ABSORPTIVE CAPACITY AND DEMAND FOR INNOVATION AS DRIVING ENGINES FOR EMERGING INNOVATION SYSTEMS (EIS): COMPARING GCC AND MAGHREB COUNTRIES

Abdelkader Djeflat
Maghtech – CLERSE (CNRS 8019),
University of Lille, France
E-mail: Abdelkader.djeflat@univ-lille1.fr

ABSTRACT

Purpose: The objective of this paper is to highlight some of the major obstacles facing the emergence of the innovation process in both GCC and Maghreb Countries. It presents an empirical analysis of the absorptive capacity and the effective demand for R&D and innovation services and compares the two blocs of countries.

Design/methodology/approach: The study uses data from fieldwork conducted in both GCC and Maghreb countries involving several institutions (enterprises, training centres, ministries, research centres, universities and industrial technical centres) together with secondary data mostly from international organisations.

Findings: Results indicate that both GCC and Maghreb Countries suffer from weak absorptive capacity of R&D funding, of higher education graduates, of new technology and researchers. Demand for R&D and innovation appears to be the second handicap in both GCC and Maghreb Countries: it results from low demand for University research services, low demand from the private sector for R&D and low demand for venture capital. The data show that overall, GCC countries seem to be performing better than Maghreb countries.

Originality/value: The originality of this work stems from two aspects: the first one is analytical tool we used and which is derived from the concept of *Emergence* and which we developed in an earlier work (Djeflat, 2006). We use for the first time the 'emergence' paradigm rather than the catch-up one in the Arab World. The second one is to investigate in depth the absorptive capacity and the demand for R&D using a comparative perspective between GCC and Maghreb Countries, a work rarely done.

***Keywords*:** innovation system; innovation emergence; catch up; absorptive capacity; effective demand; developed countries; Maghreb; GCC countries.

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INTRODUCTION

Major efforts were made by some many South countries, in recent years to boost R&D and expenditures increased in a relatively short time from 0.3 to 0.7%, and even to 1% of GDP, notably in North Africa (Djeflat et al., 2007). Often this effort associated with some kind of policy has not produced any significant result showing that, financial thrust, by itself does not get innovation off the ground within a reasonable time. On the contrary, too much funding has created some undesirable side effects. Thus, one of the important problems is the 'absorptive capacity' of these countries. Various studies on innovation have pointed out the absorption capacity as one of the major obstacles for innovation to get off the ground (Jensen et al., 2004).

ABSORPTIVE CAPACITY AND EFFECTIVE DEMAND FOR R&D AND INNOVATION SERVICES: TOWARDS A COMCEPTUAL FRAMEWORK

Absorptive capacity

The importance of absorptive capacity has been highlighted in several contributions as a complementary necessity to knowledge creation in relation to technologies acquired abroad (Kim, 1997; Mowery and Oxley, 1997), and also as a prerequisite to the learning process at the firm level. This necessitates notable intangible investments (Cohen and Levinthal, 1989, 1990), and a capacity to create new knowledge and to search and select the most appropriate technology (Narula, 2004). The lack of absorptive capacity on the part of firms could be the result of the lack of applicability of technological knowledge to local conditions, making collaboration with underdeveloped socio-economic structures virtually impossible in a non-system perspective (Szogs, 2004). The difficulties met, often reflect the crisis, which the national absorption capacity shows. According to Narula (2004), this can be due to several factors: weak or missing basic infrastructure (means of communication, electricity, health and basic education), advanced infrastructure (universities, research institutes, firms-domestic and foreign affiliates) and formal and informal institutions (intellectual property rights regime, taxation, incentive system and partnerships). It is also a characteristic of the difficult emergence stages: examining the Korean experience, Lee (2010) highlighted three stages from the initial to the final stage where the 'absorptive capacity' played a key role. In the initial stage, foreign technology acquisition accompanies investment in capital. In the second stage, Korean firms are able to absorb and assimilate foreign technology still in the introduction or growth stage in industrialised economies. In the third stage, improvements of innovative capabilities leads to the improvement in productivity.

Effective demand for R&D and innovation

Effective demand for innovation has long been neglected in the work on innovation emergence in Developing Countries. Yet work done on advanced countries has clearly shown that it is key driver of innovation at firm level. Innovation takes often place within complex, cumulative and path dependent interaction process close to what Abramowitz (1986) calls 'social capabilities', benefiting from rich learning interactive spaces in the sense that several productive encounters take place between those that need knowledge and those that could interact with them. This encounter does not, however, automatically take place. Often in Southern countries, supply of innovative effort does not meet any demand. Therefore, effective demand is considered as one of the engines of driving the innovation dynamics. Indeed, often the approach used has concentrated on the supply side. Weaknesses highlighted are related to imperfect markets for innovative products and services. It is in a way linked to absorptive capacity of the system seen above. The existence of effective demand for R&D and innovation services is crucial, while reality

shows that this demand remains still very weak in spite of the opening of these economies through various mechanisms (globalisation, free trade zone, WTO agreements, etc.) and the ensuing pressure of competition. The development of and innovation system at firm level, at a regional level or at a national level could not possibly evolve unless a substantial demand exists for new products and services and subsequently for R&D activities (Nielsen, 2005). This can also result also from rare opportunities to apply technological capabilities to solve local technical and technological problems (Casadella, 2006). These opportunities are also fundamental to develop innovation capacities (Arocena and Sutz, 1999). If opportunities to build an appropriate, tailor made and context specific solutions to local problems are not given, it would be difficult to get innovation off the ground. Several examples exist in the industrial experience of Arab Countries and particularly in those that have access to surplus income, to resort to foreign companies, design offices, laboratories and centres of research for any kind of problems faced, depriving thus local innovation capabilities from valuable opportunities to learn. In other words, innovation Emergence cannot be triggered off through conventional market mechanisms, but needs a relatively strong institutional support made of a robust legal system, a good incentive system and political engagement on the part of actors of the innovation set up (Lundvall, 1992; Von Hippel, 1988). Thus, a guarantee to innovation effort is necessary. This effort is made by individuals and institutions at various levels: micro-economic, miso-economic and macroeconomic. Public procurement is part of this guarantee to innovation effort and can play a vital role in the face of market failure in the Emergence of innovation system. It is acquiring more and more importance as both a policy instrument and a concept to be further investigated (Edquist et al., 2000). The actions of government were critical in the Emergence of innovative technologies and services in most advanced countries. This Public demand for knowledge and innovation exist even in the prospect of privatization. Innovation projects need a broad range of products and services, and an important capital lay out. Market formation is usually limited in this early development phase and only early adopters are willing to adopt the innovation as they are often very expensive and have low performance compared to the incumbent technology (Rosenberg, 1976). However, protected market niches may be created in this phase so that the technology can develop a series of such niche markets can act as a bridge to mass markets (Andersson and Jacobsson, 2000; Geels, 2002). The State plays a crucial role in creating a niche market, because it holds the power to change/ legislation and because it can act as a 'launching customer'. The government can articulate demand for a new technology by acting as an early user or by formulating policy targets. The role of the State is thus paramount. This role is even more important in countries where the technological base of the private sector is relatively weak. The State plays an important push role before the private sector and market become strong enough to take over. A public–private partnership to build this sustainable demand for innovative products is also a key to this process.

It can be seen thus that both groups of countries are subjected to limited absorptive capacity and demand for innovation. This preliminary study has shown that both components of Emerging Innovation Systems (EIS) are linked to a host of variables, which we summarise in Table 1.

EMPIRICAL EVIDENCE FROM MAGHREB AND GCC COUNTRIES

This section examines empirically the situation of Maghreb and GCC countries regarding both absorptive capacity and effective demand for Innovation.

ABSORPTIVE CAPACITY

More and more attention has been given to absorptive capacity in Developing Countries in recent year as substantiated in several studies. This notion has been even further explored and strengthened as an analytical tool in the sphere of science technology and innovation: effective demand for innovative products and services much in the Keynesian sense of the word seems to constitute one of the major obstacles. Absorptive capacity has then evolved to encompass all kinds of institutions and activities: firms and research institutions.

Table 1 Extended framework for innovation emergence

Engines for EIS	*Key components*	*Variables*	*Requirements*
Absorptive capacity	Absorptive capacity of graduates	Employability	– Quality of the education system
			– Governance of higher education
	Public Research funds	Critical mass	– Governance of research institutions
			– Quality of research institutions
	Absorptive capacity of researchers:	– Size of research Community	– Quality of research institutions
			– Brain drain and capacity to retain competencies
Effective demand	New Technology by local firms	– Technology spillover by FDI	– Corporate Governance
	Public procurement	– Protected market niches	
	Demand for Venture capital	– Availability of information	– bureaucratic procedure
			– incompetent personnel
			– lack of trust
	University research services	– need for non-government funds	– successful bridge institutions
		– access to broader science-based R&D	– emerging clusters
			– formal agreements: university-industry
	Private sector demand for R&D	– Information Patent services	– innovation as a core firms activity
		– use of external funds	– R&D as continuous activity
			– Corporate governance

Source: Elaborated by the author.

Absorptive capacity of public research funds

There has been a real effort in recent years to increase public funding for R&D in the MENA countries particularly in the Maghreb. However, there are concerns that the increases in R&D spending largely reflect salary increases in academia, that is, the fact that existing R&D efforts have become more expensive, rather than that additional R&D efforts are undertaken. In Morocco, for example, 95% of the budget is allocated to wages. While all studies come up with the conclusion that research funding is insufficient in many developing countries including GCC, detailed investigation indicates that absorptive capacity is another important issue to tackle. Indeed, in many countries, funds allocated by the State are no fully absorbed. Major efforts were made, however by some countries in the region: in recent years to boost, R&D and

expenditures increased in a relatively short time from 0.3 to 0.7%, and even to 1% of GDP, notably in the Maghreb (Djeflat et al., 2007). Often this effort associated with some kind of policy has not produced any significant result showing that, financial thrust, by itself does not get innovation off the ground within a reasonable time. On the contrary, too much funding has created some undesirable side effects. Thus, one of the important problems is the 'absorptive capacity' of these countries.

As shown in Table 2, less than 16% of the allocated funds in Algeria could be absorbed by the national research system. Many factors could explain this (Djeflat et al., 2007): the first one relates to the weakness of the human element, coupled with a poor institutional and incentive regime. The second one relates to insufficient 'critical mass', defined, as the minimum level required of a mix of human, financial and institutional ingredients. Thus, Science, Technology and Innovation (STI) policies in the sub-region need to address the issue of absorption capacity of research institutions and find ways and means to upgrade this capacity and not simply increase allocation of funding.

Absorptive capacity of graduates by local labor market

Graduates often meet critical problems of recruitment in the labor market. Thus, it is more and more evident that the university and the higher education system overall, train student whose prospects of being recruited are rather slim. The local labour market is finding it difficult to absorb graduates and in particular those that are from higher education. A close look at the rate of unemployment in Morocco for example, shows that it is the highest amongst degree holders: twice as high compared to the rate of unemployment amongst school leavers with primary cycle (Figure 1).

This situation is also found in other countries such as Algeria, Tunisia and Egypt indicating both the inadequate training system as a whole and the poor quality of the output of the higher education. On the other hand, it shows to some extent that investments are concentrated in activities with low knowledge content and that the number of innovative firms remains modest.

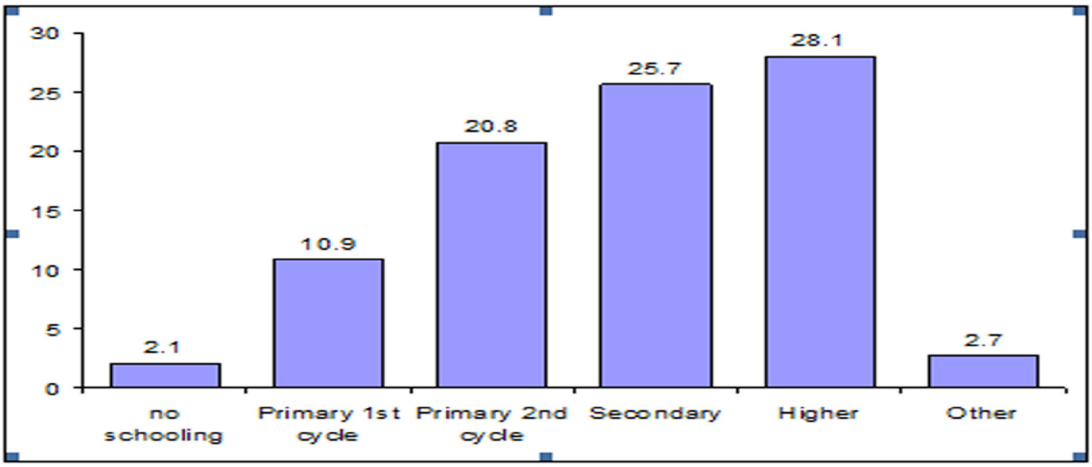
Quality of the education system: data from the GCC and indeed from the MENA region as a whole show significant progress in education at various levels, including higher education, as seen earlier. What remains more challenging, however, is the issue of *quality*, as indicated by several studies (World Bank, 2008). Data from the World Bank indicate that GCC countries are, overall, performing better than Maghreb countries including Egypt. This may be attributed to the sheer size of the population in Algeria, Morocco and Egypt in particular where the relatively high rate of birth put the strain on State budget and brings down the quality: in Maths and Sciences, for example, GCC countries perform better than Maghreb countries. Qatar leads the group with a score quite close to Finland's, followed by the

Table 2 Planned and allocated budget in the five-year period from 1999 to 2003 in Algeria (in billion Dinars)

Budget	*1999*	*2000*	*2001*	*2002*	*2003*	*Total*
Planned budget	21.15	31.21	33.66	36.38	36.38	158.78
Effectively used budget	5.1	4.1	5.1	4.6	5.6	24.5
Used/ planned (%)	24.11%	13.13%	15.15%	12.64%	15.39%	15.5%

Sources: National Syndicate of Researchers (2006), cited by H. Khelfaoui Les technologies de l'information, politique de recherche et d'innovation et politique scientifique, Report to the Ministry of Urban Planning and Environment, Algeria, p.12.

Note: 1US$ – 74 Dinars.



Source: MENESRSFC (2006).

Figure 1 Unemployment rates by educational level, Morocco, 2003

UAE. It ranks fourth worldwide before many well advanced countries in the knowledge economy such as UK, Austria and Luxembourg (World Economic Forum, 2010).

Governance of higher education: the governance model of higher education tends to be strongly influenced by tradition and the limitations put by government regulations. Still, there is a lot of variation, and many examples indicate how efficient university governance can make a tremendous positive difference (Hazelkorn, 2005). Today, the trend is towards greater room for private higher education, as a way of meeting diversified social needs. There are also risks, however, that social returns are privatised. Some studies found private education institutions to focus excessively on profit seeking: there is a strong temptation to recruit students based on ability to pay rather than academic ability. Such a selection procedure has often been detrimental to quality, especially in the Gulf States. With high dependency on tuition fees, overall university finances are unstable and unpredictable, making long-term commitments such as tenure and research difficult, if not impossible. There is also duplication of programs increasing competition for students, threatening admission standards, as well as reducing the range of courses offered. Faculties often complain about students with very little motivation for academic work, cheating on exams, pressure to negotiate grades, etc. Private higher education is nevertheless here to stay, but it is crucial in most countries to work out a better combination of public funding (e.g. of basic research), university autonomy and private initiative and accountability.

Absorptive capacity of new technology by local firms

Data from the World Economic Forum (2010) show that technology absorption at firm level is relatively high as perceived by key players in the economy. The top performer, the UAE, reached the same score as advanced countries such as Finland. Three other countries (Qatar, Saudi Arabia and Kuwait) are doing better than Peers in the region are Algeria lags behind. This indicates that potential for absorbing new products and services is relatively high and local demand should not constitute a handicap, as in other parts of the developing world. Innovation rests on the absorptive capacity of new technology at firm level. Data from the World Forum survey (2009–2010) indicates that this capacity remains relatively weak in the region. The best performer (Saudi Arabia) is well below the best performer in the world (Germany) (World Economic Forum, 2010). However, with the exception of Kuwait, GCC countries are doing better than Algeria, Morocco and Egypt. It can be a handicap if capacity for innovation is perceived as weak leading to a lack of self-confidence and trust, so vital for undertaking innovative projects. This 'psychological barrier' is often neglected in the various studies and

analyses and requires a lot more attention when designing STI policies in the region.

Technology spillover of Foreign Direct Investments (FDI): FDI are often major and valuable sources of learning and give access to latest technologies. Several studies have pointed to the benefit of attracting FDI namely in sectors where R&D activities are at the preliminary stage. In the case of GCC countries, FDI flows as a percentage of GDP has increased significantly in recent years with the exception of Bahrain. Jordan is the top performer in this respect. In relative terms, GCC countries have been able to surpass the Western European group.

In terms of ranking, Qatar and UAE lead the GCC group followed by Saudi Arabia, Bahrain and Oman. Kuwait is the weakest. Nevertheless, FDI can be the source of technology transfer, diffusion of knowledge and R&D, when certain conditions are fulfilled. These conditions exist in a number of emerging countries but not throughout the developing countries including GCC countries (World Economic Forum, 2010). Qatar and the UAE perceive a high potential of FDI bringing the latest technologies in the country and score even higher than Finland. Kuwait has a more skeptical attitude and scores less: there is no guarantee that technology transfer takes place. This skepticism has been reinforced by the reluctance of foreign firms in outsourcing easily their R&D activity to any country. Thus, a number of studies have shown relatively limited impact in STI as shown in the case of Morocco (Andersson et al., 2006).

On top of suspected reluctance on the part of foreign counterparts, existing conditions and obstacles, including regulatory and institutional issues, have hampered such outsourcing, as well as local learning processes and capacity building related to innovation. Certain local mistrust in the capacity or willingness of foreign firms to participate in the development of local S&T capabilities prevails among operatives and parts of public opinion. For example, in Morocco, such local resistance and sometimes hostility are not rooted in fundamental political, ethical or religious conflicts. They rest essentially on the perception that foreign investments and Transnational Corporations (TNCs) have not demonstrated, in the past, high willingness to contribute to the creation of local research facilities, to outsource R&D or even simple engineering tasks to local firms, local universities and local research centers (Andersson et al., 2006). Nonetheless, there are now examples of impressive leapfrogging processes in the adoption of sophisticated technologies in some Developing Countries, for example, through the diffusion of cellular technologies. Some emerging countries of the so-called BRICS group, such as India and China, have benefited largely from that, even though their number remains limited. In the Maghreb, there are now burgeoning experiences of R&D being done locally using local competencies: In the field of aeronautics Morocco, for example, the SAFRAN Engineering group has set up R&D facilities locally while in Algeria, the Lafarge multinational corporation started two years ago R&D to adopt local materials as new inputs.

Corporate governance: largely, corporate governance reflects the level of governance in general. As a whole, governance is seen as a relatively weak area. GCC countries remain weak on rule of law compared to advanced countries. Nonetheless, they seem to perform better than Morocco and Egypt. Corporate governance is overall weak as the result of the dominant family businesses in many Arab countries in the private sector. The reasons are both historical and cultural. In the public sector, State corporations have been paying limited attention to performance, accountability and evaluation, particularly in countries such as Egypt and Algeria. Recent data show that GCC countries have, overall, a better record in corporate governance than their Maghreb countries including, with the exception of Kuwait, which is lagging behind (World Competiveness Report, 2010).

Absorptive capacity of researchers

The human element is important in many respects, ranging from the formation of basic attitudes and skills to the effectiveness of the specific processes helping to transform new ideas into new products and services. The quantity as well as the quality of human capital spans multiple areas warranting measurement and analysis: education, on the job training, interaction with other entities, etc. We have seen earlier, where GCC countries stand when it comes to education and training. It is

important to address other issues such as the number of researchers and their availability, the rate of unemployment of graduates, the weakness of industrial research and finally the stability of researchers and the capacity of the country to retain qualified scientists through brain gain. Available data show that in 2006, the EU scores respectively 3953 and 3614 regarding availability of scientists and engineers while average number of the rest of the world does not exceed 1605 (World Bank, 2010). This is both the result of high capacity in human capital formation, and the ability of these economies to attract new competencies as well as to retain the established ones; notwithstanding the fact, there is a great deal of mobility amongst advanced countries also. In fact, leading emerging economies, such as India and China but also some smaller ones have recently become relatively successful in re-attracting leading talent established in developed countries. Data from the World Competitiveness Report (2010) show that the availability of scientists and engineers in the GCC countries can be quite a handicap when it comes to getting innovation off the ground and places it onto a sustainable trajectory. There is clearly also a marked deficit of relevant expertise in social sciences. The number of researchers per million people likewise remains very low, notably for Kuwait and for Oman. Four countries (Saudi Arabia, Bahrain, UAE and Qatar) are performing better than their Maghreb counterparts in the region. Oman is lagging behind. Although there is now a relatively high share of women in university education, the percentage of women researchers remains particularly low overall[1], at about 20% in Oman, 15% in Yemen and 25% in Saudi Arabia where it is expected to reach 35% by 2015. Yet it is important to be careful when comparing data from different countries. Thus regarding number of researchers, data indicate that Tunisia for example is doing very well in comparison to other countries. It performs better than most Mediterranean countries second to France only. A close look at the data though, indicates that Tunisia has a broad understanding of researchers: post-graduate students are counted as researchers which gives a wrong picture of the reality (Djeflat et al., 2007). It is also important to compare the effective time researchers devote to academic research. Field surveys in countries of the sub-region indicate that less than 10% of time is effectively devoted to research. Full Time Equivalent (FTE) ratios are not always available and often, lack of viable data and limited field survey lead to rough estimates of this ratio. While the size of the research population is a key element, researchers within a country can be badly distributed. They are often concentrated in universities in the developing world, while best practices indicate that they are dominant in enterprises in advanced countries. Data from a study in South Korea, for example (Djeflat et al., 2008), show that more than 60% of researchers are in firms while less than the third of the total number are within universities. This shows the importance of technological research in relation to what be called academic research.

Quality of research institutions: performances in the research area rest not only on the quality of the human potential but also on the quality in which research projects are conducted. This translates to poor performances no matter how competent or brilliant the human element is. It is a fact that researchers in the developing world who perform poorly in their home institutions can substantially improve their research results when recruited in institutions from the North: universities, laboratories and R&D facilities within companies. This gap in the quality of research institutions contributes largely to feed the so-called 'brain drain' more than anything else, notably in the fields of scientific and technological research, where equipment, consumables and specific facilities are required to conduct research experiments and projects. In terms of quality of research institutions, recent figures (World Economic Reforms, 2010) show that GCC countries perform on the whole better than Maghreb countries, with the exception of Bahrain. Qatar takes on the leadership slightly lower than Finland but twice as high as the poorest performer, which is Bahrain. However there seems to be a little consistency problem when comparing with quality of the education system, where Bahrain is in a better position, showing that quality of research institutions rests on other parameters such as

[1] INCONET-GCC Field survey 2010.

governance and funding. In more general terms, GCC countries are better ranked in the MENA region than peers with the exception of Bahrain.

Brain drain and capacity to retain competencies: training on its own is not sufficient. A policy to limit the emigration of tertiary educated workers is also needed. Data from the World Development Indicators (2000) indicate that GCC countries do not suffer a great deal from this problem compared to countries like Algeria or Morocco where it reached 18% according to World Bank figures (2000). It is a well-documented fact that Maghreb countries (Algeria, Tunisia and Morocco) as well as Egypt have been losing relatively high proportions of their competencies each year to the benefit of OECD countries. They can be divided in two categories: those where it is relatively significant (Jordan: 7.4%, Kuwait: 7.1% and Bahrain: 5.1%) and those where it remains relatively low (Qatar: 2.1%, Saudi Arabia 0.9%; UAE: 0.7% and Oman: 0.4%). More recent data from the World Competitiveness Report confirm this trend: they show the GCC countries are doing better than peer countries from the region as a whole. Due to small population, GCC countries are even attracting competencies from the world and in particular from other Arab countries through 'brain gain'. Qatar leads the group in terms of retaining and attracting competencies and holds the second highest position in the world. This is a comparative advantage and a valuable asset on which to build, its future STI policies.

DEMAND FOR INNOVATION AND R&D SERVICES

Public procurement of advanced technology products

Public procurement of advanced technology can be measured in relation to the perception, which we have of the capacity of government to acquire new technology products and services. Public procurement can play a vital role in the face of market failure in the Emergence of innovation system. It is acquiring more and more importance both as a policy instrument and as a concept to be further investigated (Edquist et al., 2000). The actions of government were critical in the Emergence of innovative technologies and services in most advanced countries. Public demand for knowledge and innovation exist even in the prospect of privatisation. Innovation projects need a broad range of products and services, and an important capital lay out. Market formation is usually limited in this early development phase and only early adopters are willing to adopt the innovation as these early innovations are often very expensive and have low performance compared to the incumbent technology (Rosenberg, 1976). However, protected market niches may be created in this phase so the technology can develop, a series of such niche markets can act as a bridge to mass markets (Andersson and Jacobsson, 2000; Geels, 2002). The State plays a crucial role in creating a niche market, because it holds the power to change/legislation and because it can act as a 'launching customer'. The government can articulate demand for a new technology by acting as an early user or by formulating policy targets. The role of the State is thus paramount. This role is even more important in African countries where the technological base of the private sector is relatively weak. The State plays an important push role before the private sector and market become strong enough to take over. A public–private partnership to build this sustainable demand for innovative products is also a key to this process. Recent figures show that Government procurement GCC countries have reasonably good performance better than Maghreb countries including Egypt. In this respect, both Qatar and the UAE have higher scores than Finland. However, this needs to be put in relative terms: this may reflect simply that Finland suffers lower level of imperfection in terms of market capacity to generate adequate level of demand. The situation differs from one country to the other. Overall, government procurement remains one of the key problems in most of the Arab world, when looking at the ranking of many countries: Morocco, Algeria, Egypt, Libya, Lebanon and Kuwait.

Demand for University research services

Often the lack or limited interactions between university and industry are explained by institutional factors and the attitudes often negative held towards each other. We found this when looking at the low interaction in the petrochemical sector in Algeria, where stereotype attitudes held the main company towards national universities as a whole prevented for years the establishment of useful and mutually beneficial relations (Djeflat, 1992). Senker (1998) cites three main factors to explain the increase in university interactions with industry:

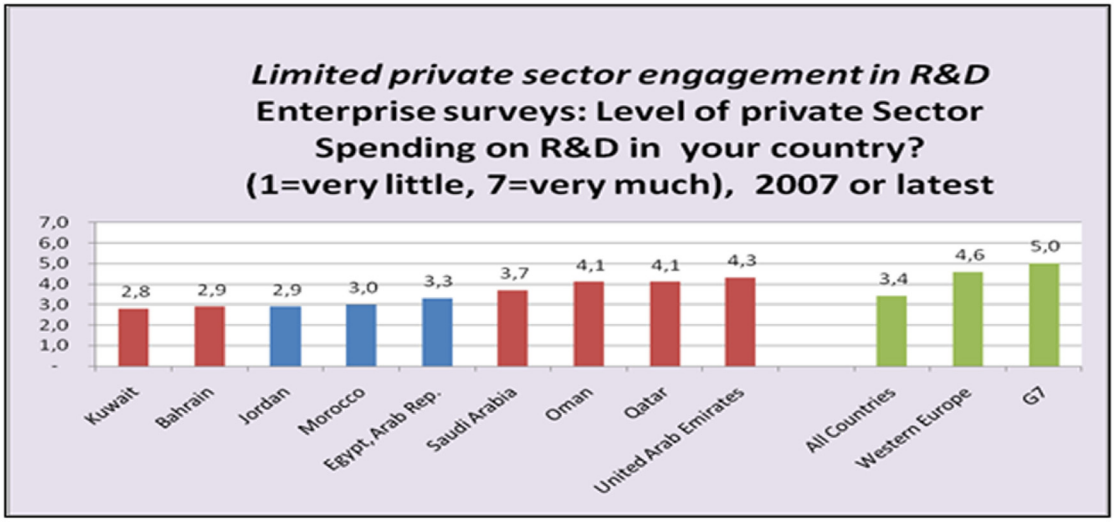
- the need for universities to look for non-government sources of funds
- the need for industry, spurred by competition and shorter time horizons for R&D, to access a broader science base than available in-house and
- the push for greater returns from government support for R&D (e.g. via the commercialisation and diffusion of publicly funded research).

We view this lack of interaction as a reflection of weak demand for university services and specifically research services on the part of local industry. Often this demand exists, but imperfect market dynamics makes it difficult for universities to work out positive answers to the formulated needs. This has brought governments to initiate what is called in generic terms 'bridge institution'. They have taken different forms and shapes: technology transfer and industrial liaison offices at universities, valorisation agencies, technology incubators and science parks and centers of excellence, all with the goal of increasing efficiency from public R&D spending and diffusing knowledge. Among the most successful initiatives are those which have taken an interdisciplinary approach and concentrated on specific technology clusters (e.g. biomedical and information technologies). A survey conducted in Algeria shows that less than 5% of SMEs in the country have formal agreement with local universities and training centers (Djeflat et al., 2007). The rest have either sporadic and discontinued relations based often on personal ties or no relations whatsoever (the majority). Attempts were made to build better relations between industry and university, using different approaches. However, they seem to have yielded limited result and several studies conducted on a regional basis have concluded that real brick walls tend to exist between the two kinds of entities. Yet, the GCC countries are doing better overall than Maghreb countries in the region in terms of university-industry collaboration in R&D. Qatar leads the group but remains behind the advanced countries such as Finland and the world leader, USA. Egypt and Algeria are lagging behind. This is also the result of the fact that the recruitment of research personnel is not widely practiced: local enterprises prefer to rely on in-house expertise (World Economic Forum, 2010).

Private sector and company demand for R&D

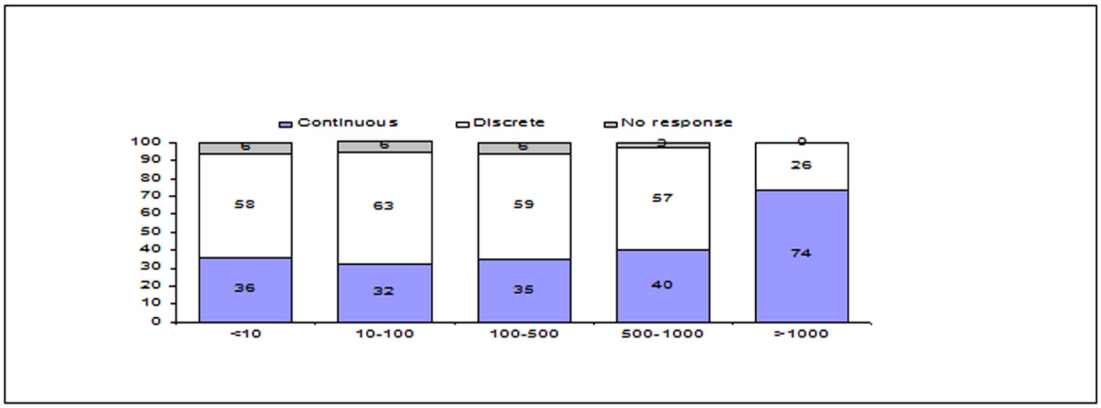
One of the key features of sustainable R&D system is private engagement in spending, because public funding on its own is insufficient and remains dependent on State budget, which is often vulnerable. In advanced countries, private funding of research remains the dominant feature when looking at advanced countries. GCC countries private engagement remains relatively weak in comparison to EU and OECD countries. Nonetheless, they seem to score better than Maghreb countries in four out of the seven countries: Saudi Arabia, Oman, Qatar and UAE. Saudi Arabia R&D funding, for example, is made up of 79% public, while private sources count for 10% only. In Yemen, international funding represents the bulk of R&D funding, while private funding does not exceed 5% of the total. This results from the fact that Saudi Arabia R&D activities are concentrated within the oil sector (concentrated mainly in the two oil corporations: Aramco and Sabic). Kuwait lags mainly because of the dominant position taken by public research institutions. These are in any case indications that a great deal more effort is needed to spur private investment in R&D (Figure 2).

On the other hand, private funding needs to be sustainable and recurrent to have the desired effect on R&D activity outcome as shown by best practices in OECD countries. An exploration into private funding in Morocco shows most of it to be undertaken on a 'one off' basis that is, investment



Source: World Economic Forum (2010).

Figure 2 Private engagement in R&D in GCC countries: 2010

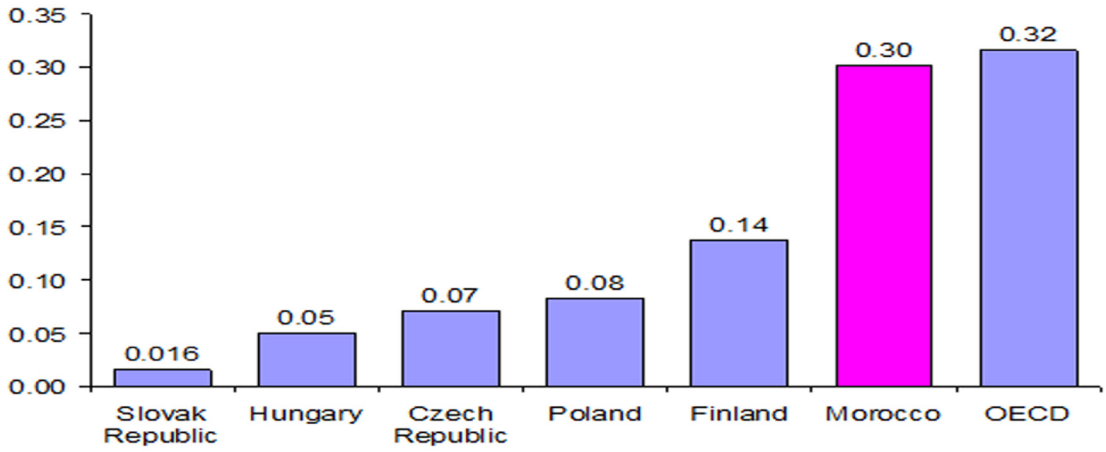


Source: R&D Maroc (2005).

Figure 3 R&D activities by firm size: Morocco 2006

is occurring in a discrete manner, as immediate opportunities arise. This applies notably to firms with less than one thousand employees (Figure 3). In SMEs, which represent the bulk of productive companies, innovation is generally not well integrated as regular activity, and relatively few firms have a research and development project in the pipeline. One third of firms do engage in innovation as a continuous activity, however.

Whereas larger firms are more engaged in R&D as a continuous activity, these are mostly foreign firms. Exporting firms are more engaged in innovation than other firms are (Andersson et al., 2006). Further, innovation projects are rarely funded from outside the firm. Financing is mostly done by using internal funds (87% of firms use self-financing), less than half of them rely on bank credit (44%) and venture/risk capital plays a small although not negligible part (10%). In terms of policy, both incentive schemes and institutional arrangements more adapted to the local practices and cultures need to be implemented to place innovation squarely at the core of firms' activities, especially among SMEs.



Source: OECD (1998–2001, 2003) and MENESRSFC (2006).

Figure 4 Risk capital as a percentage of GDP, Morocco

Demand for venture capital

Private engagement in R&D rests often on the risk reducing mechanisms available locally. Thus, availability of venture capital is one of the key elements in this respect. However, this is only part of the story. The other one is the demand of venture capital, which rests often on the capacity of innovation in the country. It is often put forward that venture capital is relatively scarce in many developing countries, which constitutes one of the major obstacles for the growth of young companies. Banks naturally focus on running conventional accounts and allocating credits where risks are lower, often to non-innovative projects. Survey data show that little venture capital is available in the region as a whole. Nonetheless, three GCC countries (Bahrain, Oman and Kuwait) seem in a rather favourable situation when compared to peer countries from Western Europe. Bahrain's score was similar in 2008 to average G7. The 2010–2011 scores indicate, however, that Qatar has taken the leading position, while the GCC group is overall doing a great deal better than Maghreb countries namely Morocco and Algeria (World Economic Forum, 2010). When looking at innovation performances, this potential seems to be under-exploited by innovative firms and need better integration in STI policy (World Bank, 2010). A close examination of venture capital data shows that this category could include a variety of items, some of them relatively remote from what risk capital really means. Thus looking at data on venture capital as a percentage of GDP in morocco (Figure 4), it can be seen that the country is performing almost as good as OECD countries and twice as good as Finland. In effect, the figures are not comparable to those of OECD namely because funds include a broader set of financial transactions such as public finance mechanisms to attract FDI.

Information on patent services: lack of information can constitute an obstacle to absorption and consequently in the reduction of effective demand for innovative products and services. Thus, firms knowledge of local patent services and tax incentive schemes can be determinant in the performances in terms of registered patents. While innovation dynamics exist irrespective of size or sector of activity, often it rests on the right environment in which the firm evolves, and the constitutive elements such as sound and reliable data sources, properly functioning patent services and adequate tax incentive systems. Their existence does not guarantee though that they are necessarily known by potential innovative firms. Proper channels of information are required to diffuse widely the various laws, regulations, incentive schemes and other policy decision taken by Government. Thus, in Morocco, for example, less than 30% of firms interviewed in a survey (R&D Maroc, 2005) know about existing tax breaks and innovation credits. The rest are not aware of their existence. Similarly, 45% of them have no knowledge whatsoever of local patent office services.

Moreover, 37% of SMEs in Morocco do not use the services of the national patent office, in spite of knowing their existence (R&D Maroc, 2005). There are several reasons to that, ranging from complicated and *heavy local procedure, incompetent personnel, lack of trust* in their ability to properly protect their inventions and even suspicion that they might be given to competitors. Consequently, in terms of policy issue, adequate information channels and beyond that properly orchestrated campaigns need organising to overcome these obstacles.

CONCLUDING REMARKS

However, two key elements need taking into account and are often neglected: absorptive capacity and demand for STI products and services. They can constitute sever bottlenecks to any strategy and any system for innovation. Maghreb countries experience has shown how severs they can handicap policies and programs. However, preliminary assessment of the situation shows that they have some assets, which can be mobilised to get around these difficulties, and they are indeed performing better than Maghreb countries on many aspects. Limited size of the countries, relatively better governed education systems and substantial oil revenues. GCC countries seem to progressing in a significant way into that direction.

Both absorption capacity and demand for innovation depend to a certain extent on quality and governance. While the issue of quality mobilises a great deal of attention on the part of policy-makers, very little research seems to be done regarding quality as a component for innovation. Recent work put quality infrastructures as a condition for emergence of innovation (Peuckert and Gonçalves, 2011). This includes Metrology, Accreditation and Conformity Assessment. Overall, decision-makers have put the emphasis on quantity and this general trend can be quite easily figured out when considering countries with sizeable populations such as Egypt, Sudan, Algeria and Morocco where the priority is to cope with increasing demand. This is not quite the situation in GCC countries where small size constitutes an asset for quality performances. Market failure in general and more specifically when it comes to STI exchange, requires that institutions play a key role in governing the whole process adequately. This is reflected through the systemic nature of building capacity at both the strategic and the operational level. It is even more so in GCC countries where both demand and supply of STI output are relatively new and do not pertain to a long tradition driven by a relatively strong industrial sector.

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BIOGRAPHICAL NOTES

AbdelkaderDjeflat currently teaches industrial and development economics at the University of Lille in France and is Director of the Master on International Cooperation. He is Coordinator the International Network on S&T for Maghreb Development (MAGHTECH) and Senior Researcher at the Clerse Laboratory (CNRS UMR 8019). As full Professor in Economics at the University of Oran in Algeria, he heldthe position of Dean of the Faculty of Economics and then Chairman of the Scientific Committee. He was also principal adviser to the National Economic and Social Council (CNES) of Algeria on Knowledge-based economy and did consultancy work for various international organisations: the World Bank Institute, the United Nations Commission for Western Asia (ESCWA) and the Economic Commission for Africa (ECA) UNDP and the European Union. He has written and edited several books and published about 100 articles in various international journals. Currently, he is a Vice President of the GLOBELICS Network.