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National Innovation Systems: the Moroccan Case

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Abstract

Morocco has introduced in the late 90s a National Innovation System (NIS) to make innovation a driving force for economic development in a particularly competitive context. However, the anticipated dynamics of this system do not live up to expectations. In this context, this paper proposes an analysis of the architecture of the Moroccan NIS, its achievements in the field of innovation, and its limits. The overall goal of the article is to understand why technical high-performance remains of limited impact over Moroccan economy.

Keywords: NIS, National Innovation System, R&D, Morocco.

1. Introduction

Innovation is one of the foundations for building competitive advantages specific to each economic context. Nonetheless, innovation is not an isolated series of phases, but rather a set of ongoing interactions between the possibilities that the technology or the market can offer, the means employed by the company or the State as well ass actors' strategies (Boyer and Didier, 1998). It is therefore a process heavily influenced by public policy (Haddad, 2010).

The first integrated approach to National Innovation Systems (NIS) was proposed by Lundvall (1985 and 1988). This approach is based on the concept of "*national system of production*" suggested by Liszt and Von Hippel's work on the informal technical collaborations among companies. Lundvall proposes three interacting spheres for the said national system of innovation: first, a productive sphere related to its economic and industrial structure. Second, a training-based sphere related to human resources training. And finally, a research sphere, characterized mainly by bonds built between public research institutions and companies (Djeflat, 2002).

Several authors have emphasized the interest of developing national innovation systems (NIS) in developing countries, stressing that this is a new area of research (Djeflat 2003, 2004, 2008, Casadella and Benlahcen-Tlemcani 2006, Balzat and Hanusch 2004, ...). Their work shows in particular that proficiency in knowledge utilization is accompanied by a reduction of poverty and an improvement of income distribution. The research of Djeflat (2009) even describes a system to implement for a "take off" of research and development and innovation in African countries.

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Following on the footsteps of developing countries that began to adopt national innovation systems in the past decade (Fagerberget, Srholec, 2008), Morocco has initiated since the late 90s, a policy to implement such a system. The objective of this policy is to offer a platform for the development of innovative businesses. Indeed, the geo-economic context of Morocco is characterized by a strong industrial competition from Asian countries including (China and India) and countries around the Euro-Mediterranean, and by signing free trade agreements (US, EU, Turkey, Egypt ...) which represent both threats and growth opportunities. The implementation of this system was therefore also for Morocco a way to position itself in the global innovation stage. We first describe this system. We show subsequently that its current configuration, characterized by weak interactions between different actors, prevents the achievement of its set goals.

2. Moroccan NIS: description and analysis

Since the late 90s, Morocco has initiated its NIS. This policy has resulted in the creation of different agencies and programs that operate at different levels of innovation promotion.

2.1. Moroccan NIS Actors

The main actors of Moroccan NIS, as depicted in Figure 1, are:

- The Permanent Inter-ministerial Committee for Scientific Research and Technological Development (**PICSRTD**): Chaired by the Prime Minister, the Committee is the national instance for leadership, coordination and funding of scientific and technical research. It consists of 24 diverse government officials, which meet under the call of its President. This structure reduces the flexibility and cost-effectiveness of this entity.
- The Ministry of Higher Education, Scientific Research and Professional Training (**MHESRPT**): a government body responsible, at a national level, for managing research and promoting innovation, R&D and University-Private sector partnerships.
- The Ministry of Commerce, Industry and New Technologies (**MCINT**): that, in its new restructuring, has established a department for new technologies, innovation and R&D.
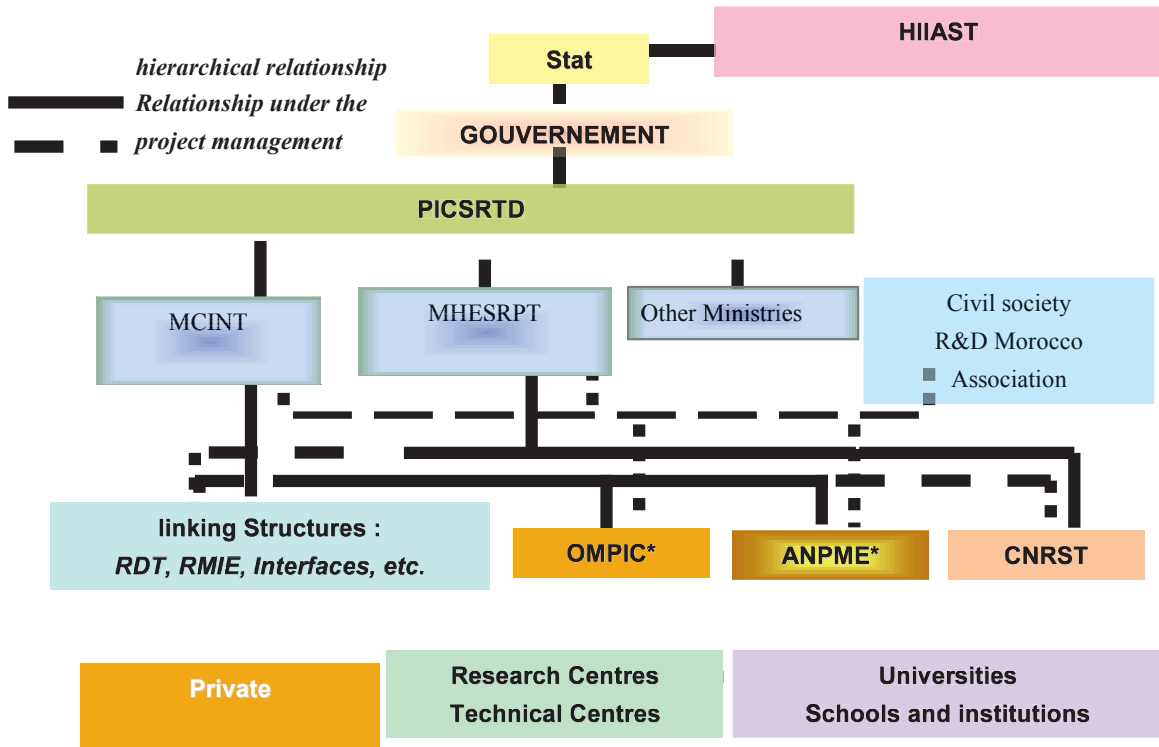

Figure 1: Moroccan NIS Actors

Source :   MHESRPT

* : ANPME :   National Agency for the Promotion of Small and Medium Enterprises

OMPIC : Moroccan Bureau for Industrial and Commercial Property.

- The Hassan II Academy of Science and Technology (HIIAST): its mission in particular is to contribute to the promotion of scientific and technical research and its integration with its national and international socio-economic environment.
- The National Center for Scientific and Technical Research (NCSTR): its role is mainly to create an enabling environment for development of research and innovation, notably by implementing the strategies developed by the MHESRPT.
- Universities, research centers and technical centers (in 2010, Morocco had 112 universities, 17 public research institutions, 63 public institutions for higher education not related to universities and 192 private ones).
- Private sector.

Figure 1 shows the structure of Moroccan SNI implemented by the system stakeholders. The interactions between these stakeholders vary between hierarchy and project management relationships. The degree of involvement and responsiveness of these actors differ from one actor to another.

2.2. Moroccan NIS redefined

Weak coordination, the multitude of actions undertaken by individual players in the NIS, the absence of a one-stop shop for innovative projects, all these factors led the Moroccan authorities in 2009 to redefine the NIS structure by adopting a strategy called "*Morocco Innovation Strategy*." This strategy aims to build an appropriate ecosystem, including innovative companies, project developers, universities, technical centers, venture capital organizations and technology development centers. The goal is to consolidate past initiatives within an overall vision, give a new impulse to innovation and try to catch up in this area with its competitors (Morocco Innovation Strategy report, Ministry of Industry and Trade, 2009).

The Moroccan government has implemented, as part of its innovation strategy, the Moroccan Centre of Innovation: a new structure ensuring the role of stop-shop for innovative projects. Its main mission is the management and promotion of mechanisms for financing innovation. These financing mechanisms cover different steps of the span-lives and of innovative projects. These instruments baptized *PTR*, *Intilak* and *Tatwir*, seek the support of innovative start-ups and the emergence of innovative projects carried by the developing companies or by consortia of companies acting within a cluster. This national strategy has been implemented by the MCINT, MHESRPT and the General Confederation of Enterprises of Morocco (GCEM) following a comprehensive study based on an international benchmarking and consultation with all stakeholders in the Moroccan NIS.

2.3. Innovation Promotion Mechanisms

A variety of incentives and structures are set up by the Moroccan government to promote innovation, technological development and technology transfer. These mechanisms are distributed according to a complementarity vision into infrastructure, financing, human resources and legislative framework:

Infrastructure:

The MHESRPT has established structures named university/business interfaces. The goal is to provide universities with structures that can contribute to the valorisation of research results, technology and engineering know-how transfer to the socio-economic realm. 26 interfaces are already operational in 2012, involving 180 individuals (source: MHESRPT). The structures put in place also cover Technology forecasting, through the Moroccan Institute of Scientific and Technical Information, which provides scientists and industrial with scientific and technical information tailored to their needs. The government has also set up Technical Support Units for Scientific Research, which are technology platforms equipped with heavy equipment, where high-level scholars, specialized centers and businesses can work on studies and conduct research activities.

Clusters development and technology parks are part of the Moroccan national innovation strategy that aims to promote innovation by establishing unifying platforms that, in turn, can help establish industries in targeted sectors. Cluster Policy is still new in Morocco. Morocco has in its active one cluster of electronics, mechatronics and mechanical

engineering and a few ICT Techno-parks, aerospace and automotive technology parks, and innovation agro-poles and cities for businesses in early startup stages. Hence, it is premature to assess their impact and role of catalyst in the innovation process.

Financing:

Morocco has several funding mechanisms in its credit, including:

The Technology Dissemination Network: network of public and/or private areas of innovation and modernization of SMEs/SMIs, creating synergies between various skills from universities, industrial technical centers, regional delegations of Industry Ministry and professional associations.

Moroccan Network for Incubation and Spin: whose mission is to encourage the creation of university incubators to enable project developers to enhance their patents and/or results of their research by creating innovative businesses.

INNOV'ACT: a program that provides technical and financial support to innovative projects driven by companies in partnership with public research laboratories.

Other funding programs are newly established for the benefit of innovative start-ups and businesses that initiate any innovative development project. In addition, other funds were established with the same purpose, namely the investment Promotion Fund (including investment in technology transfer), the Hassan II Fund for Economic and Social Development and the National Fund for Supporting Scientific Research and Technological Development, which is fed mainly by the contribution of telecommunications operators (0, 25% of their annual net turnover). However, the Moroccan NIS does not have a clear and shared-by-all-stakeholders definition of innovation, innovative project or innovative company. The projects supported range from collaborative R&D projects and technology transfer projects to patentable projects. This creates a blur in the meaning of innovation in the Moroccan NIS.

Human resources:

Research has shown that the absorption capacity of an economy "depends greatly on the level of education and training" (Mytelka, 2001, p. 2). Dahlman and Nelson note that "a key input is a technical human capital base able to assess and decide on technology matters, [which] requires a well-developed educational system that lays the necessary foundations at all levels" (Dahlman and Nelson 1995). In this context, Morocco has undertaken restructuring in its educational system including the reform of education and training (2000) and the emergency program, which is a program of an overall budget of 12.6 billion dirhams that aims to reinvigorate the reform of the educational system. The main objective is to link universities with their socio-economic environment, professionalize their courses and improve their performances. (2009-2012).

In 2010, the number of staff in the R&D in Morocco was within 40,000 (source MHESRPT). This figure originates mainly from the public sector (~ 91%), although the number of research staff in the private sector has increased very significantly between 1999 and 2010, from 650 to 3145.

Legislative framework:

In addition, the state has established legislative incentives for both researchers and companies to invest in R&D and innovation (Law 08.00 for the public interest group; 01.00: law reforming higher education; and allowing the university, among others, to acquire stakes or set up businesses; law 17.97 for governing patents ...).

2.4. Selected Indicators of Innovation in Morocco

R&D expenditure ratio to GDP:

The financing of innovation and research development in Morocco is mainly provided by the public sector. Nevertheless, the target set in 2006 by Morocco to reach 1% of GDP in 2010 for scientific research has not yet been achieved, since in 2010 this percentage did not exceed 0.63 (source MHESRPT). Table 1 summarizes the situation in Morocco against major world powers in innovation and R & D according to the R & D budgets allocated in 2010.

Compared to countries that have experienced a breakthrough in R&D and innovation, Morocco still needs a lot of effort in the funds allocated to scientific research.

Table 1: Percentage of GDP dedicated to research 2010 (Source: MHESRPT + Deloitte benchmarking report)

Country	USA	Japan	China	Germany	North Corea	France	UK	India	Canada	Russia	Morocco
Percentage of GDP dedicated to research	2,8	3,41	1,50	2,46	3,13	1,98	1,75	0,90	1,83	1,04	0,63

Moreover, often only part of this percentage intended for research is engaged (75% in 2006) by the government. In addition, a considerable part of the research budget is devoted to faculty salaries. In payroll, compensation for scientific research perceived by faculty represents a very important percentage. Therefore, apart from wages, the funds devoted to scientific research remain extremely low.

Scientific production:

In 2003, The Moroccan government undertook an assessment of its national research and innovation in the fields of sciences. In 2009, another assessment in the field of humanities and social sciences was undertaken. The first evaluation shows that the scientific production in the early 2000s, that allowed Morocco to have the third rank in Africa, was done only by 30% of professors and researchers in science and technology fields. While the second emphasizes that more than 50% of professors and researchers in the field of humanities and social sciences have never been published. Moreover, Morocco has slipped since then from third to fifth rank in terms of African scientific production.

Patents:

The Moroccan Bureau for Industrial and Commercial Property (OMPIC) grants since 2008 to depositors of university patents (be it an institution or a faculty) a 50% reduction of costs involved. Also, as of 2009, a section was introduced in the university budget for the management of the patent filing fees and related annuities. These efforts helped increase from 25 patents filed by universities in 2008-2009 to 41 patents in 2010. (Source: OMPIC). Overall, deposited patents increased from 910 to 1007 patents between 2006 and 2010, respectively.

Despite these significant efforts by the Moroccan government to create a favorable environment for the emergence of innovation, the results seem to be far short of the ambitions laid out. The Global Innovation Index shows that Morocco has lost, in 2009-2010, 17 ranks compared to its 2008-2009 ranking (source: report of the Global Innovation Index, 2008-2009 and 2009-2010 editions, INSEAD).

3. NIS in the literature

3.1. NIS: literature definition and evolution

Theories of innovation have gradually evolved, starting with the innovative entrepreneur (sole proprietorship). They widened later to the environment in which the company operates. Finally, these theories became national systems that, among other things, ensure coordination and regulation. Indeed, since the work of Schmpeter (1934) that stressed innovation major role in boosting the economy under the action of contractors. Next, Freeman (1974) dealt with the concept of R&D organization within companies. Afterwards, Von Hippel (1976) has highlighted the interactions between firms in the process of technological innovation. Subsequently, Lundvall (1985) set the ground rules for NIS and then Freeman (1987,1988) who focused on the role of social and political institutions in the innovation process technology.

In addition, several researchers agree on key aspects of NIS definitions:
- NIS consists of structures and economic institutions that influence the technological level of a country (Edguist and Lundvall 1993, Pattel and Pavitt 1994, Metcalfe 1995)
- The importance of role of networking and interaction between economic actors in the diffusion of technology (Freeman 1987 Lundvall 1992 Nelson and Rosenberg 1993).

- Innovation is not a step, but rather a gradual and cumulative process. This nonlinear process is located in a wider dynamic system, which is The National Innovation System. NIS is characterized by interactions between customers, suppliers, universities, banks, economic actors.... This system is parameterized by the nature of its component institutions and the flows and links that connect these components (Lundvall, 2000).
- The variety of interactions between institutions as part of a NIS: technical, commercial legal, social, financial ... Their aim is to ensure the development, protection, financing and regulation of innovation (Niosi et al 1993,). The same approach is used in defining the Organization for Economic Cooperation and Development (OECD report 1994) , which defines the NIS as "*a system of interacting private and public companies (large or small), universities and government agencies interact production-oriented science and technology on a national territory. The interaction of these units may be technical, commercial legal, social and financial, inasmuch as the purpose thereof is to develop protect, financing or regulation in new science and technology*".
- "The usefulness" of knowledge transmitted in networks to the economy (Lundvall 1992).

3.2. Narrow & broad NIS:

Beside these aspects, two approaches have emerged: that of narrow NIS and broad NIS. According to Adeoti (2002), a narrow NIS is an integrated system of economic agents and institutions directly related to the promotion of production and use of innovation in an economy. This approach includes the institutions and policies in relation to the activity of technological innovation. OECD (1999) nominates five types of institutions of narrow NISs:

- Governments that play the key role in setting broad policy directions,
- Bridging institutions, such as research councils and research associations, which act as intermediaries between governments and the performers of research,
- Private enterprises and the research institutes they finance,
- Universities and related institutions that provide key knowledge and skills,
- Other public and private organizations, such as public laboratories, joint research institutes and patent offices that play a role in the National Innovation System.

On the other hand, the broad approach of NIS includes, in addition to the components of the narrow NIS, "*the social, political and economic factors that may affect learning, research and exploration activities: the national financial system, monetary policies, the internal organization of private, pre university education system, labor market and institutions and regulatory policies*"(Feinson, 2003).

Referring to the literature, the pattern of Moroccan NIS as presented in Part 1 is designed from an international model. However, the results are still modest and far from being comparable to Moroccan competitors. Nevertheless, an important point learned from the literature on NIS is that interactions between different actors in the NIS are crucial.

Hypothesis: the low efficiency of Moroccan NIS is not linked to financial resources or to skills of the actors but to weak interactions and coordination failures between actors.

4. DISCUSSION

To test the hypothesis of the study, three levels of interaction in the diagram of NIS Moroccan are studied: (i) the coordination at the strategic level, (ii) the interaction between research structures and (iii) interactions between universities and the private sector. This latter level is considered on an analysis of two programs implemented by the Moroccan government to gear the university/business partnership.

4.1. Strategic coordination

The Permanent Inter-Ministerial Committee for Scientific Research and Technological Development (PIMCSRTD), the highest coordination and orientation, held only four meetings since its inception in 2001, the last being in 2007(source: MHESRPT).This can be explained as loss of interest of the highest political structure of the Moroccan NIS.

The national innovation strategy has provided a new instance of governance public / private called "national committee of innovation" emanating from the PIMCSRTD. This committee, whose mission is to evaluate the progress

of projects launched by the strategy and to adjust actions, has not yet emerged since the presentation of the strategy in 2009 (source: MCINT).

4.2. Interactions between research structures

The diversity of educational and/or research institutions led to panoply of actors including: universities (over 80% of national research), higher education institutions and public and private research institutions. So far, these actors do not coordinate in the best manner possible. When it is done at all, multi-actor coordination is infrequent, irregular, and most importantly never institutionalized. This situation is further complicated by different ministerial supervision of each actor. Research, however, is national and must comply with the directions and priorities set for development by the government. While retaining their specificity, these actors need tools to coordinate their actions so that they converge towards the desired objectives.

4.3. Interaction university/business

For illustration purposes, two programs, designed to fund innovative projects, are discussed in this section: the *Moroccan Network for Incubation and Spin* and the INNOV'ACT.

Moroccan Network for Incubation and Spin (MNIS)

The MNIS program began in 2002 and has had two phases: and first phase on the period 2002-2007 with French cooperation, then a second phase of sustainability (source CNRST).

- Funds allocated to the program:
    o first phase ~ 20 MDH,
    o Second phase ~ 11 MDH.
- Achievements (2002-2012):
    o 49 projects were selected by the selection and evaluation committee,
    o 5 projects have not started,
    o 19 projects have been abandoned or terminated,
    o Creation of 8 new businesses.
- Sectors of projects mainly supported:
    o Industrial,
    o agro-food businesses,
    o biotechnology,
    o ICT.

INNOV'ACT

Over the period 2005-2009, 20 projects were supported by INNOV'ACT, with the completion of 15 projects and a allotted funding of 6 MDH, of which only about 4 MDH were actually utilized. In 2009, an amount of 2 MDH was allocated to this program as the first endowment, but only four projects were supported (ongoing in 2012). (Source: R&D Morocco, MHESRPT). Several informational seminars were scheduled for both businesses and researchers. Despite these efforts, the results are not worthy of neither effort nor the resources allocated.

These two cases presented are programs intended to fund innovative projects. The insufficient results of the two programs may mean that these poor results are not due to meagre funding, nor to the lack of programs and structures. These deplorable results can be explained by several hypotheses: (i) the deficiency in risk taking and entrepreneurial culture in Morocco, (ii) the heavy and complicated administrative procedures and (iii) the lack of an effective information apparatus. In any case, coordination and promotion of interactions remain the Achilles' heel of the Moroccan NIS.

The Lack of responsiveness of businesses to such programs shows that the establishment of funding programs and support is not sufficient to create links between businesses and universities. Furthermore, the university has difficulty

feeding the innovation process. In 2009, about 6000 doctoral students enrolled in science and engineering fields, the number of theses defended did not exceed 300 dissertations.

Interaction between universities and businesses is still weak and threatens the sustainability of the Moroccan innovation chain, characterized by a lack in the valorization of R&D product and a deficiency in the involvement of companies in the process of research and innovation. Researchers note that companies are not able to enhance (or even believe in) their projects. These projects are often expensive, and their profitability is not necessarily immediate.The reluctance of manufacturers may be explained by and cumbersome administrative procedures for the release of financial incentives presented by the government. The fact that Moroccan economic structure is composed of over 90% of SMEs/SMIs emphasizes this reluctance.

In addition, the important human-resources turnover in these interfaces has failed to capitalize on the know-how; especially since these interfaces have for the most part no administrative existence for lack of organization. Volunteering was the hallmark of those who generously work in these structures. Needless to say that the procedures used to manage R&D and innovation finances in universities is not paralleled with its counterpart at the private sector.

In addition, Moroccan businesses often suffer from low mangers/employees ratios, which may lead to the absence of an internal vision of development and low competitiveness resulting in turn in low commitment to R&D. Behind all this, there is also an untrusting image that society, and particularly firms, have about universities in Morocco.

5. Conclusion

An innovation system is an open complex system composed of many actors and their interactions. In Morocco, awareness of authorities of the importance and challenge of science and technology in economic development is not new. In both phases, the Moroccan NIS was designed according to international standards, mobilizing very important resources and skills. The conclusion reached after analysis of said system is that the benefits are still very limited compared to the efforts and results expected.

The low efficiency of Moroccan NIS is not linked to financial resources nor the skills of the actors but to weak interactions and coordination failures between actors. This hypothesis was illustrated by the analysis of three interactions of the Moroccan NIS. These results are consistent with the literature which has set interactions between different actors of the NIS in the heart of the problematic.

This failure of interaction and coordination can, itself, be explained by several types of causes: the culture of education, governance networks and interactions, and administrative procedures. Verification of these hypotheses can be investigated to further this work.

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