academic entrepreneurial propensity, as capture by the intellectual property disclosures among them. The results, as presented in Table 4.3, showed that faculty members who perceived that their university provided innovation support system are 93% likely to make intellectual property disclosures. The positive relationship between innovation support system and intellectual property disclosures have been well established in literature. From the perspectives of theory of planned behaviour, as advanced by Azjen (1989), a well-supported entrepreneurial behaviour in the university settings have a way of resonating among the academics, to the extent that the behaviour becomes normal in the system. The innovation support system is known to have triggers for promoting academic entrepreneurship in the research system. The experience of research institutions in the USA after the passage of Bayh-Dole Act of 1980 was a case in time, which triggered huge patent disclosures among the faculties. Today, in Nigeria, apart from improved patent awareness among the faculties, about forty-four universities, research institutes and polytechnics have established technology transfer offices to link up with industry on R&D commercialisation (NOTAP, 2018). Mere recognition of researchers with patentable research outputs in the university could attract positive outcomes for the universities.

Moreover, the faculties’ perception of university characteristics, in terms of disposition to meeting industry challenges with research results showed high likelihood of engagement in academic entrepreneurship. The result suggests that faculties who perceive their universities as being responsive to market needs tend to engage in patent disclosures. Some academics finds fulfillment in seeing the fruits of their research efforts in the market, that is, beyond paper publication. On strategic resources, faculties’ perception of universities context having requisite strategic resources for academic entrepreneurship does not show significant relationship with likelihood of making IP disclosure among them.

On the control variables, gender showed positive relationship and very high likelihood to make patent disclosures among the faculties, particularly the male gender. The result suggests a very high possibility of academic entrepreneurship among the male faculties than the female counterparts. Highest academic qualification does not show any significant likelihood of influencing patent disclosures among the faculties. However, the chances are that entrepreneurship training attended could be a positive factor, but it was not included in the analysis.
Table 4.3: Binary logistic regression analysis of the influence of faculties’ entrepreneurial perception on academic entrepreneurship propensity

<table>
<thead>
<tr>
<th>Independent variables</th>
<th>B</th>
<th>S.E.</th>
<th>Sig.</th>
<th>Exp(B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAC1: Innovation support system</td>
<td>.659</td>
<td>.246</td>
<td>.007</td>
<td>1.932</td>
</tr>
<tr>
<td>FAC2: University Characteristics</td>
<td>.577</td>
<td>.274</td>
<td>.035</td>
<td>1.780</td>
</tr>
<tr>
<td>FAC3: Strategic resources</td>
<td>-.209</td>
<td>.330</td>
<td>.526</td>
<td>.811</td>
</tr>
<tr>
<td>Gender</td>
<td>2.302</td>
<td>1.057</td>
<td>.029</td>
<td>9.998</td>
</tr>
<tr>
<td>Qualification</td>
<td>.334</td>
<td>.494</td>
<td>.499</td>
<td>1.397</td>
</tr>
<tr>
<td>Constant</td>
<td>-4.640</td>
<td>1.322</td>
<td>.000</td>
<td>.010</td>
</tr>
</tbody>
</table>

2 Log likelihood: **122.424**

Cox & Snell R Square: **0.099**

Nagelkerke R Square: **0.181**

Dependent variable: Intellectual property disclosure

*Parameter estimates changed by less than .001.

CONCLUSION AND POLICY RECOMMENDATIONS

The paper examined the roles of knowledge institutions in stimulating innovations and technology commercialisation in a developing country using primary data collected from thirteen selected universities. It also evaluated the perceptions of faculties’ on the entrepreneurial context of the universities and how the perceptions drive them to engage in academic entrepreneurship. The results showed that faculties’ positive perception of university characteristics (OR=1.78, CI 95%, p < 0.05) and innovation support system (OR=1.93, CI 99%, p < 0.01) were positively related and significant to academic entrepreneurship. However, faculties’ perception of strategic resources (OR=0.811, CI 95%, p > 0.52) did not show significant relationship to academic entrepreneurship. In addition, male gender is more likely to engage in academic entrepreneurship in these institutions. Other key results included poor perception on the reward system for innovation, as greater emphasis was placed on publication, rather than research commercialisation. The study concluded that strengthening existing innovation facilities, increased incentive system for innovation and devising motivation for female faculties could trigger higher academic entrepreneurial propensity among the faculties.
REFERENCES


