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Knowledge-based Economies: Globalization and the Business of Science

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I. Introduction

The mind-boggling pace of recent progress in human knowledge – notably in the basic sciences – has impacted the world economy, consequently the economic growth and global competitiveness of Morocco and the Arab Region will depend on our ability to benefit from, and to add value to, scientific discovery. Professor Stafford Beer described this fast-approaching world as *Absolutum obsoletum* (if it works it is out-of-date) (Beer, 1985). In the face of this almost evolutionary trend the term knowledge-based economies takes on a special significance. Knowledge-based economies may mean enjoying access in real time to information (i.e. knowledge) necessary for making appropriate competitive decisions. The competitive edge is gained through the possession of information that others may not benefit from. To gain that edge, the information technologies (a product of scientific research) that involve computers, internet, satellite feeds, dedicated lines, telephones, etc. must be harnessed in the Arab Region – there is no need to insist on how much progress has been made in this field.

The concept of knowledge-based economies is most challenging when it involves entrepreneurship based on new high-end (state-of-the-art) knowledge, new research, and innovations. Though basic science has not traditionally had an immediate impact on industry or the economic world in general, and delays in return were often incompatible with the short-term market expectations, recently the picture has changed. In the course of the last decade for example, the employment generated by start-up companies in the United States has more than compensated for the unemployment produced by the layoffs resulting from the

restructuring of multi-national companies. Since the early 1970s universities and their incubators, particularly in North America and more recently in Europe and Asia, have been supporting young entrepreneurs in the start-up phase of their business endeavours. In addition, a culture of entrepreneurship has developed in major R&D laboratories worldwide, and start-up companies resulting from these activities are flourishing. Which only goes to prove that the relationship between science and research, on the one hand and business on the other, is becoming more and more closely linked together.

In the Arab Region, and specifically in Morocco where natural resources are limited, such science-business symbiosis needs to be recognized as one of the important keys to a better future. Our economic development must increasingly be based on the output of the most cherished resource, 'human capital'. As a result, universities are initiating efforts to add value to the results of their research, with the establishment of University-Industry interfaces, and small business incubators. The Moroccan National Charter for Education and Training, and the resulting legal texts, has encouraged such entrepreneurship. On the other side of the fence, the appearance of the first timid venture capital funds has taken place and industry has responded with it own embryonic research and development (R&D) programmes. These trends must be encouraged and reinforced.

Faculties of Science are increasingly including in their curriculum courses such as management and management information systems, entrepreneurship, marketing and finance (these would not have been deemed appropriate, or necessary, only a few years ago) besides the traditional offerings in mathematics, physics, computer science, chemistry, biology and geology. The Faculty of Science in Rabat has offered programmes in insurance statistics and a Master's programme in mathematics for finance has recently been accredited. This is in recognition of the fact that our products (the results of basic science research) are best exploited when placed in a socio-economic context.

This recent 'scientification' of commercial technology has brought the interface between universities and industry into sharp focus. In particular, academic entrepreneurship, that is, the variety of ways in which academics take direct part in the commercialization of

research, is gradually becoming an integral part of university activity worldwide. The jargon of economics is fast invading the scientific research arena. Similarly, the most rapidly growing and wealth-creating industries such as biotechnology, computers and telecommunications are progressively more research-based. Such entrepreneurship already flourishes in some countries, and must now also be placed in the forefront of the public policy arena of the Arab States. It is understood that talking about science in such blatantly economic terms might be difficult for those used to a more traditional approach. And yet our whole intellectual property system (IPS) which has been in place for some time, with its patents and royalties, is really an older expression of this new reality.

Strong national commitments are, indeed, necessary to encourage this science-business relationship if sustainable economic growth is to be ensured. As this commitment is developed, several key institutional factors, outlined as follows, will be crucial to our success.

Firstly, heavy investment must be made in human capital formation and training. The percentage of populations receiving a university education is still dismally low. When this is considered in conjunction with the high rate of illiteracy and the fact that only 23.5 per cent of students entering primary school in Morocco, for example, eventually complete the secondary cycle, the magnitude of the challenge becomes evident (Prospective Maroc, 2030). Data provided in *Table 1* below serves as the backdrop for human development activity in our Region. The existence of a wide range around the mean of Arab country indicators, with a high incidence of outliers and skew, rendered the mode a more reliable measure of central tendency (raw data were taken from the Human Development Report, 2006, UNDP). When compared to Norway the highest ranked nation or to South Korea (ranked thirty-three, a country 'within reach'), Arab nations generally lag behind in terms of control of demographic growth, life expectancies and access to education. It, therefore, comes as no surprise to see that the technology indicators, also shown in this table, show a wide lag behind for the Arab Region.

Table 1. Arab States Human Development Indicators

Indicator	Arab mean (range)	Arab mode	Norway	Republic of Korea
HDI rank	85 (33-153)	82	1	26
Annual population growth rate %	1.95 (1-3.1)	2.0	0.5	0.3
Life expectancy at birth	70.8 (52.5-74.2)	72.5	79.3	76.9
Infant mortality /1000 births	27.3 (7-78)	21	4	5
Grade 5 (% of Grade 1)	92.2 (73-100)	96	100	100
Adult (15+) illiteracy %	23.5 (6.7-48.8)	20.5	0	2
Technological indicators : Cell telephone subscribers/1,000	381.7 (53-908)	313	861	761
Internet users/1,000	113 (5-321)	104	390	657
Hi-tech exports (% of manufactured exports)	3.75 (1-13)	2	18	33

Source: UNDP Human Development Report, (UNDP, 2006).

Beyond access to university education, programme adjustments – both in educational curriculum and research orientations – to meet demand in the private sector require a welcoming national policy environment and sufficient levels of public funding. It is now generally recognized that without educational investment and appropriate research funding no significant level of sustainable national economic development can be attained. Yet the Moroccan investment in research stands at only 0.6 per cent of gross domestic product (GDP) compared to 3 per cent in South Korea.

In addition to a greater budgetary commitment to research, national decision-makers and universities must put in place mechanisms that adjust research funds and orientations to demand in the private sector and that facilitate faculty's bridging of the gap between

academia and the private sector. This can be ensured through an association of venture capital and shared salary schemes which encourage the private sector to feel it has a stake in the university.

Secondly, incentives should be designed for young people to become entrepreneurs and encourage the expansion of existing entrepreneurial ventures (State of Virginia. 2007). In the Arab Region, this requires major changes in institutional mentalities in and out of academia. Given the proper encouragement, the university could ensure qualitative development leaps, bounds and innovations that accelerate economic development at a greater pace than that obtained through traditional macroeconomic measures. A hard look must be taken at the tax codes to include the necessary breaks for start-ups, university incubators and young businesses in general that add value to scientific production. Properly administered, entrepreneurial incentives can have complex repercussions, including orienting students' educational choices towards scientific disciplines with an economic impact.

In a country such as Morocco where the overwhelming share of research is carried out at universities it becomes even more imperative that the interface between university research and commercialization be well-developed, in order to maximize social benefits from research. In recent years university researchers have managed to significantly increase the Faculty's operating budget, complementing state-provided funds with returns from the commercialization of know-how and research development activities. And yet, even if all other elements favouring science-based entrepreneurship are at hand, results in terms of economic performance are likely to be meagre, unless the appropriate climate is in place within the university system itself. A number of factors are likely to be crucial: (i) the degree to which up-to-date research results and methods are communicated to students as part of the regular instruction; (ii) whether the internal reward systems (be they monetary or non-monetary) encourage excellence in both teaching and research, and (iii) the extent to which the university system allows for, and promotes, innovation and personal initiative.

II. Conclusions

Innovation plays a crucial role in entrepreneurship, and scientific and technological innovations are the basis for development. Innovation may be defined as:
"The transformation of knowledge into products, processes, and businesses that create and sustain economic and societal well-being".

Thus the three elements of innovation are: (i) knowledge; (ii) a workforce able to transform knowledge; and (iii) the infrastructure necessary for both.

Scientific and technological innovations can provide the base for traditional manufacturing to move from low-skill to high technology sectors, allowing the creation of new higher-technology manufacturing industries. Currently, only 11 per cent of Morocco's exported goods may be considered as products of high technology (as compared to 33 per cent in South Korea and 31 per cent in Malaysia). Our service industries also need to move toward knowledge-based services, e.g. software, business, biomedical, and financial services.

Finally, the legal system needs to address the issue of intellectual property and enforcement of patent protection. Innovation is not an end-game strategy. It is a *modus operandi* for an economy that can face the challenges of globalization.

Succinctly put, successful knowledge-based economies require that universities be open to influences from the outside world and that they disseminate information about their teaching and research activities outside academia, and in so doing facilitate society's access to relevant information about research results. Likewise society must put in place the necessary instruments to encourage and expand this effort through taxation and other incentive schemes.

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