EMERGING INNOVATION SYSTEMS (EIS): A NEW CONCEPTUAL FRAMEWORK FOR ANALYSING GCC AND MAGHREB COUNTRIES POLICIES

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ABSTRACT

Purpose: This paper examines some of the difficulties met by GCC and Maghreb countries to innovate and impulse a sustainable growth through the lenses of the *Emergence* paradigm. It looks more precisely at the state of innovation systems and how they work in this crucial stage of emergence.

Design/methodology/approach: Both in depth analysis of the existing literature and data collection. The study uses data from fieldwork conducted in both GCC and Maghreb countries involving several institutions (enterprises, training centers, ministries, research centers and industrial technical centers) together with secondary data mostly from international organisations.

Findings: Results indicate that both GCC and Maghreb Countries have not been using the right conceptual framework which is appropriate for their specific situation but rather an approach which is more indicated for emerging economies such as the Brazil, Russia, India, China and South Africa (BRICS) whose main objective is to catch up advanced economies. Our study shows in the case of GCC and Maghreb Countries, most key players and stakeholders of the innovation process are either partially included or totally excluded from the innovation sphere. Two major conclusions can be drawn: the first one, is the need to construct an innovation system which brings back all the key players in the innovation sphere. The second one is to build an innovation system more appropriate to the Emergence stage, which could exercise a relatively strong push for an effective demand for R&D products and services to emerge and which we call here 'Emerging Innovation System' (EIS).

Originality/value: The originality of this work rests on the analytical framework used. While most work done on these issues concentrated on input–output analysis examining mostly deficiencies

in investment in R&D and registered patents, our approach gives a new interpretation through the Emergence paradigm. The EIS approach developed in earlier work (Djeflat, 2008, 2009) proved very useful to highlight unknown aspects of the difficult situation suffered by both GCC and Maghreb countries.

***Keywords*:** Emerging Innovation Systems; EIS; innovation system; innovation emergence; catch up; developed countries; Maghreb; GCC countries.

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INTRODUCTION

GCC and Maghreb Countries have been trying to get their innovation systems off the ground for several years. For that purpose, many efforts have been made to accelerate this emergence stage using different policies without significant results particularly in industry. While the approach in terms of innovation systems is real and attracts a great deal of attention from policy makers in these countries, many of them are seeking the best and quickest way to start off innovation notably in their industrial sector, looking at the advanced world experience and trajectories but more and more to the Brazil, Russia, India, China and South Africa (BRICS) experience. Explicit efforts are made in many of these countries to accelerate this emergence stage. Yet when looking at these countries, where innovation is effectively taking place, a variety of situations and trajectories exist. This paper addresses the fundamental issue of innovation 'Emergence' in late industrialising countries such as GCC and Maghreb countries, both in terms of policies and conceptual framework. The issues raised relate to innovation dynamics in the early stage of system construction and notably: What are the characteristics of innovation systems in the pre-Emergence stage? How do GCC and Maghreb countries compare? What are the driving engines for innovation Emergence?

EMERGING INNOVATION SYSTEMS (EISS): A CONCEPTUAL FRAMEWORK

'Innovation Emergence' rests on the premise that innovation systems need both strong policy impulses from government and market dynamics for innovation to effectively take place. Innovation in the developing world as a whole suffers from a real crisis, not a maturity crisis known in certain advanced countries crisis but a crisis of birth in the framework of an innovation life cycle to be determined. If National Systems of Innovation (NSI) in the developed world are considered to be in an advanced stage, those of the developing world are rather in a primitive stage (Gu, 1999). Innovation Emergence is the prerequisite for innovation systems to operate in a conventional manner. Innovation systems theory has long been characterised by the difficulty in using it in system construction (Lundvall et al., 2002), yet many Less Developed Countries (LDC) seem to have resorted to this approach to build their innovation systems. Good examples are found among the BRICS countries. In many other LDCs, like GCC and the Maghreb countries (Algeria, Tunisia, Morocco), innovation systems construction takes place in a very specific environment with very little experience in the fields of R&D and innovation, and a relatively weak industrial sector in terms of performances, suffering notably from high levels of obsolescence both in terms of human resources and equipment. While innovation has always existed in some form or another in LDCs and in particular in Central American (Cummings, 2010), its broad systemic nature has not been recognised as such by both policy makers and researchers, preventing is from becoming a full-fledged economic and social phenomenon. A variety of situations of pre-emergence innovation exists and several attempts were made to characterise them, as we will see later.

Emergence, take off and catch-up: issues for a debate

The Emergence process is inspired from the take-off paradigm inspired to some extents from the stages of growth theory of Rostow (1960). Various critics have long pointed out the main weakness of the take-off paradigm in development study regarding namely its linearity and we would go along with this, knowing that standard theory

has largely failed to convey the complex nature of development. While empirical evidence and theoretical analysis have long showed its limitations, it is our belief that it could still see be adopted it when it comes to innovation and innovation systems theory, with, of course serious shortcomings regarding the sequencing. Several contributions substantiate our argument. Thus four stages were found in analysing emergence of sectorial innovation through the Samsung example (Ali, 2010). Godinho (2010) analysing the Indian and Chinese IPR system highlighted a 'historical take off' of the system. Incubators were found as a means of innovation 'take off' through strengthening technological capabilities, technological learning and innovation (Krammer, 2010). Tacit knowledge plays the most important role during the early stages (Lundvall and Borras, 1998) of the industry life cycle, new economic knowledge tends to result in a greater propensity for innovative activity to cluster, while they tend to be more highly dispersed during the mature and declining stages of the life cycle (Audretsch and Feldman, 2004).

While Take off may have relatively strong argument for it, the literature on *Innovation Emergence* remains scarce. As mentioned in earlier work (Djeflat, 2010), the term 'emergence' rests on *measurable motion to measurable motion* (Lewes, 1875), meaning the rising of novel and coherent structures, patterns and properties a specific sequence of interrelated problems, and associated solutions (Corning, 2002) for the micro-innovation system. Further analysis (Alkemade and Hekkert, 2008; Klepper, 1997; Metcalfe et al., 2005) identified distinct phases in the emergence process of a technological innovation system. A particular point of interest is the moment of take-off, seen as a separate phase in the diffusion process (Geels, 2002), the point where the system has gained momentum and from whereon, it becomes very difficult to stop the diffusion process (Rogers, 1962). Innovation emergence appears to be more appropriate for than catch-up for several reasons: Firstly, it is more adapted to the current state of economies where innovation systems are still in the construction stage in which most Developing countries are (Muchie, 2003). System construction or promotion (Lundvall et al., 2002) is preferred to system *reproduction*, which is more appropriate for catch-up countries. Secondly, it put the emphasis on the necessity for a critical mass and the creation of learning capacities in a bottom up strategy (Casadella, 2006). Thirdly, it stresses the need for the existence of a 'friendly environment', that is, an environment that facilitates interactive learning mechanisms in which innovations can come about (Szogs, 2010). Fourthly, emergence needs a strong state support regarding, in particular the institutional dynamics in terms of regulations, salaries and incentive systems, public procurements and so on, while the conditions of market dynamics are being put in place in transitional economies such as Maghreb countries for example. Similarly, sectorial innovation systems cannot be assumed ex ante as shown in studies in the agro-food industries in North African countries (Ait Habouche et al., 2004) knowing that this is a prerequisite for catch up to take place (Avnimelech and Teubal, 2006).

Characteristics of EISs

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 NSI of the North, innovation systems in the South cannot be assumed to have similar characteristics (Edquist, 1997) and we could not assume the existence ex-ante of NSI: often NSIs exist in a preliminary form, are unstructured, disorganised and fragmented, and mostly incomplete, with weak or missing links and weak incentive systems (Djeflat, 2004; Narula, 2004). They suffer from a deficit of interactions between the main components (Casadella, 2006) and pronounced rent seeking on the part of the main actors (Djeflat, 2004) to the extent that they can be considered as non-existent (Arocena and Sutz, 2003). The linkages between the various actors are of rather sporadic nature, which leads to more fragmented systems (Narula, 2002). The institutional infrastructure differs immensely from that of developed countries and is most often characterised by institutional inappropriateness and inadequacy to foster innovative activities and lack of physical and human resources (Szogs, 2010). For example, studies on North and West Africa show the existence of uncoordinated

components largely disconnected from public policies (Djeflat, 2003; Casadella, 2006; Carré, 2002).

The diffusion of the NSI concept in the South is possible only if two requirements mentioned previously are fulfilled and well understood: the character ex-post of NSI and the construction of technological capability. NSIs in the South reflect routine perspectives of techniques, where learning by using predominates and where R&D activities are not clearly defined and formally articulated within enterprise strategies (Arocena and Sutz, 1999, 2002). Problems of vulnerable and unstable macroeconomic environment are also quite important (Cassiolato and Lastres, 1999) and constitute real obstacles for innovation to the extent that we could talk about *national system of inertia* (Hobday, 1995; Hobday et al., 2004). Networks between industry and R&D tend to be absent (Wangwe, 2003). The inability to put in place mechanisms of collective learning is a marked feature, knowing that without collective learning, it is difficult to talk about the existence of innovation system (Archibugi et al., 1998). In this respect, the innovation gap as defined by Arocena and Sutz (2000), goes beyond access to technological know-how and entices three fundamental problems (Oyelaran-Oyeyinka, 2004). These relate to the inability of local institutions to interact with productive entities, to the difficulty in the building of local knowledge through the tacit knowledge of small structures in an unstable competitive environment and finally to the repetitive techniques of learning through imitation. Similarly, the emphasise needs to put the importance of building technological and financial capabilities, managing the diffusion process, adopting and modifying technologies to put up a real 'National Technology Systems' (NTS) (Lall and Pietrobelli, 2002): many of these capabilities are missing in the Developing World. Similarly, countries in the South can have only poor learning interactive spaces as a result of the scarcity of these interactions (Arocena and Sutz, 2003) and consequently, NSI in the South are relational, normative and built ex-post (Arocena and Sutz, 1999, 2002).

NSI functions in the wake of diversity and variety (Johnson, 1992), of uncertainty resulting from their evolution according to a selected trajectory, selectivity and path-dependency or historicity and finally of irreversibility (Niosi et al., 1992). While trajectory constitutes a key concept in the catch up theory (Malerba, 2004), in Emergence approach, they take a particular meaning. Trajectories in Developing Economies do not seem to be continuous and linear. This gives NSIs in the South their own specificities and the heterogeneity of their trajectories, and explains to some extent the various stages of development they have reached. They are often *broken trajectories* of sectors which accumulate know how and knowledge, which manage the process of gathering the necessary conditions for emergence but manage also to regress, and dis-accumulate through de-learning. The sources of dis-accumulation are numerous: instability of competencies, relatively high and continuous labour *turnover* (Oyelaran-Oyeyinka, 2004), the attractiveness of more lucrative sectors often in the tertiary sector, the exodus of competencies and the effects of structural adjustment programs. The latter have been major factors of dis-accumulation as a result of dismantling numerous public enterprises in the manufacturing sector and the laying off of their employees (Casadella, 2006; Djeflat and Boidin, 2002; Djeflat, 2004). The declining investments in industry as a result of falling external revenues has contributed a great deal to these broken trajectories. This interrupted learning process helps to explain the weaknesses of learning and managerial capacities in the strict sense of the word (Johnson and Lundvall, 2003; Lall and Pietrobelli, 2002). Liberalism can also lead, in the South, to making less effort in R&D to benefit from ready-made technology due to a more open economy and additional facilities for importing (Naclerio, 2004). This is not to be assimilated to what Johnson (1992) calls de-learning, the capacity of forgetting (Mytelka, 2000) so indispensable to technical change at the firm level. Competition for local resources coming from basic and more urgent needs in terms of health, food and basic infrastructures contribute also to adjourning or marginalising research and innovation programs and policies. Finally, 'rent-seeking', which characterises many Developing economies, tends to strengthen existing structures and practices, leaving very little room for creativity, invention or innovation. Consequently, two major conclusions can be drawn: the first one, is the need to construct

an innovation system more appropriate to the Emergence stage, which we call here 'EIS' whose main characteristic is to exercise a relatively strong push for an effective demand for R&D products and services to emerge; and the second one is the necessity to build an innovation system which could move the whole apparatus from Emergence to catch up at a latter period.

DIFFICULT INNOVATION EMERGENCE IN GCC AND MAGHREB COUNTRIES

It is a fact easily documented that major efforts have been made by a number of Arab countries to launch innovation, pressurised as it were, by innovation-based competition. We will look at the usual indicator to highlight the difficulty of emergence of the innovation process. Finally, emergence can be also localised either in a sector or in a territory or both: Employment has been multiplied by eight in nine years, while it is multiplied by six in six years and by four in five years in the case of Casa technopark and Elgazala. The number of jobs in the MSC in 2005 is 30 times higher than in ElGazala and 38 times higher than in Casa technopark. In the (MSC), the number of enterprises was multiplied by 23 since its creation, while in the case of ElGazala; it was multiplied by 2, and 0.5 in the case of Casa technopark in Morocco (Figure 1).

R&D expenditures: It is a fact that innovation inputs remains relatively poor in these countries. As an example, Maghreb countries experienced a relatively slow pace of R&D expenditures than South Korea known for the successful Emergence of its innovation system. In terms of industrial research, South Korea is in the sixth place among OECD countries with R&D expenditure reaching US$14.43b per year. Globally, industrial R&D reached 2.64% of GDP in 2003, while enterprises account for 70% of the total R&D expenditure: half of these come from the electronics sector, followed by the automotive (14.8%) and chemical industries (10%).

Patents: Similarly, the results of these R&D expenses remain weak and irregular, a common feature of many Developing countries (Fagerberg et al., 1999; Fagerberg and Godinho, 2004). Figures from the Algerian Patent Registration Office for example show the weak performances of R&D and the relatively slow and difficult progress that has been made sowing a difficult Emergence innovation system: less than 10 patents on average registered each year during the ten years between 1983 and 1993. Comparatively in South Korea, the total number of registered patents grew 100 times between 1981 and 2000 with a sizeable share of residents' share. Furthermore, the difficult Emergence of the innovation system is corroborated by the high proportion of individual innovators, which represent 84% of the total in

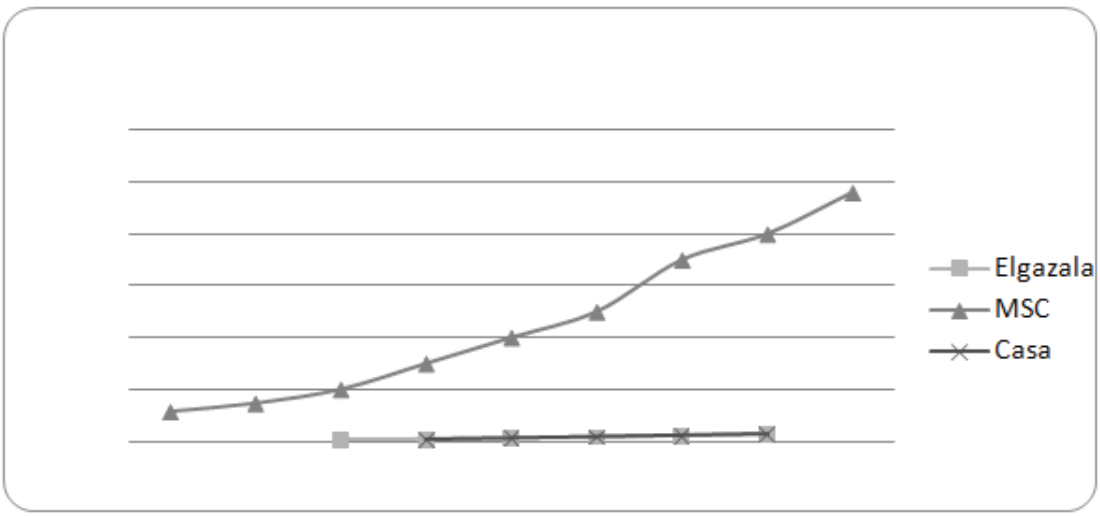


Figure 1 Employment creation at the take off stage in the MSC and in the Maghreb

Algeria, while the share of enterprises did not exceed 9% (Djeflat et al., 2008). Research centers and universities also lag behind with only 6%, showing a real crisis of institutional research. This is also the syndrome of stagnation and difficult Emergence. In comparative terms, in France the proportion of institutions reached 68% while the share of individuals did not exceed 16%, another indicator of an innovation system in the stage of maturity. This can easily be seen when using conventional metrics such as number of registered patents. Looking at GCC and Maghreb countries, for example, data of the World Bank (2010) indicate that they are performing poorly relatively to peers in the region with the exception of Saudi Arabia, where they are heavily concentrated in the oil sector (Aramco and Sabic corporations essentially). In the 2003–2007 period, the number patent application filed with USPTO reached 463 lower than Morocco's with 610. The average number of patents per million inhabitants registered in the 2005–2007 period, does not exceed 5.16% for Saudi Arabia for example which slightly lower than that that of Morocco, while for Oman this is negligible (0.08%) (WIPO, 2008). Individuals constitute the bulk of patent holders. Thus in the case of Morocco, for example, they constitute 72% of all patents registered locally. Institutions are poorly represented: 17% are enterprises (SMEs) while universities are 11% only (Andersson et al., 2006; Djeflat et al., 2008). Comparatively, the balance is in favour of institutions in advanced countries. Thus in France, for example, individuals share does not exceed 16% of the total, while enterprises share represent 68%. This indicates that the institutional base for inventions is rather weak in the region, which may reflect lack of trust between inventors and institutions, and deficiencies in incentives on the part of institutions to cherish innovation. In the GCC countries, the proportion of patents by individuals is not clear due to lack of data. However, firms may resort, to other methods for protecting their innovation such as those listed in the Oslo Manual as seen previously: 'confidentiality agreements and trade secrecy', 'secrecy that is not covered by legal agreements' and 'lead-time advantage over competitors'. Many innovations are not patented because they are of an intangible sort, or because patents would do more harm than good by disclosing valuable information without providing the means for protecting exclusive rights. This may be particularly the case for smaller firms and in areas where information on cross-country legal conditions are opaque. These are undeniably more difficult to investigate being sometimes part of the strategies used at firm level. Similarly, cost considerations cannot be minimised even if data are not easily obtainable. Thus, SMEs are dominant in many countries (estimates in Turkey give 99.98%) and the costs of patent application could prove too high for most of them to incur (Beyhan et al., 2002). In many developing countries, weaknesses in the implementation of Intellectual Property Rights (IPR) add to the problems.

High-tech exports: apart from signaling the degree of economic diversification, high-tech exports as a percentage of total exports have been extensively used in recent years as a metric for innovative capabilities in both the developed and developing countries. It can indicate a potential demand for innovative products and services of a country coming from foreign markets. Available data show (World Bank, 2010) relative weaknesses of GCC countries when compared to Maghreb countries such as Morocco. In this latter country, high-technology exports as percentage of total manufactured exports reached an average of 10.3% in the 2003–2007 period. Oman which takes the leadership of the GCC group does not exceed 1.4% while, Qatar and Bahrain are lagging behind during the same period. Many countries of the sub-region recently upgraded their share of high-tech content of their exports as shown by available data in the case of Morocco and Tunisia. In this respect, Morocco is outperforming not only its neighbours, but also a country such as India. On the other hand, a closer look reveals that the medium- and high-technology exports in 2003 were heavily concentrated in

(1) 'lamps, tubes et electronic valves', which account for 36%

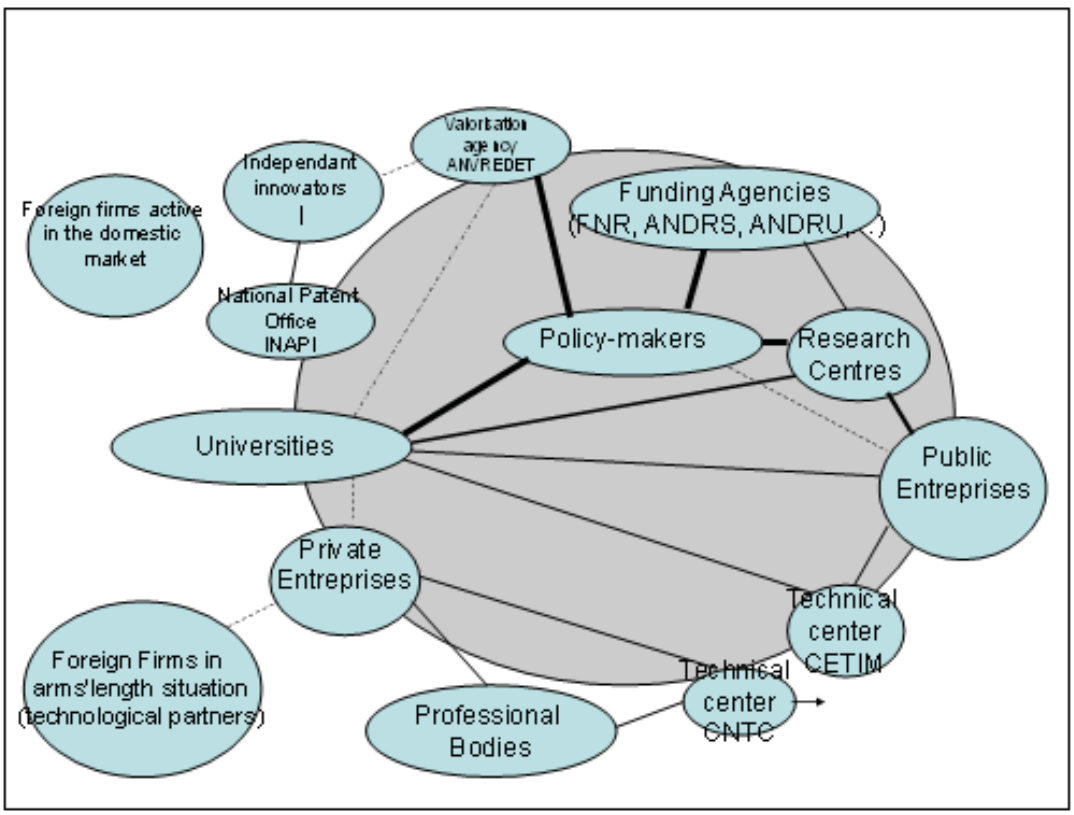
(2) inorganic chemicals and halogens, mostly phosphoric acid, accounting for 31%

(3) fertilizers (phosphates), accounting for another 22% (Ministère des Finances, 2005).

Using instead the OECD's classification of industry by technology intensity, in 2000, low technology sectors accounted for 73% of all manufacturing

exports with medium low-technology sectors accounting for another 8%. A set of[1] high-tech export categories, mainly electronics components, accounted for less than one % of all manufacturing exports. Medium-high technology exports accounted for 19%, however, mostly phosphate based fertilizers and mineral acids as described above. Notwithstanding the non-negligible medium-high technology exports, Morocco's exports structure is opposite to that of the average OECD country where high and medium-high technology sectors now account for two-thirds of total exports. Best practices indicate thus policies should enhance the share of high technology exports through various incentives and various support programmes. While all types of firms – Moroccan owned, 100% foreign-owned, and those with mixed ownership – were predominantly in low technology sectors (mostly textiles), 100% foreign-owned firms had a higher share of high- and, in particular, medium-high technology exports sectors (MENESRSFC, 2002). Fertilizers were entirely exported by Moroccans, while foreign firms concentrated on machinery, electric apparatus and equipment, and as seen above, mostly lamps. While entirely foreign firms had higher technology content in their manufacturing exports than Moroccan firms, firms with mixed ownership did not. An estimated 94% of their exports were in low and medium-low technology sectors.

The structure of the economy requires, however careful attention. In the GCC countries, the services sector is relatively important, as shown by its share of employment. The not yet exploited potential for innovation in this sector deserves special attention by policy makers. Services represent between 60% of GDP (UAE) and 90% of GDP (Oman) according to World Bank data (2010). The services can be sources of incremental innovation in GCC countries: radical



Source: Djeflat et al. (2008).

Figure 2 The current national innovation system excludes most key players

innovation rarely occurs in services (Carvalho, 2008). This is not, however specific to GCC countries. Reasons include the inadequacy of the instruments used (services introduced recently to the assessment process) to the difficulty in integrating them in Country Innovation Surveys (CIS). Thus, in a recent CIS in Turkey for example, process innovation was excluded yet essential in the services sector (50% of GDP).

Exclusion of key players

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). Others are partially included in the innovation system (Valorisation agencies, universities, private and public enterprises) (Figure 2). Only a small group can be considered a being fully included: these are policy-makers, research centers and research funding agencies (Djeflat et al., 2008). This fragmented and often excluding innovation system feature seems to be quite common in many Developing Countries as seen earlier.

CONCLUDING REMARKS

In this paper, we attempted to set the basis for the issue of innovation emergence both as a concept and as a policy instrument. In a situation of de-structured, fragmented, immature and sometimes virtually non-existent Innovation systems, in which most GCC and Maghreb countries find themselves, it would be difficult to work out catch up strategies. Several attempts are being made to build innovation systems, inspired by those in advanced countries. These attempts are centralised and state-supported and take very little account of the creative potential of these countries, which are largely decentralised in nature, hence the very limited results obtained.

The EIS paradigm proposed in this paper takes into account this largely decentralised creative potential and the effective capacity to mobilise knowledge resources, and to exercise a sufficiently powerful thrust for innovation to take place through the emergence of effective demand for R&D and adequate absorptive capacity. The EIS needs to be further examined both theoretically and from an empirical point of view. It needs to take into consideration the specificities of countries, knowing that Innovation emergence is context specific and strongly localised, even if common elements such as effective demand and absorptive capacity are similar in nature everywhere.

There are common weaknesses that hinder the GCC and Maghreb countries' Innovation System Emergence. We could mention several[2]: slow pace of reforms in the countries' education systems, inadequate public awareness of science and technology and insufficient degree of preparedness for knowledge activity due to overemphasis on physical assets and suboptimal allocation of resources and attention to the soft architecture of the knowledge economy. Other weaknesses include risk-aversion to investment with regard to venture capital and technology financing, weak IPR regimes and lack of regional coordination of investments and scientific efforts.

REFERENCES

Ait Habouche, M., Jaidi, L. and Zaidi, D. (2004) *Gouvernance et institutions intermédiaires dans les processus d'innovation*, Femise Report, Université de la Méditerrannée, Marseille, France.

Ali, M. (2010) 'A spiral process of model of technological innovation capabilities in a Developing Country: the case of Samsung', *Paper presented at the eighth Globelics conference*, Kuala Lumpur, 1–3 November.

Alkemade, F. and Hekkert, M. (2008) *Development Paths for Emerging Innovation Systems: Implications for Environmental Innovations*, ISU Working Paper 09.08, University of Utrecht.

Andersson, T., Djeflat, A. and De Silva, S.J. (2006) 'The innovation system and related policy issues in Morocco', *Working Paper, International Organisation for Knowledge Economy and Enterprise Development (IKED)*, Jonkoping University, Sweden.

Archibugi, D., Howells, J. and Michie, J. (1998) 'Innovation systems in a global economy', *CRIC discussion Paper, No.18, Centre for Research on Innovation and Competition (CRIC)*, The University of Manchester, UK.

Arocena, R. and Sutz, J. (1999) 'Looking at national systems of innovation from the South', *Industry and Innovation*, Vol. 7, No. 1, pp.55–75.

Arocena, R. and Sutz, J. (2000) 'Interactive learning spaces and development policies in Latin America', *DRUID Working Paper*, 13/2000, DRUID, Copenhagen Business School, Denmark.

Arocena, R. and Sutz, J. (2002) 'Innovation Systems and Developing countries', *DRUID Working Paper*, No. 02–05, DRUID, Copenhagen Business School, Denmark.

Arocena, R. and Sutz, J. (2003) 'Understanding underdevelopment today: news perspectives on NSI', *First Globelics Conference: Innovation Systems and Development Strategies for the Third Millennium*, Rio de Janeiro, Brazil.

Audretsch, D.B. and Feldman, M.P. (2004) *Innovative Clusters and the Industry Life Cycle*, Springer, Netherlands.

Avnimelech, G. and Teubal, M. (2006) 'Innovation and Technology Policy for Catching Up: A Three Phase Life Cycle Framework for Industrializing Economies', *Studies and Perspectives Series*, No.69, United Nations, Economic Commission for Latin America and the Caribbean.

Beyhan, B., Dayar, D., Findik, D. and Tandogan, S. (2002) 'Comments and critics on the discrepancies between the Oslo Manual and the Community Innovation Surveys in developed and developing countries', *Working Paper, Science and Technology Policies Research Center*, Series, 09/02, TEKPOL, Ankara.

Carré, H. (2002) 'Innovation et développement dans une économie de rente: le cas du secteur agro-alimentaire au Sénégal', in A. Djeflat and B. Boidin (Eds.). *Ajustement et technologie en Afrique*, Paris, Publisud.

Carvalho, L. (2008) *Innovation and Entrepreneurship: A Model to Service Sector*, PhD Thesis, Evora University, June, Portugal.

Casadella, V. (2006) *Le Système de Construction de Compétences au Sénégal*, Doctoral thesis, University of Perpignan, France.

Cassiolato, J.E. and Lastres, H.M. (1999) 'Local, national and regional systems of innovation in the Mercosur', *DRUID Conference Paper*, DRUID, Copenhagen Business School, Denmark.

Corning, P.A. (2002) 'The Re-emergence of "Emergence": A venerable concept in search of a theory', *Complexity*, Vol. 7, No. 6, pp.18–30.

Cummings, A. (2010) 'Building innovation capabilities for cashew nut processing in El Salvador', in B. Johnson and O. Segura (Eds.). *Systems of Innovation and Development: Central American Perspectives*, Universidad Nacional, Costa Rica.

Djeflat, A. (2003) 'Les Systèmes Nationaux d'Innovation: entre globalisation et territorialisation', in M. Rautenberg (Ed.). *Dynamiques locales et Mondialisation, Revue CLES*, l'Harmattan, Octobre, pp.131–153.

Djeflat, A. (2004) 'National Systems of Innovation in the Mena Region', *World Bank Institute Report*, World Bank, Washington, DC.

Djeflat, A. (2008) 'Innovation takes off through Industrial Technical Centers in Maghreb Countries: a missing link in NSI or new opportunity?' *Sixth Globelics International Conference*, Mexico City, Mexico, 22–24 September.

Djeflat, A. (2009) 'Building systems for innovation take off', *African Economies, African Journal for Science, Technology, Innovation and Development*, Vol. 1, No. 1, pp.54–78.

Djeflat, A. (2010) 'Building Systems for Innovation take off in pre-catch up countries: the case North African Economies', *Paper Presented at the 8th Globelics Conference*, Kuala Lumpur, 1–3 November.

Djeflat, A. and Boidin, B. (Eds.) (2002) *Ajustement et Technologie en Afrique*, Publisud, Paris, France.

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

Djeflat, A., Devalan, P. and Youcef Ettoumi, F. (2008) 'Evaluation des Politiques et Programmes d' innovation dans le secteur industriel', *Final Report*, European Commission – Ministry of Industry, Brussels: EC.

Edquist, C. (1997) *Systems of Innovation, Technologies, Institutions and Organizations*, London: Pinter.

Fagerberg, J. and Godinho, M. (2004) 'Innovation and Catching-up', in J. Fagerberg, D. Mowery and R. Nelson (Eds.). *The Oxford Handbook of Innovation*, Oxford, UK: Oxford University Press.

Fagerberg, J., Guerrieri, P. and Verspagen, B. (Ed.) (1999) *The Economic Challenge for Europe: Adapting to Innovation Based Growth*, Cheltenham, UK: Edward Elgar.

Geels, F. (2002) 'Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case study', *Research Policy*, Vol. 31, pp.1257–1274.

Godinho, M. (2010) 'Analyzing the evidence of IPR take-off in China and India', *Paper Presented at the 8th Globelics Conference*, Kuala Lumpur, 1–3 November.

Gu, S. (1999) 'Concepts and methods of NIS approach in the context of less-developed economies', *DRUID Conference Paper*, DRUID, Copenhagen Business School, Denmark.

Hobday, M. (1995) *Innovation in East Asia: The Challenge to Japan,* Cheltenham, UK: Edward Elgar.

Hobday, M., Rush, H. and Bessant, J. (2004) 'Approaching the innovation frontier in Korea: the transition phase to leadership', *Research Policy*, Vol. 33, No. 10, pp.1433–1457.

Johnson, B. (1992) 'Institutional learning', in B. Lundvall (Eds.). *National Innovation System: Towards a theory of innovation and interactive learning*, London: Pinter Publishers.

Johnson, B. and Lundvall, B. (2003) 'National System of Innovation and Economic development', in M. Muchie, P. Gammeltoft and B.A. Lundvall (Eds.). *Putting Africa First: The Making of African Innovation System*, Aalborg, Denmark: Aalborg University Press.

Klepper, S. (1997) 'Industry Life Cycles', *Industrial and Corporate Change*, Vol. 6, No. 1, pp.145–181.

Krammer, E. (2010) 'Impact of Technology incubators on the underlying processes of innovation in the south African sector', *Paper Presented at the Eighth Globelics Conference*, Kuala Lumpur, 1–3 November.

Lall, S. and Pietrobelli, C. (2002) *Failing to Compete: Technology Development and Technology Systems in Africa*, Cheltenham, UK: Edward Elgar.

Lewes, G.H. (1875) *Problems of Life and Mind (First Series)*, Vol. 2, London: Trübner.

Lundvall, B., Johnson, B., Andersen, E.S. and Dalum, B. (2002) 'National systems of production, innovation and competence building', *Research Policy*, Vol. 31, No. 2, pp.213–231.

Lundvall, B.A. and Borras, S. (1998) *The Globalizing Learning Economy: Implications for Innovation Policy*, Brussels: Commission of the UE, p.170.

Malerba, F. (2004) *Sectoral Systems of Innovation: Concepts, Issues and Analyses in Six Major Sectors in Europe*, Cambridge: Cambridge University Press.

MENESRSFC (2006) Ministry of higher education and research *Internal report*, Morocco.

Metcalfe, J.S., James, A. and Mina, M. (2005) 'Emergent innovation systems and the delivery of clinical services: The case of intra-ocular lenses', *Research Policy*, Vol. 34/9, pp.1283–1304.

Muchie, M. (2003) 'Re-thinking Africa's development through the National Innovation System', in M. Muchie, P. Gammeltoft and B.A. Lundvall (Eds.). *Putting Africa First: The Making of African Innovation System*, Aalborg, Denmark: Aalborg University Press.

Mytelka, L. (2000) 'Local systems of innovation in a globalized world economy', *Industry and innovation*, Vol. 7, No. 1, pp.15–32.

Naclerio, A. (2004) *La dimension systémique du Système National d'Innovation: Une application au cas de l'Argentine*, Thèse de doctorat. Université Paris, Vol. 13.

Narula, R. (2002) 'The Implications for growing cross-border interdependence for systems of innovation', *MERIT-Infonomics Research Memorandum series*.

Narula, R. (2004) 'Understanding absorptive capacities in an Innovation Systems context: Consequences for Economic and Employment Growth', *DRUID Working Paper*, No. 04–02, DRUID, Copenhagen Business School, Denmark.

Niosi, J., Bellon, B., Saviotti, P. and Crow, M. (1992) 'Les systèmes nationaux d'innovation: vers un concept utilisable', *Revue française d'économie*, Paris, Vol. 7, No. 1, pp.215–249.

OECD (2003) *Science, Technology and Industry Scoreboard 2003 – Towards a knowledge-based economy*, Paris.

Oyelaran-Oyeyinka, B. (2004) 'Learning and local knowledge institutions in African industry', *UNU/INTECH Discussion Paper Series*, Maastricht, Netherlands.

Rogers, E.M. (1962) The diffusion of innovations, cited by Alkemade, F. and Hekkert, M. (2008) 'Development paths for emerging innovation systems: implications for environmental innovations', *ISU Working Paper 09.08*, University of Utrecht.

Rostow, W.W. (1960) *The Stages of Economic Growth: A Non-Communist Manifesto*, Cambridge: Cambridge University Press.

Szogs, A. (2010) 'Technology transfer and technological capability building in informal firms in Tanzania', PhD thesis, CIRCLE, Lund University, Sweden.

Wangwe, S.M. (2003) 'African systems of innovation: toward an interpretation of the development experience', in M. Muchie, P. Gammeltoft and B.A. Lundvall (Eds.). *Putting Africa First: The Making of African Innovation System*, Aalborg, Denmark: Aalborg University Press.

WIPO (2008) *World Patent Report: A Statistical Review – 2008 Edition*, WIPO, Geneva, Switzerland.

World Bank (2010) *World Development Indicators*, Washington, DC.

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