Human Resource Management Research 2014, 4(3): 69-74
DOI: 10.5923/j.hrmr.20140403.03

Synergy between Academic Research and Industrialization: The Search for Development in Nigeria

Anietie E. Efi

Department of Business Management, University of Uyo, Nigeria

Abstract Adam Smith in the 18th century and Alfred Marshall in the 19th century addressed the question of how investments in "research" influence the wealth of nations. However, Dusgupta and David, (1994) point out that academic institutions operate based on the principles of 'public science and emphasizes the free, rapid and impartial dissemination of research results, whereas the industry operate under the principles of 'private science search for the appropriation and commercial exploitation of knowledge. Given these differences, very close interaction between the two spheres can ultimately be 'costly' in terms of the production and diffusion of knowledge. These claims bring forward three questions that define the purpose of this paper; Does academic research and industry collaboration has any synergistic effect in economic development? Does academic institutions' collaboration with industry shift the focus away from basic research? What are the consequences of the shift? Using the desk review approach the study argues that academic research and industry collaboration although obviously an essential ingredient of development and prosperity is and can also be contentious. These challenges or contentions can be minimized if there are clear policy directives from the policy makers, the professional organisations and the media. It recommends that Nigerian, indeed African academic institutions need to encourage technological advancement and education in Africa to ensure its future by promoting academic institutions-industry collaboration through research.

Keywords Research, Industrialization, Development, Collaboration

1. Introduction

The relationship between economic growth, industrialization and education has been one of the central threads of economic analysis. Both Adam Smith in the 18th century and Alfred Marshall in the 19th century, two important figures from the economics profession, addressed the question of how investments in "research" influence the wealth of nations. Throughout the 20th century, as Krueger and Lindahl (2001) points out in their survey of these issues, modern professional economists have been attempting to develop empirical estimates of the relationship between education (research) and economic growth. Some of the most famous names in late 20th century economics made their reputations studying the question of returns to investment in education. Jacob Mincer (1974), Gary Becker (1964) and a long list of researchers inspired by their work have produced hundreds of books and papers.

In a modern economy it is essential to transform scientific research into competitive advantages. In the US, extensive universities - industry collaboration and the ensuing transfer of scientific knowledge has been viewed as one of the main contributors to the successful technological innovation and economic growth of the past three decades (Hall, 2004). At the same time, the insufficient interaction between universities and firms in the EU is, according to a report of the European Commission (1995) itself, one of the main factors for the poor commercial and technological performance of the EU in high-tech sectors.

Nowadays, increasing the transfer of knowledge from universities to industry is a primary policy aim in most developed economies. In the 1980s, spurred by the so-called competitiveness crisis, the US introduced a series of structural changes in the intellectual property regime accompanied by several incentive programs, designed specifically to promote collaboration between universities and industry (Lee, 2000). Almost 30 years on, many elements of the US system of knowledge transfer have been emulated in many other parts of the world (Banal-Estanol, Jofre-Bonet and Meissner, 2010).

The increased incentives (and pressures) to collaborate with industry have controversial side effects on the production of scientific research itself. Nelson (2004) argues that industry involvement might delay or suppress scientific publication and the dissemination of preliminary results, endangering the "intellectual commons" and the practices of "open science" (Dasgupta and David, 1994). Florida and

* Corresponding author:
efianietie1@gmail.com (Anietie E. Efi)
Published online at http://journal.sapub.org/hrmr

Cohen (1999) claim that industry collaboration might come at the expense of basic research: growing ties with industry might be affecting the choice of research projects, “skewing” academic research from basic to applied approach.

Faculties contributing to knowledge and technology transfer, on the other hand, maintain that industry collaboration complements their own academic research by securing funds for graduate students and laboratory equipment, and by providing them with ideas for their own research (Lee, 2000). Financial rewards might even have a positive impact on the production of basic research because basic and applied research efforts might be complementary (Thursby et al., 2007) or because they might induce a selection of riskier research programmes (Banal-Estañol and Macho-Stadler, 2010).

Therefore, paper aim to achieve the following objectives:

1. To find out the extent to which research findings enhance industrial productivity
2. To find out the extent of shift from basic to applied research due to collaboration with industry
3. To find out the possible consequences of this Shift?

These objectives are necessitated by the claims and counter claims above and raise 3 questions from the objectives for discussion:

1. Does research findings enhance industrial productivity?
2. Does collaboration with industry shift the focus of academic research from basic to applied research?
3. What are the consequences of the Shift?

Using the desk review research methodology, this paper is organized in four sections. Section one deals with the role of academic research in industrialization. Section two is concerned with the impact of research findings on the direction of academic research and academic development. Section three evaluates the implications of such shift, the synergy and consequences and section four is the conclusion.

2. The Role of Education and Academic Research in Industrialization

To set the pace for an understanding of this section we begin with a quotation by D. N. McCloskey (“The Industrial Revolution in Britain 1780-1860: A Survey,” in Roderick Floud and Donald McCloskey, The Economic History of Britain since 1700):

In the eighty years or so after 1780, the population of Britain nearly tripled, the towns of Liverpool and Manchester became gigantic cities, the average income of the population more than doubled, the share of farming fell from just under half to just under one-fifth of the nation’s output, and the making of textiles and iron moved into the steam-driven factories. So strange were these events that before they happened they were not anticipated, and while they were happening they were not comprehended.

The social order around us every day springs up each morning seemingly of its own accord. But everyone knows that our complex societies follow millions of familiar and largely accepted patterns. We do not reinvent social order from scratch at dawn. It is also very clear that there are societies that lose the thread or no longer trust the pattern of yesterday because it did not work through lack of basic success in providing the minima of life or the minimum of what people believe is important. Social breakdowns, in many forms, exist all around us. Social change is not the same as social breakdown, although sometimes change can provoke such breakdowns. The last few centuries have illustrated this many times in the revolutions, wars and crises that shook the world.

More pertinent in our day, as thinkers as diverse as Angus Maddison (2007), Francis Fukuyama (1999), William Baumol (2004) or William Easterly (2001) have all argued, is the difficulty of making the voyage from one kind of society to another. Chinese, Indian and Brazilian peasants are making this kind of voyage every day, in millions, as they leave their rural lives and move to the city. This role will be discussed in two sections:

a. The role of the 19th century ‘Education system’ in the transition to industrial society and;
b. Academic research in the 21st Century and industrialization.

2.1. The role of the 19th Century ‘Education System’ in the Transition to Industrial Society

What does this system do that is so crucial for industrial society and the kind of economic growth that is typical of industrial society?

1. Diffusing and inculcating the organizational attributes of the factory.

Attempts to reform British and American society from the 1830s on, in what is now labeled the Victorian era were a monumental success. The impact on social capital in both societies was extraordinary, as masses of rude, illiterate agricultural workers and urban poor were converted into what we now understand as the working class. Under the discipline of the time clock, these workers understood that they had to keep regular hours, stay sober on the job, and maintain minimal standards of decent behavior (Fukuyama, 1999: 268). Key contributions here are:

i. punctuality, obedience to non-fealty/non-divine authority,
ii. faith in an external hierarchy of knowledge, acceptance of the pre-determination of tasks and objectives
iii. common language
iv. shared codes of group behavior in the workplace, acceptance of strangers
v. basic definitions of collective-interests and self-interests.

2. Diffusing and inculcating the organizational attributes of anonymous urban life, mass-citizenship and the administrative state.

“Among the Nandi, an occupational definition of time evolved … at 5:30 in the morning the oxen have gone to the grazing ground, at 6.00am the sheep is unfastened… In Madagascar the time might be measured by 'a rice cooking' (about half an hour) or 'the frying of a locust' (a moment). The Cross River natives were reported as saying, 'the man died in less than the time in which maize is not yet completely roasted (less than fifteen minutes)' (Thompson, 1967). Key issues here are:

i. common language, capacity to find essentials like: a place to live, a job, food through written non-familial/non-tribal sources,
ii. Shared codes of group behavior in contexts like factories or urban agglomerations (punching-in, commuter train schedules, etc.)
iii. acceptance of strangers
iv. facilitates articulation and expression of demand for mass-consumption and welfare state services by universalizing the experience of "outsourcing" formerly family-only or local-only functions—expands sphere of legitimacy/trust for material and immaterial, and
v. Accepting/believing in the myths, codes that bond people to the national form of cooperation-interdependency.

3. Augmenting the size and fitness of the population available for increasing the division of labor in industrial work and life;

i. increases the inter-changeable wage-labor ready proportion of the population for both goods and services production
ii. relieves parents of working-day child-minding responsibility.

4. Improving the overall societal capacity to produce (acquire and invent), accumulate (maintain/remember) and depreciate (forget, denigrate) knowledge;

i. increases the supply of workers with high cognitive and research capacities,
ii. alters the rates and methods for the diffusion of knowledge in society,
iii. provides a structure for creation and retrieval of knowledge.

The historical record and the evidence collected by social scientists are less definitive, regarding the link between industrial society and either economic growth or social well-being. There are important examples of well educated, mostly industrial societies – perhaps most prominently the former Soviet Union and China but also parts of Latin America – that failed to match the growth rates of Europe, Japan and North America. Mass compulsory education systems, even ones that generate relatively high rates of literacy, are not enough. Crucially it is how the specific behavioral and cognitive attributes generated by industrial schooling is used that is one of the main distinguishing features between the unstable, low growth industrial societies and the more stable, higher growth ones. Institutions (other than education), events and values are major factors shaping the way different kinds of knowledge are used and the economic payoffs associated with that use. Well educated people working in a centrally planned economy do not perform as well as those working in more open market-welfare or mixed economies.

2.2. Academic Research in the 21st Century and Industrialization

The 20th century was the education and research century. For the first time in human history the majority of the world's population learned to read and write (Cohen and Bloom, 2005). The introduction and spread of universal compulsory education, the daring and innovative mass education systems pioneered in the 19th century, made this happen. The 20th century also demonstrated that universal compulsory education and academic research is indispensable for economic prosperity and social well-being in an "Industrial Growth Society" (IGS).

For the 21st century the verdict has not yet been pronounced. What we do know is that there are signs in the world around us already that point to an even more significant role, and potential payoff from investing in education and academic research. From an economics point of view, authors such as Dasgupta and David (1994) point out that universities and industry operate under different systems. The former, based on the principles of 'public science; emphasizes the free, rapid and impartial dissemination of research results; the latter, based on the principles of 'private science', search for the appropriation and commercial exploitation of knowledge. Because of these differences, very close interaction between the two spheres can ultimately be 'costly' in terms of the production and diffusion of knowledge. Nelson (2001) argued that a strong commercial orientation in academic research may be weakening the traditional commitment of university researchers to publish and contribute to public science. These arguments reflect some of the main concerns that have emerged with relation to the negative effects that greater involvement of universities with industry could generate for scientific performance, based on publication delays, increased secrecy, and the private appropriation of university research outputs.

Despite these concerns, there is empirical evidence that lecturers are combining increasingly traditional activities of research with activities of industry (Lee 1996; Azagra et al. 2006; Powers 2004; Lee and Rhoads 2004). Moreover, most studies in this area find a positive relation between lecturers' scientific performance and various forms of linkage with the socioeconomic environment, such as, patenting, industry funding, collaboration and co-publication with industry. Most of these studies use patents as a proxy for University –Industry- Relationship (UIR), and find that inventors publish more than their non-inventor colleagues (Azoulay et al. 2005; Breschi et al. 2005, 2007; Van Looy et al. 2004, 2006; Meyer 2006). Also, studies that take account of industry funding, show that researchers who are funded by industry are more productive than colleagues that are not (Blumenthal et al. 1996; Gulbrandsen and Smeby 2005). Finally, and in line with these findings, researchers involved in co-authorship with industry, publish more and receive more citations to their work than their non-collaborating colleagues (Godin and Gingras 2000; Hicks and Hamilton 1999; Van Looy et al. 2004).

The fact that university lecturers are involved in both research and UIR activities, and that the latter can have a positive effect on their scientific production, suggests that these activities are complementary to the extent that the development of one increases the effectiveness of the other (Milgrom and Roberts 1990). Complementarity, in this context, goes far beyond the joint development of the two types of activities and assumes the generation of synergistic effects on scientific performance: the greater the linkages with industry, the greater the effectiveness of the lecturer's academic research, and vice versa. In a study based on interviews with scientists at five US universities, Siegel et al. (2003) found that 65% of researchers reported that interaction with industry had positively influenced their research. Some scientists reported that these interactions improved the quantity and quality of their basic research, stating explicitly that, 'There is no doubt that working with industry scientists has made me a better researcher. They help me refine my experiments and sometimes have a different perspective on a problem that sparks my own ideas' (Siegel et al. 2003: 42). Thus, interactions between university and industry do not imply knowledge transfer only from university to industry; the transfer takes place in both directions. Breschi et al. (2005) suggest that the resolution of industry problems may be both economically valuable and scientifically relevant, even to the point of opening up new disciplines and lines of research. Moreover, through UIR, researchers gain access to industry R&D facilities as well as additional financial resources that may be used for the purchase of equipment or hiring of additional personnel for research (Breschi et al. 2005; Kline and Rosenberg 1986). These factors contribute to improving research performance and constitute another argument in favour of the existence of complementarity.

However, it would be wrong to state that UIR are always beneficial to the development of university research or, alternately, to suggest that more linkages will mean higher levels of scientific production. In fact, in a previous study (Manjarrés-Henríquez et al. 2008), we found that the effect of UIR on scientific production depends on the interaction tools used. Specifically, when UIR involve activities with a high scientific-technological content (R&D contracts), it exercises a significant and positive effect on scientific production, but only up to certain level, after which there are decreasing marginal returns to scientific output (Manjarrés-Henríquez et al. 2008). This is related to the effect of 'squeeze time', that is, that those researchers who receive larger amounts of industry funds may find strong economic incentives to take time from their research to do 'industrial work'.

3. The Shift of Focus and the Consequences

On the one hand, scholars in the 'new economics of science' are concerned about the commercial 'contamination' of academic research. David (1998) maintains that academics frequently interacting with industrial partners are likely to change their research orientation towards short-term commercial research and to decrease the quality of the university research. The unintended consequences of the commercial orientation of individual academics can be summarised as a 'secrecy problem' and a 'skewing problem' (Van Looy et al., 2004).

In terms of the secrecy problem, Blumenthal et al. (1996) carried out a survey and found that 47% of firms asked scientists not to disclose the results obtained from the contract research. According to another survey by Rham (1994), 53% of the academics replied that they had been requested to delay the publication of the research output by the cooperating companies. The skewing problem is observed in the study by Gulbrandsen and Smeby (2005). They found that academics funded by industry do less basic research than those without industry funding. Furthermore, Godin and Gingras (2000) showed that the university researchers cooperating with industry are more involved in applied research than those not engaged in such collaboration.

On the other hand, a different group of the empirical studies that have been carried out do not support a negative relationship between academic research and commercial influence. Agrawal and Henderson (2002) found that the number of patents produced by academics is positively related to the number of papers they published. Ranga et al. (2003) could not find any evidence supporting a trade-off relationship between applied research and basic research. Markiewicz and Di Minin (2004) found that there was not a substitution but a complementary relationship between the number of papers and the number of patents applied for after publication. Moreover, in terms of the quality of the research, the papers co-authored by scientists in academia and industry recorded higher citation counts than those authored by academics only (Hicks and Hamilton, 1999).

In order to explain the positive and reinforcing effects from the relationship between publishing and patenting activities, there have been several theoretical analyses. Owen-Smith (2003) maintains that a 'hybrid regime' emerged in the US university system after the 1980s. He states that success in the commercial sphere interacts with that in the academic sphere. In this vein, Van Looy et al. (2004) develop the concept of a 'compounded Matthew effect' at the individual level. They assert that the interaction between the production of papers and patents creates a 'cumulative advantage' altogether, so academics successful in the scientific area are also able to demonstrate excellence in the area of knowledge-transfer activities. Regarding 'a resource effect', Calderini et al. (2007) and Breschi et al. (2004) maintains that university patenting can attract more financial and cognitive resources for academic research from industry.

Azoulay et al. (2006) argue that academics involved both in publishing and patenting activity can benefit from 'within-scientist economies of scope'. Stephan et al. (2007) suggest 'duality' of the research output as a reason for the apparent complementarity between patenting and publishing. The results from 'dual' research may be not only publishable but also patentable.

On the one hand, the majority of empirical studies are based on the behaviour of academics in research-oriented universities such as MIT (Agrawal and Henderson, 2002) and the Catholic University of Leuven (Ranga et al, 2003; Van Looy et al., 2004) rather than in local teaching-oriented universities. Because of the resource effect, the research outputs produced by academics in this type of universities tend to support a positive relationship between publishing and patenting.

Furthermore, most of the empirical studies address these issues by focusing on academics in the disciplines of 'use-inspired' science such as mechanical and electrical engineering (Agrawal & Henderson, 2002), life sciences (Blumental et al., 1996; Louis et al., 1989; Owen-Smith & Powell, 2003) and nano-science (Meyer, 2006). Academics in these disciplines are likely to produce commercial outputs as well as contributing to scientific progress. Accordingly, the research focusing on areas of applied research such as life sciences and nano-science is likely to support a positive empirical relationship between academic research and entrepreneurial activities. Considering the limitation of the type of institutions and the disciplines involved, a research framework covering a wider set of characteristics of academics can probably produce richer information on the relationship between academic and entrepreneurial activities at the individual level.

Conversely, even though a positive relationship between patents and papers production is found, the concerns about the 'contamination' of open science due to secrecy and the skewing problem may still be valid.

4. Conclusions

This paper shows that education and academic research is necessary for industrial development. The form of education and research that emerged in the 19th century generates specific cognitive, behavioral and social knowledge that are critical ingredients for the way industrial societies organize:

a. Production and consumption
b. Daily life in cities and nations
c. The size and fitness of the population for work
d. The creation and use of knowledge.

Therefore, it is documented that:

- Education and research is a necessary but not sufficient condition for the spectacular feats of industrial development in the 20th century.
- The intricacy of the relationship between educational activities and the industrial form of economic growth is confirmed by the technical economics literature.
- Economists have demonstrated that both individuals and societies gain from the investments made in education and academic research.

That education and academic research is an essential ingredient of prosperity is at once obvious and contentious. Obvious because any person able to read this text knows what a difference it makes in their lives to have gone to school, to have learned to read, write and calculate. Contentious because when social scientists try to "prove" that education and academic research is a cause of economic growth and industrialization it turns out to be quite difficult to decide which came first; the chicken or the egg. What is more, even the basic terms such as "what is education and research" and "what is prosperity, economic growth and industrialization" become vast and cloudy terrains for the technical experts like economists, sociologists, education specialists and policy analysts.

REFERENCES

[1] Agrawal, A. and Henderson, R. (2002). Putting patents in context: Exploring knowledge transfer from MIT, Management Science. 48, 44-60.

[2] Albert Banal-Estanol Mireia Jofre-Bonet Cornelia Meissner (2010). The Impact of Industry Collaboration on Research: Evidence from Engineering Academics in the UK. August.

[3] Azoulay, P., Ding, R. and Stuart, T. (2009). The Impact of Academic Patenting on the Rate, Quality, and Direction of (Public) Research, The Journal of Industrial Economics, 57(4), 637-676.

[4] Banal-Estañol, A., and Macho-Stadler, I. (2010). Scientific and Commercial Incentives in R&D: Research vs. Development? Journal of Economics and Management Strategy, 2, 123-132.

[5] Baumol, W. J. (2004). The Free-Market Innovation Machine: Analyzing the Growth Miracle of Capitalism, Princeton University Press.

[6] Becker, G. (1964). Human Capital: A Theoretical and Empirical Analysis with Special Reference to Education. New York: National Bureau of Economic Research.

[7] Benhabib, J. and Spiegel, M. (2005). Human Capital and Technology Diffusion, in P. Aghion and S. Durlauf, eds, Handbook of Economic Growth, Elsevier, North-Holland.

[8] Blumenthal, D., Gluck, M., Louis, K. S., Stoto, M.A. and Wise, D. (1986). University industry Research Relationships in Biotechnology: Implications for the University, Science 13 June, 232, no. 4756, 1361 - 1366.

[9] Breschi, S., Lissoni, F. and Montobbio, F. (2008) University patenting and scientific productivity. A quantitative study of

Italian academic inventors, European Management Review 5, 91-110.

[10] Calderini, M., Franzoni, C. and Vezzulli, A. (2007). If star scientists do not patent: an event history analysis of scientific eminence and the decision to patent in the academic world, Research Policy, 36, 303-319.

[11] Cohen, J. and Bloom, D. (2005). Cultivating Minds, Finance and Development, IMF, Vol. 42, No. 2 www.imf.org/external/pubs/ft/fandd/2005/06/cohen.htm.

[12] Dasgupta, P. and David, P.A., (1994). Toward a new economics of science, Research Policy, 23 (5), 487—521.

[13] Easterly, (2001). The Elusive Quest for Growth, New York: MIT Press.

[14] European Commission (1995). Green Paper on Innovation, Luxemburg.

[15] Florida, R. and Cohen, W.M. (1999). Engine or Infrastructure? The University Role in Economic Development In: Branscomb, L.M., Kodama, F., Florida, R. (Eds.), Industrializing Knowledge: University–Industry Linkages in Japan and the United States. , London: MIT Press, 589–610.

[16] Fukuyama, F. (1999). The Great Disruption: Human Nature and the Reconstitution of Social Order. New York: Free Press

[17] Godin, B. (1996). Research and the practice of publication in industries. Research Policy, 25, 587-606.

[18] Gulbrandsen, M. and Smeby, J.C. (2005). Industry Funding and University Professors' Research Performance. Research Policy, 34, 932-950.

[19] Hall, B. (2004). University-Industry Research Partnerships in the United States, in Contzen, Jean-Pierre, David Gibson, and Manuel V. Heitor (eds.), Rethinking Science Systems and Innovation Policies, Proceedings of the 6th International Conference on Technology Policy and Innovation, Purdue University Press.

[20] Hicks, D., and Hamilton, K. (1999). Does University-Industry Collaboration Adversely Affect University Research? Issues in Science and Technology, 74-75.

[21] Krueger, A. and Lindahl, M. (2001). Education for growth: why and for whom? Journal of Economic Literature, 39:1101-1136.

[22] Lee, Y. S., (2000). The sustainability of university-industry research collaboration: An empirical assessment. The Journal of Technology Transfer, 25(2), 111-133.

[23] Maddison, A. (2007). Contours of the World Economy: the Pace and Pattern of Change, 1-2030 AD, London: Cambridge University Press.

[24] Manjarres-Henriquez, L., Gutierrez-Gracia, A.,Carrion-Garcia, A., and Vega-Jurado, J., (2009). The effects of university—industry relationships and academic research on scientific performance: Synergy or substitution? Research in Higher Education, 50 (8), 795-811.

[25] Mincer, J. (1974). Schooling, Experience and Earnings. New York: National Bureau of Economic Research.

[26] Nelson, R., (2004). The market economy, and the scientific commons. Research Policy, 33(3), 455-471.

[27] Owen-Smith, J., and Powell, W. (2001). To Patent or Not: Faculty Decisions and Institutional Success at Technology Transfer. The Journal of Technology Transfer, 26(1-2), 99-114.

[28] Stephan, P., Gurmu, S., Sumell, A.J. and Black, G. (2007). Who's Patenting in the University? Economics of Innovation and New Technology 61, 71-99.

[29] Thompson, E. P. (1967). Time, Work Discipline, and Industrial Capitalism, Past and Present, 38, December, 56-97.

[30] Thursby, J., and Thursby, M. (2007). Patterns of Research and Licensing Activity of Science and Engineering Faculty, in Ehrenberg, R. and P. Stephan, eds., Science and the University, Madison: University of Wisconsin Press.

[31] Van Looy B., Debackere, K., Callaert, J. (2006). Publication and Patent Behaviour of academic researchers: conflicting, reinforcing or merely co-existing. Research Policy, 35, 596-608.