

The Role of Algerian Universities in National Innovation System (NIS)

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Abstract—One of the most important functions of universities is to provide a learning environment which releases the latent potentialities of their students and provides them with the abilities they need to promote innovation, in whatever sector of the economy they subsequently work. University research can help support this learning environment and produce outcomes which complement and support business research and innovation.

This paper intends to identify the role of the Algerian universities and research institutions in the National Innovation System (NIS) and investigates the contribution of universities in various manufacturing companies.

Index Terms—Innovation, NIS, university, Algeria.

I. INTRODUCTION

Universities have long been considered important institutions in national innovation systems (NIS) [1], [2]. Over the decades the university has been delegated a variety of roles in addition to education and research; these include public service, improving national competitiveness, helping to ameliorate social injustice (e.g., affirmative action), and regional economic development. The NIS perspective highlights the fact that countries organize innovation differently. Not unexpectedly, the role of universities in each NIS differs significantly. The NIS perspective has been criticized by scholars who have asserted that innovation processes in industries and regions differ even within the countries. For example, [3] argued that the institutions and entrepreneurship of Silicon Valley and Boston differed appreciably, something she attributed to cultural characteristics, rather than path dependent historical outcomes and different industry foci.

The NIS is important because it sets the basic parameters for what is possible. For example, in China universities can own profit-making firms, while in the United States a university's direct ownership of a commercial firm would invalidate its tax-exempt status—a line that private and public research universities have been unwilling to cross. Thus, national laws and decisions provide the parameters for the actions of organizations such as universities.

The main objective of this paper is to build a theoretical framework linking these universities with the national system of innovation.

II. LITERATURE REVIEW

The concept of innovation systems can be understood as a network of actors/institutions that interact in the production, transfer, diffusion and the use of new knowledge or technology to produce innovation. For [4], a system of innovation includes “all important economic, social, political, organizational, institutional and other factors that influence the development, diffusion and use of innovations”. Many scholars [2], [5] agree that – in general – one can group these various organizational, institutional and other innovation actors into three main key categories of actors: Authorities, Suppliers of Knowledge and Skills and The Users/Adopters/Transformers of these knowledge and skills into innovation. In many countries, the position of authorities is often held by the Government, while the suppliers are often represented by Higher Education Institutions and the users are usually Industrial sectors. Scholars argue that the successful innovation performance of the system is determined by the effective interaction between these key actors [6].

The literature broadly defines the NIS as a network of institutions, policies, and agents supporting and sustaining scientific and technical advance [7]-[10]. In knowledge economies, Universities are vital actors in the creation, acquisition, dissemination, and use of knowledge [9]. Three core actors to an NIS are Universities, industry, and government [11], [12].

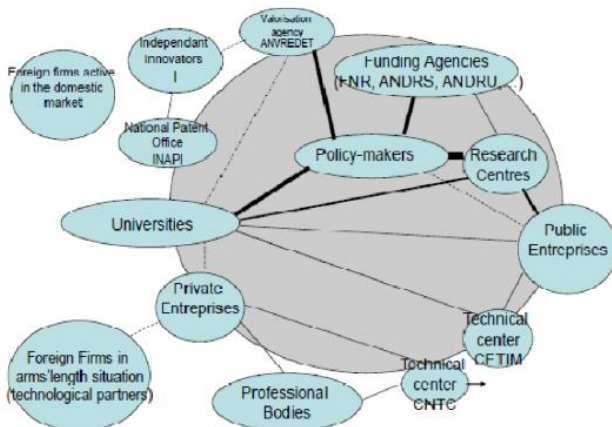
Universities–industry relations are myriad and can include: labor market related linkages, linkages for creation, acquisition, and dissemination of knowledge, and linkages to create new enterprises. Universities are the major educational and training institutions where students and professionals educated and trained gain knowledge and skills, and become part of the labor pool in regional economies [13]. Linkages between Universities and industry also take a variety of forms such as joint R&D projects, technology licensing, consulting, internships, and other collaborations between firms and Universities to develop a product or technology [14].

In Developing countries, innovation is largely inaccessible, the performance of innovative activities are dismal and where neither market dynamics nor public policy impulses are strong enough to get innovation off the ground.

Unlike NIS of the North, innovation systems in the South cannot be assumed to have similar characteristics [4] and we could not assume the existence ex-ante of NIS: often NISs exist in a preliminary form, are unstructured, disorganized and fragmented, and mostly incomplete, with weak or missing links and weak incentive systems [15], [16].

They suffer from a deficit of interactions between the main components [17] and pronounced rent-seeking on the part of the main actors [16] to the extent that they can be considered as nonexistent [18]. The linkages between the various actors are of rather sporadic nature, which leads to more fragmented systems [15]. The institutional infrastructure differs immensely from that of developed countries and is most often characterized by institutional inappropriateness and inadequacy to foster innovative activities and lack of physical and human resources [19]. For example, studies on North and West Africa show the existence of uncoordinated components largely disconnected from public policies [20], [17], [21]. In Algeria, we found that most key players appear to be excluded from the national innovation sphere (foreign firms, professional bodies, independent innovators who constitute incidentally more than 84% of patents holders).

Only a small group can be considered a being fully included: these are policy-makers, research centers, and research funding agencies [22]. This fragmented and often excluding innovation system feature seems to be quite common in many Developing Countries (Fig. 1).



Source: A. Djeflat, P. Devalan, and F. Y. Ettoumi, 'Evaluation des Politiques et Programmes d'innovation dans le secteur industriel', Final Report, European Commission - Ministry of Industry. Brussels: EC, 2007.

Fig. 1. The current national innovation system excludes most key players.

III. THE ALGERIAN CONTEXT

The main role of the Algerian universities has essentially been aimed at creating the required capabilities to support the economic development and industrialization of the country through the acquisition of advanced and new technology from developed nations. A series of reforms have been introduced in Algerian higher education Policy.

In 1971, radical changes were introduced such as the increase of the number of student intake and the change on the contents of teaching programs with the aim to enable universities to support the ambitious economic and social government programs [23].

In 1999, a second major reform was introduced with the objective to prepare Algerian universities to support the transition from a centralized to a free market economy [24]. A degree of autonomy was then granted to universities and faculties in order to align part of their activities to the specific needs of their region and industry in order to diversify their sources of funding for research and development programs.

This has stimulated demand from local private and public companies for specialized postgraduate courses and consultancy services which, in turn, has been crucial for the emergence of a fledgling entrepreneurial academic culture. However, this demand has been limited in extent, occasional in character and dependent on isolated actions or instructions from the top (Ministries or National headquarters for state companies).

This second reform did not provide for sufficient power to be devolved to local actors. Algerian universities are still heavily dependent on the Algerian Ministry of Higher Education and Scientific Research of which the main mission of the Algerian universities is around teaching. The level of research activities is rather low and essentially limited to fundamental research of which the themes and objectives are fixed and funded by the State and the Ministry of Higher Education and Scientific Research. The research priorities and management are essentially led by the General Direction of Research and do not always fall within the responsibility of universities.

A. Efforts of R&D and Patent Diffusion in Algeria

While the US, the EU and Japan are still leading the world in the term of research and development efforts, they are being increasingly challenged by emerging economies, especially China. (UNESCO Science Report, 2010) The Arab World has been trying to improve its NIS over the last few years, although 95 % of the world researchers are found in Asia, Europe, and North America, whereas Africa, Latin America, Oceania, and Caribbean represent only 5% of the world researchers (UIS S&T statistics; 2005) this fact shows a huge gap between the north and south in the matter of research as well as GERD as a percentage of GDP (Algeria is still behind by 0.07 % GERD) (UIS S&T Database, 2008).

As we all probably know, the innovation system approach was employed using experiences of high income countries, with developed infrastructures and institutions, well built knowledge base, and well-functioning /economic systems, whereas, the situation of developing countries as Algeria is rather different than those of developed economies. It has much lower income levels, a smaller amount of the role played by institutions and infrastructures on R&D aspects, and less accumulated knowledge. In addition, the foreign direct investments in Algeria are playing much more important role than in the rich industrialised countries applying the national innovation system concept, but it's not the case for the less developed countries. Therefore the relationships between globalisation and national/local systems need to be further researched.

Table I demonstrates some statistics of patents taken from the INAPI offices, and web site, it illustrates the number of Patents delivered for national firms by the INAPI, and the number of patents demanded in the period between 1999 and 2007, we have asked the INAPI offices for recent statistics of this kind, but each time we called they kept saying that it is still confidential and that they cannot offer us such information, because they do not concern the INAPI itself but also the local firms which have asked about the patents of their products and services, as well as the ministry of the industry, anyway; was 214 in the date of 2007, while it was 590 patents in 2006 and 550 in 2005, with the exception of the drop of the number of patents in 2007, comparing with

the previous year, patents number was raising by time in the last decade.

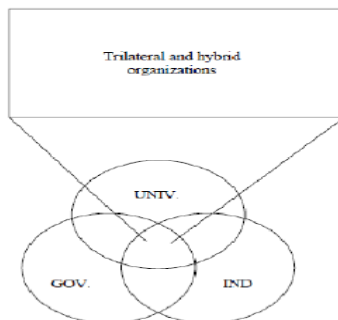
TABLE I: STATISTICS OF THE ALGERIAN PATENTS BETWEEN 1999-2007

yare	Total of deposits	certificats	Deposits of non residents		National deposits	Delivered patents	Actuel patents
			via national way	PCT			
1999	284	06	248	/	36	143	96
2000	159	02	127	/	32	78	42
2001	147	07	38	56	51	69	61
2002	334	04	41	250	43	119	167
2003	328	02	16	280	30	250	200
2004	393	01	30	304	58	290	322
2005	514	01	34	431	59	550	498
2006	669	04	47	564	58	590	669
2007	852	03	31	734	84	214	852
Total	5876	39	2590	2619	671	2699	3553

University-industry Linkages

The goal of supporting university-industry linkages is to promote the relevance and contribution of universities to socio-economic development. Although there is no step-by-step model describing how university-industry linkages are to be developed. In the National Innovation System (NIS) framework, innovation is viewed as a collective process in which firms do not innovate in isolation but within a larger system involving firms, universities, research centers, government agencies and other actors [25]. The NIS model considers all aspects of the economic and institutional structure of a country that influence the development, diffusion and use of innovations [4].

In the Triple Helix model developed by [26] (Fig. 2), innovation is seen as a product of interaction between three main actors: university, industry and government. In this model, universities focus on establishing institutional interface structures including industry liaison/technology transfer offices, business and technology incubators, and fostering entrepreneurialism through various policies and incentives. Universities, for example, may even look to industry to recruit entrepreneurial researchers to work among their faculty and act as role models.



Source: Etzkowitz and Leydesdorff (2000).

Fig. 2. The ‘Triple Helix’ of University–Industry–Government relations.

The triple helix culture is still at its infancy in Algeria. A greater decentralization devolving more power to local and regional authorities is needed to enable key actors to perform their role in the development of technological capability at regional and national levels. The Algerian case suggests that transfer of knowledge can be expected to be successful when organizations acquire the ability to assimilate and apply this knowledge, and also to manage their relationship with other

spheres and institutions in ways that facilitate knowledge production and knowledge sharing [27].

Benefits from university-industry collaboration include: providing alternative funding channels in an era of constrained financing; access to/or acquisition of state-of-the-art equipment; improved curriculum and training in technology-oriented programmes and problem-solving; enhanced employment prospects for students; supplemental income for academic staff; and clearer contribution of universities to the economy, among others (World Economic Forum, 2011; [28]). 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 university-industry linkages is becoming increasingly prominent in the discourse on higher education in Africa.

Although strengthening university-industry linkages offers many potential benefits, enthusiasm should be tempered with realism and recognition of the trade-offs inherent in promoting such linkages. While some universities have prospered significantly through large research contracts and the commercialization of marketable technology, many others have not necessarily accrued substantial revenue through activities directed towards the productive sector, though they have still benefitted in other ways [25].

IV. METHODOLOGY RESEARCH

This section explains and justifies the research methodology which is essentially qualitative based on 119 case studies. Data about the relationships between universities and the NSI have been collected through in-depth interviews and desk research.

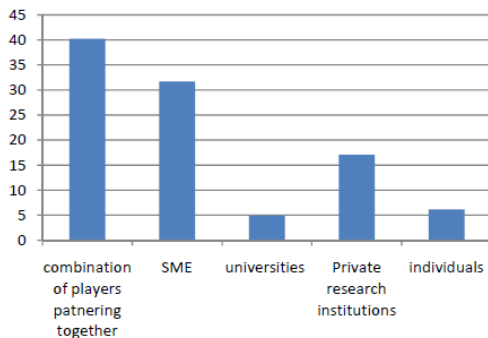
Semi-structured interviews have been conducted in various modes: face-to-face, by telephone with 82 enterprises that have accepted to answer. Average interview length is 16 minutes.

All respondents were directly involved in the innovation strategy or process within their company, they were mainly senior business executive. The sample regroups different sectors: Telecommunications, chemicals, agro-food, textiles, energy industries ...that have been interviewed in the region of Tlemcen and Oued Tlilet in the west of Algeria.

A. Results

The following figures are the main results of the survey:

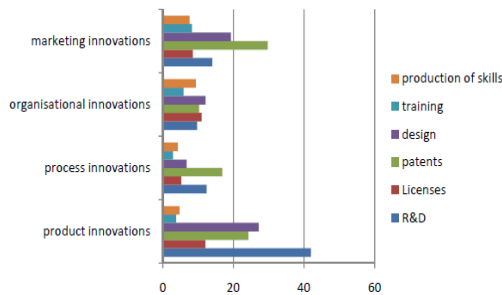
Fig. 3. shows that less than 5% of the companies interviewed consider universities as a driver of innovation; however a larger portion is attributed to private research institutions.



Source: established by the author

Fig. 3. Drivers of innovation.

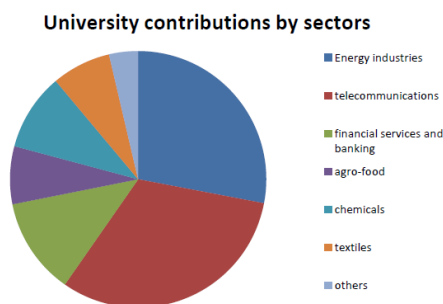
Combination of players partnering is the main driver of innovation followed by the Small and Medium enterprises then by individuals.



Source: established by the author

Fig. 4. Different universities contributions in innovative firms.

Fig. 4 illustrates four main contributions of universities in innovative actions: R&D activities, Licenses, patents and designs. These contributions differ from a type of innovation to another. The observations concern the product innovations in which R&D is the main university contribution then about the marketing innovations in which patents play a major role



Source: established by the author

Fig. 5. Sectors in collaboration with universities.

The Fig. 5 shows the industry sectors that benefit most from the contribution of universities it appears that they are mainly telecommunications, energy industries and financial services and banking. The others are partially included.

B. Discussion

The contribution of universities seems to be negligible in innovation system and firms' respondents recognize fully the

need to embrace the changing nature of innovation. They rely mainly on R&D and scientific research to drive innovation may be more than creativity.

Indeed, the university seems partially included in the innovation system however; companies see little interest in a merger with the university and public research centers.

Research is often seen as the most important driver of innovation, especially of technological innovation. For this reason the measures governments used to assess the performance of universities frequently include indicators of research-related engagement with business, or of the level of patenting, licensing and start ups.

Links between universities and entrepreneurial companies need to be strengthened; also academics and students linkages need to be encouraged to work closely with innovative SMEs.

V. CONCLUSION

The role of Algerian Universities is still limited in carrying out R&D and patents for industry. Universities have an explicit role in the cultural development of Algeria and culture provides one of the important framework conditions within which the innovation system operates. A diverse, open society is not only more creative, it is also more tolerant of difference and more open to the take-up of new ideas and technologies than a more closed society. Indeed, a major factor impacting on innovation success is the preparedness of consumers to take up new things, to take risks and to try ideas. In many cases the exploitation and impact of new technologies depends more on the creativity of consumers than of those who develop the technology. Indeed, universities facilitate an open mind and managed risk taking approach among their skills students and trainings.

Government must give universities the autonomy to operate effectively, and form partnerships. The best people to decide a university's strategy are its own board and faculty heads, not government ministries. Without freedom to operate – with appropriate checks and balances – they cannot form effective partnerships.

Also, help universities strive for excellence. Companies want to work with the best – and so Algeria must take care always to feed and promote its best universities, in order that more job-creating partnerships can be formed. Finally, enhanced survival rate of start-ups that formed partnerships with university researchers.

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