Knowledge Production: Research and Technological Development in the Mediterranean Region

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Since the Lisbon Declaration, aiming to make the EU "the most dynamic and competitive knowledge-based economy in the world by 2010," and various reports by international institutions on the knowledge economy, in particular those of the World Bank and the UNDP, the production of knowledge has become a major concern for Mediterranean countries. This concern is growing deeper as the date approaches for the full constitution of the Euro-Mediterranean Free Trade Zone, slated for 2010-2012, as per the Euro-Med Association Agreements. The year 2006 constitutes the half-way point, in particular for the Maghreb countries – Algeria, Morocco and Tunisia. It is also an important year because it is the first year following the tenth anniversary of the Barcelona Process, celebrated in November of 2005. At the anniversary event, significant defects of the Barcelona Process were discussed, especially with regard to implementation, and important resolutions were taken, in particular in the sphere of scientific and technological cooperation. We should therefore stop to ask whether all of these resolutions have been put into practice and whether the Euro-Mediterranean scientific and technological Partnership has effectively been set in motion. This year likewise marks the end of FP6 (the EU's 6th Framework Programme for Research and Development) and will be used to take stock of the progress made and prepare FP7, in which the issue of scientific and technological cooperation with TMCs (Third Mediterranean Countries) takes on great importance. At a time when innovation has become the catchword of global competition and when the Mediterranean market is increasingly flooded by Asian products, the European Union, and the Mediterranean countries *a fortiori*, realise that they are still far behind the USA in R&D expenditure (amounting to 23% of world expenditure, as opposed to 36.7% for the US) and that Southern Europe, particularly Portugal and Greece are lagging behind, and this lag is only intensified by the arrival of the new EU Member States.

The Mediterranean Region as a whole is even lower on the ranks, considering the weakness of the Southern Mediterranean countries. In this article, I will first present an overview of the state of research and technological development, and then discuss the perspectives open to the Mediterranean. The limited space of this article and the scope of the topic have led me to focus my analysis on the Maghreb as an illustration of this problem in the Southern Mediterranean, considering that there are no fundamental differences among the remaining TMCs, with the exception of Israel and Turkey, to a certain extent.

Imperatives, Challenges and Obstacles Regarding Technology Production in the Mediterranean Countries: An Inventory

Both facts and statistics confirm that the Mediterranean continues to experience a gap between its southern and northern shores, not only with regard to development, but also and above all, to research, technological development and the production of knowledge in general. If the expression of the digital divide is widely accepted in literature and use, the term "technology or cognitive divide" could easily apply as well. Although conventional indicators on research and technological development are not unanimous, we will use them here because there is a great deal of data available for these indicators.

Research Institutions and Infrastructures: If the

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matter has been largely settled in the Northern Mediterranean countries, in the South, the majority of Mediterranean countries are still establishing institutional schemes. The majority of countries having established scientific and technological development as a national priority, they have for the most part instituted state decision-making entities designed to launch research initiatives and promote technological development. The latter entities take the form of Ministries, State Secretariats and National Commissions. Legislation has been passed to accompany this process, as, for instance, Algeria's Law of 1998 on scientific and technological development. Scientific and technological research programmes and schemes have been developed, such as, in Morocco, the Thematic Scientific Research Support Programmes (PROTARS 1/1999 and PROTARS II/2000) and *"Vision et Stratégie de la recherche Horizon 2025"* (Research Perspectives and Strategy, Planning Horizon 2025), published in 2006. This is also the case with Tunisia's National Programme for Research and Innovation (PNRI), designed to meet the technological innovation needs of businesses.

By the same token, Algeria has established a five-year development and research plan (1998-2002) following the 1998 law and the roadmap, "Vision Algérie 2030," which contains an important section on scientific and technological development. This institutional renewal has been accompanied by a strengthening of research infrastructures in the majority of countries. Thirty research centres, 139 laboratories and 634 research units were inventoried in 2005 in Tunisia, the majority of which were working in the natural sciences. In Algeria in 2006 there were 638 laboratories, of which 47% were working in the fields of science and technology. In 2006, some 2,300 projects were underway, of which 1,540, that is 70%, were being carried out at institutions under the auspices of the Ministry of Higher Education and Scientific Research (MESRS) and involved 76% of national researcher potential. The MESRS launched no less than 19 National Research Programmes (PNR) in 1999.

The Human Potential: This remains the keystone of a policy for knowledge production and competitive R&D. Despite possible reservations with regard to quality, the human potential becoming involved in research is on the rise. In 2004-2005, Morocco had 10,135 official researchers, two thirds of whom (6,256) were working in the natural sciences and technologies. In 2005-2006, Tunisia had 25,445 researchers with an FTE (full time equivalent) of 14,650, which constitutes an increase of 13.4% over the preceding year. This means there are 4.28 researchers per 1,000 workers. In Algeria, the number of researchers is 15,000 in all disciplines as per university statistics for 2006-2007, 77% of whom are working in research laboratories.

R&D Expenditure: The gap between the two shores of the Mediterranean in this sphere remains high, yet efforts continue to be made in R&D expenditure to reach the threshold of 1% of the GDP established by such international institutions as the UNDP. The Southern Mediterranean countries do not surpass 1% of GDP, with the exception of Israel, which assigns over 4% of its GDP to R&D (4.8% in 2001), on a level with leading world countries such as Sweden (4.27%), Finland (3.06%) and Japan (3.06%). Hence, in Morocco in 2003, the said expenditure was only 0.79%, of which only a negligible amount was attributable to the private sector (12% in 2003); the figure was 0.77% for Tunisia in 2004; and 0.75% in Algeria, where the private portion was likewise very weak. In terms of US dollars (USD) PPP per capita, Tunisia registered 52 USD PPP per capita in 2003 as opposed to Norway's 649, France's 617 and Italy's 305. With regard to emerging countries, Brazil registered 77 and China 66.

On a global scale, the EU Innovation Scoreboard shows that, among the countries representing over 0.1% of worldwide research and development expenditure, only Turkey (0.18%) and Israel (0.80%), of all Southern Mediterranean countries, were given a non-negligible score. The other Southern Mediterranean countries listed ranked relatively low: Egypt (0.03%) and Tunisia (0.02%). Among Northern Mediterranean countries, France (4.21%) ranked highest, followed by Italy (1.68%). The other Northern Mediterranean countries had relatively modest scores: Spain (0.84%), Portugal (0.14%) and Greece (0.10%).

Performance

Performance will essentially be estimated with regard to scientific production and technological production.

Space limits do not allow the use of other indicators, such as high-technology product exports.

Scientific Production: Scientific production clearly confirms the cognitive gap between the Northern and Southern Mediterranean countries mentioned above. It remains relatively low, despite real financial efforts made by the public authorities. Nonetheless, it is a constantly evolving parameter: publications practically doubled from 1996 to 2003 in the three Maghreb countries, Algeria, Tunisia and Morocco. In Morocco, though ranked third in Africa after South Africa and Egypt, scientific production in the technological sphere remains relatively low: of 1,400 theses defended in 2004, the natural sciences represented 48% of the total, whereas engineering sciences only represented 1%. Moreover, 60% to 70% of scientific production is done in conjunction with foreign partners, primarily from Europe. In Algeria, the data published shows that scientific publications by national researchers did not surpass 5.41 publications per million inhabitants in 2002, and three fourths of these were joint publications, primarily done in conjunction with French and OECD (Organisation for Economic Co-operation and Development) partners. Another noteworthy point is that a substantial number of these joint publications were written by researchers of the Algerian diaspora living abroad. In Tunisia, there were 1,010 scientific publications in 2004, which was nearly double the number produced in 2000 (i.e. 540). The majority of these publications involve the natural sciences. Information Technology (IT) is burgeoning: the number of publications has multiplied by 10 since 1993. Yet they remain comparatively low. In 2003, some 425 publications were produced, as compared to the number in France (31,971), Italy (24,696) and Spain (16,826). Tunisia, with 40 publications per million inhabitants, is far behind France (524), but ahead of Egypt (24) and Morocco (15). In terms of quotes from IT articles, Tunisia (619) lags behind Morocco (926) and Egypt (3,319), and far behind Turkey (10,130) or Greece (11,996). Research is highly international, given that 69% of publications are co-signed with foreign partners.

Technological Production: The deficiency of technological production in the Southern Mediterranean countries is not difficult to demonstrate. In Morocco, 48 patents have been registered by 24 laboratories or laboratory groups in the past ten years, not including the fields of computer science and mathematics. Yet globally, 561 patents were registered in 2004, of which 104 were by nationals: 72% were registered by individuals. In Tunisia, 579 have been registered since 1990, 16% of which were registered by research institutions, 20% by businesses and 64% by individuals. In 2005, there were only 56 patents. If we consider the number of patents registered with the USPTO (US Patent and Trademark Office), the proportion was slightly over 0.1% per million inhabitants in 2002, identical to that of Egypt. This is very poor in comparison to Belgium (70.4%), France (68.1%), Italy (30.3%), and Spain (8%). Nonetheless, certain Northern Mediterranean countries are experiencing difficulties; suffice it to consider the performance of Portugal (1.3%) or Greece (1.8%). In Algeria, only four patents were registered at the USPTO level during the 1977-2005 period. This figure rises to 31 for Morocco, 14 for Tunisia and 154 for Turkey. Nevertheless, certain sectors are beginning to distinguish themselves for their dynamic innovation and constitute a true "success story". This is the case with the Algerian public enterprise, SAIDAL, and the private groups Poulina and ONA (Omnium North Africa), in Tunisia and Morocco, respectively.

The Imperatives

One of the factors that explain the backwardness of the southern shore is the inexistence of national innovation schemes that are thorough, operational and competitive. It is well-known that in the majority of cases, these innovation schemes are embryonic, disjointed or incomplete.

The Issues of Mobility and Brain Drain: Although these two issues seem quite different, they are, in fact, related. Hindrances to the mobility of qualified workers indirectly contribute to their exodus. It is increasingly obvious that mobility poses major problems for knowledge production and, above all, for its socialisation. If the lack of qualified worker mobility has experienced little improvement in 2006, definitive departures continue to be one of the major concerns. This phenomenon, which also affects Northern Mediterranean countries, has affected Algeria more than any other Maghreb country. Approximately 420,000 Algerians left the country in the 90s.

The Issue of Low Investment by International R&D Firms: The Euro-Mediterranean region remains relatively poor in terms of attraction of innovative companies, both with regard to volume and sectors. Though a significant number of multinationals have established R&D facilities in Israel (Intel, IBM, Motorola, BMC, Marvell, CISCO, HP, Nestlé, etc.) that invest

1.5 billion US dollars in research partnerships, this is not the case in the other countries of this region.
University-Business Relations and Enhanced Value of Research Results: The problem of enhancing research remains a central concern for the authorities in the different Southern countries. Institutions have been established to manage these interfaces, but with little success. In Morocco, the department of scientific research has established programmes to build bridges between universities and the business world, as for instance, the "Valorisation de la recherche" (Enhancing Research Value) programme, staggered over the course of three years and with a budget of 7.7 million Euros.
Financing Research and Development: The matter of financing innovation remains central, considering the weakness of venture capital in the Southern Mediterranean region. In Tunisia, high technology venture capital only represented 22% of total risk capital for 2002-2003, compared to Denmark (69.8%), Germany (63.4%), France (57.4%), Spain (44.7%) and Italy (33.7%). Nonetheless, initiatives have been undertaken to make up for the R&D lag. In 2004, Morocco launched an innovation support fund, "Innov'act", essentially for SMEs and supported by the international institutions, GTZ (Germany) and IFC (World Bank). Venture capital grew tenfold between 1990 and 2002, reaching 132 million US dollars (0.3% of the GDP) and putting Morocco in a good position in the Mediterranean Basin. Other funds have also been created, such as the Sindibad seed and venture capital fund. In Algeria, FINALEP, a venture capital bank, is just getting off the ground.
Governance and Innovation: Europe's lag behind other parts of the world is likewise associated with a lack of suitable governance. This issue was raised in 2006 at the workshop organised in The Hague by the European Trend Chart on Innovation. One of the most crucial matters with regard to research in the Northern Mediterranean countries particularly concerns deciding on the best innovation governance system. This greatly affects research and development in the Southern Mediterranean countries.

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Perspectives and Solutions on the Horizon

The new awareness of the issue reached by both the public authorities and economic actors of the Southern Mediterranean countries has led to intensified efforts in the production of knowledge and technological research and development. These efforts were stepped up in 2006, particularly due to the situation explained above, but also because of the growing importance attached to the need to enter the knowledge economy by the Southern Mediterranean countries. In April 2006, Algeria organised its first national conference on the knowledge-based economy upon initiative of the *réseau Maghtech* (The Maghreb Technology Network) and the University of Mostaganem.

National Initiatives

Simplifying Procedures and Improving the Innovation Climate: The three Maghreb countries have begun a series of reforms with a view to simplifying procedures in order to allow greater celerity for investment and the transformation of ideas into projects and thus into investment. By way of illustration, according to a World Bank report (Doing Business in 2006), Morocco has reduced the number of steps required for registering a trademark or patent to 4, as opposed to the 6.6 required on average by the rest of the subregion, and the average of 4.7 steps registered by OECD countries.
Creation of Networks: Although still low, network creation is beginning to gain importance. In addition to already extant networks, such as the Maghtech Network, which is exclusive to the Maghreb, other networks have begun to emerge in the majority of the Southern Mediterranean countries, a phenomenon greatly facilitated by the massive introduction of ICT into their economies. In Morocco, eight thematic networks and six skill clusters existed in 2006. In Algeria, six thematic networks were launched and their number is growing exponentially.
Growing Participation and Interest of the DIAST (Scientific and Technological Diaspora). More and more programmes to involve expatriates in the transfer of know-how are being planned, such as TOKTEN ("Transfer Of Knowledge Through Expatriate Nationals"), which is operating in over 40 countries in Africa, Asia and Latin America. Other national programmes exist. Tunisia's Ministry of

Higher Education, Scientific Research and Technology has launched a programme for cooperation with Tunisians residing abroad; and Morocco has the FINCOME programme for collaboration with skilled expatriates (International Forum of Moroccan Competences Abroad).

University - Business Partnerships for Enhanced Research. In Algeria, an agency has been created to manage this interface – the ANVREDET (*Agence Nationale pour la Valorisation de la Recherche et du Développement Technologique*, i.e. National Agency for Research and Technology Development). In Morocco, university-business interface structures were created within the framework of the 2000-2004 Development Plan. There are 15 interface structures at present. In Tunisia, such liaison also involves foreign enterprise. Dassault Systèmes has signed an educational partnership with the University of Tunis according to which it will supply product development software.

Onset of Multinational Investment in R&D in Southern Mediterranean countries. In Algeria, a number of foreign companies are carrying out research in the field of hydrocarbons. In Morocco, there are several companies that have set up R&D facilities: STMicroelectronics, Matra Automobile Engineering - Casablanca and Lead Design in the field of integrated circuits, as well as Teuchos, a subsidiary of the European Safran Group, working in the field of aviation and aerospace component conception.

Multilateral Cooperation

As indicated above, the European Union – after the mixed conclusions reached in 2005 on results of the Barcelona Process, the birth of the US's Greater Middle East Initiative and the establishment of the Morocco-US Free Trade Agreement – realised it was losing opportunities. It therefore decided to make up for lost time, accelerating the pace of scientific and technological cooperation with Third Mediterranean Countries and accentuating its efforts to support technological research and development. According to the MED7 report based on meetings held in 2005, the European Union considers scientific and technological cooperation one of the pivotal elements of Euro-Mediterranean cooperation. European research policy for the 2007-2013 period, as manifest in FP7, is considered an opportunity for renewing Euro-Mediterranean cooperation and allowing Third Mediterranean Countries to become full actors in the knowledge society that the EU endeavours to build. These efforts were evident as early as 2006 in the 6th Framework Programme (FP6), which ended in December of 2006 and in which Morocco participated with 53 projects. This allowed it to strengthen its technological platforms, its centres of excellence and its skills areas and to develop scientific and technological information. In the Commission's proposal for FP7, international cooperation appears explicitly in the FP7 Cooperation Programme (allocated 32.4 billion euros), where activities of mutual interest will be clearly identified and undertaken in a preferably multidisciplinary approach. Ten topics have been identified, namely, Energy, ICT, the Environment and Transport. The FP7 People Programme (4.7 billion euros) will involve 'incoming' and 'outgoing' international fellowships and action will be taken to limit 'brain drain'. The FP7 Capacities Programme (4.2 billion euros) will include horizontal measures of support to political dialogue and national policy coordination.

The need to build competitive innovation systems was emphasised at the meeting in Casablanca in May of 2005. The implementation of national innovation systems in the Euro-Mediterranean region is considered a necessary means of reinforcing sustainable growth on both sides of the Mediterranean, particularly in view of the forthcoming Free Trade Zone, to be functioning by 2012. The establishment of a Euro-Mediterranean Innovation Area or Euro-Med Innovation Space (EMIS) is considered not only crucial but also a necessity for sustainable growth and development. EMIS will be part of the EU's broader policy to develop an Innovation Policy for Europe and the FP7. It is likewise a manner of strengthening neighbourly relations, as per the recommendations of the Lisbon Process.

On an individual basis, the southern Mediterranean countries benefit in different ways from European cooperation. In Algeria, scientific and technological cooperation with the EU remains relatively weak. The main projects fall within the framework of the Eumedis initiative (interconnection of research networks) and Tempus (higher education reform and fellowship programme). But Algeria means to step up cooperation over the 2006-2010 period through a law in the process of being passed and a forthcoming agreement with the European Union. Morocco established an in-depth strategy to develop its scientific and technological relations with the EU, signing an agreement for scientific and technological cooperation in 2003 which came into force in 2005. Morocco hopes to receive 20 million euros through the MEDA

initiative for 2007-2013. Tunisia has called its researchers to make proposals to participate in FP7. A partnership agreement between Lebanon and the EU was concluded in 2000 and the first action plan was established in 2006, with the primary institutions of higher learning concerned being the American University of Beirut, the University of Lebanon and Saint-Joseph University. CEDRE, the Lebanese-French research grant programme, is the main bilateral cooperation programme and has funded one hundred or so projects.

The implementation of national innovation systems in the Euro-Mediterranean region is considered a necessary means of reinforcing sustainable growth on both sides of the Mediterranean

Among other initiatives supported by the EU, the ESTIME project is designed to contribute to building bridges for research between Europe and the Mediterranean region by providing clear-cut guidelines on research, technological development and innovation in Mediterranean countries. It involves eight Mediterranean partner countries (Morocco, Tunisia, Algeria, Egypt, Lebanon, Syria, Jordan and Palestinian Territories) and has received funding from the European Commission from September 2004 to February 2007. In this context, a number of meetings were organised over the course of 2006 to evaluate the progress made in building bridges and the problems and issues raised: in July 2006 in Algiers, in November 2006 in Casablanca and in December 2006 in Beirut. Likewise, the Euro-MedaNet1 and Euro-MedaNet2 projects worked towards scientific and technological cooperation in the Euro-Mediterranean area. The international closure conference for the latter projects, held in March 2006 and organised by the IRD (French Development Research Institute) and the European Union, examined the conditions and feasibility of heightening cooperation in the Mediterranean. Such multilateral cooperation strengthens the extant bilateral cooperation between the Northern and Southern Mediterranean countries, which is relatively active but is more concerned with the scientific rather than technological domain.

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