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Identification of key sectors in Med Countries:

Innovation perspectives

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This presentation would like to focus on methodological aspect linked to the identification of key sectors and enterprises in Med countries that have an innovative potential. Today we know a lot more on Mediterranean countries, because a large effort has been done in accumulating data and identifying the S&T capabilities (See MEDA Innovation trend chart, See also UNDP report on Arab countries). But still most of the vision is one from the side of S&T policies, rather than from the "demand" side: enterprises.

I would like to argue that in order to identify key sectors, it is necessary to go beyond the statistical definition of an economic activity (a branch, a sector, an industry). In order to do that one needs to take into account the real dynamic of the innovation in a firm in the context of a developing economy or a catching-up economy. The most appropriate framework is that which we call "technological learning framework". I will take examples from China and Latin America to make my point clearer. Parts one and two of this paper are more academic. Part 3 is more practical.

1. Technological learning of latecomer companies

Since the seminal work on technological learning in the developing world of Jorge Katz and Alice Amsden, a lot of the work has focussed on South Korea and Taiwan on the theory of late industrialization, the role of the state, and the creation of international value-chains. A theory of the necessary steps to upgrade and attain a certain level of technological development has emerged (Hobday, 1995; Kim, 1997). Observing the Taiwanese electronics industry, Hobday predicted a continuous upgrading from simple suppliers, own equipment manufacturer (OEM) to own brand manufacturers. Dutrénit (2000) draws attention to the importance of the transition process from building the minimum knowledge base to building strategic capabilities in latecomer firms.

Technological learning has been at the centre of these discussions, so much so that some authors propose to replace the concept of National System of Innovation by that of National System of Technological Learning (Mathews, 1999). Technological learning is seen as a structural feature that goes hand-in-hand with some special institutional arrangements (Kim, 1997).Learning (and achievement) in general have been seen as an underlying feature of Asian societies (Rowen, 1998). There has been an impressive number of studies centred on issues like the national innovation system, institutions, and the overall environmental conditions of industrialization (Chaponnière, 1985; Chen et Sewell, 1996; Shin, 1996; Kim,

1997; Lall, 1998; Shin, 1998; Mathews, 1999). Indeed, some studies such as Gereffi (1999) and Ernst and Kim (2002) have been sought to understand the subcontracting process in East Asian economies, and the creation of global chains of supply. In one such analysis of the Taiwanese electronics industry (Ernst et Kim, 2002, p.3) emphasize the diversity of linkages between sub-contractors, foreign clients and providers of technology: "International linkages include a variety of ties with sales, manufacturing, and engineering support affiliates of foreign firms; they also include different forms and trajectories o integration into global production networks of American and Japanese electronics firms. Taiwanese firms typically have relied on concurrent knowledge outsourcing: they have pursued different approaches in parallel, rather than concentrating exclusively on one particular linkage."

This diversity of sources of technology has been one of the secrets of rapid industrialization. It has been either done by large companies (in the case of Korea) or SMEs (in the case of Taiwan and today in the case of China). In Latin America the same process has been more difficult mainly because not so much of a lack of learning (Rivera Vargas, 2002), but rather because of the commercial strategies of North American firms (Lowe et Kenney, 1998). Nonetheless, in these "emerging economies" the actual industrialization process is based on technological learning in a large variety of companies. In China, it is not so much through technology transfers from foreign firms that invest in China (inward FDI) or through some other providers such as universities, technical centres or consultants, but through foreign clients.

2. Understanding technological learning in firms

Technological learning is a cumulative process over time, very specific to each firm, and collective in the sense that it involves more than one person inside the company (Arvanitis et Villavicencio, 1998; Figueiredo, 2002). Economists have used the notions of "production capabilities" and "technological capabilities" in order to differentiate two resulting paths of technological learning, particularly in the developing countries (Bell et Pavitt, 1995). These terms encapsulate the notion of "absorptive capacity" introduced by Cohen and Levinthal (1990), in that an enterprise needs to develop sufficient capabilities that permit to absorb the new technologies. Nevertheless, it should be reminded that Cohen and Levinthal only discussed the case of rather large and sophisticated economies, and gave a particular importance to R&D. As the literature showed, learning cannot be reduced to R&D, even if it is an essential component. Moreover, R&D is not linked to production or the market in a linear and simple way (Rosenberg, Landau et Mowery, 1992). The existence of an R&D unit is not limited to some large R&D facility with specific research projects; R&D's functions can be much wider, supporting the whole productive process, particularly in small and medium enterprises where it is frequently undercounted (see Acs et Audretsch, 1991; Kleinknecht, Poot et Reijnen, 1991; Kleinknecht et Reijnen, 1991; see Arvanitis, 1996; Arvanitis et Vonortas, 2000). R&D, in fact, affects the strategic capability and thus we try in the interviews to understand what is called an R&D unit in each company.

An empirical description of technological learning would identify two types of activities: those that permit to enhance products and processes inside the enterprise (internal learning) and activities with the same purpose but in relation to clients, suppliers, and external sources of knowledge (external or interactive learning) (Pirela, Rengifo, Arvanitis et Mercado, 1993; Arvanitis, 2000). Internal learning includes activities such as: seeking technological information on alternative technological routes, adaptation of technology, development of

better and new products and adaptation and design of processes. Product and process innovations, strictly speaking, are part of this learning experience as well as R&D, design, engineering, maintenance, and quality management (see Table 1).

[Insert Table 1 about here]

External or interactive learning activities can take a very wide variety of forms. Table 2 summarizes those external relations that are related to a foreign provider of technology, and their impact on the creation of technological capabilities.

[Insert Table 2 about here]

Companies that upgrade from productive capabilities to technological capabilities combine internal and interactive learning and, as their experience evolves, they enter a more complex organizational learning. Companies need a strong combination of this internal and external learning and, as their experiences evolve, they follow in a more complex organizational learning (see for a similar statement Figueiredo, 2002). The *integration of technological learning with the market* is of paramount importance in the further development of the company. This integration of technology and market is a "soft" skill. This latter "soft" skill has mostly interested the business management literature mainly on joint-ventures.

3. Three strategies for identifying technological learning and innovation capabilities

Three strategies can be used to determine the real productive and technological capabilities of firms. They are:

a. Understanding the innovative environment of the firms;
b. Understanding the learning dynamic of specific companies
c. Measuring and identifying types of innovative companies.

It is necessary to identify the actors that are active in promoting innovation. The knowledge of the "innovation world" is paramount. It is not sufficient to list the techno poles, incubators, and firms working in venture capital in order to know what is happening. It is also necessary to dispose of an economic geography of industrialization. Industries are located geographically and we need to have this precise geographical location. Moreover, the regional economic dynamism is influencing a lot the location of firms and it is thus necessary to understand it. One product of a dynamic economic region is the multiplication of "intermediate organizations", that is cooperative structures that link companies to markets, to providers, to technology inputs. The Region of the North of Mexico has been demonstrating this dynamic (Villavicencio, 2003, 2003). Associations of entrepreneurs and engineers on both sides of the US-Mexican border are transferring competencies and producing a lot of common projects between the two sides. They are one of the ain sources of inputs for companies in Mexico and the US. Another such example is the Pearl River Delta, in the South of China, around the city of Guangzhou which is arguably the most dynamic economic region in the world (Jastrabsky et Arvanitis, 2004). In both cases, in Mexico and China, the abundance of locally-embedded intermediate organization has played a fundamental role in up-grading the local industry. But it should also be noted that the innovation world, the intermediate organizations, the national and local programmes promoting innovation cannot create the entrepreneurial dynamic. They can only act upon an industrial basis that does not depend upon innovation but upon commercial strategies of the firms. In other words, it should

be wrong to believe that promoting innovation and technological learning will create an industry.

How can we grasp the dynamic of innovation in specific firms? First of all, I would suggest that the economics of industry, when they rely on industrial statistics have little meaning for innovation and learning. Learning, because of its local root in local firms, needs to be seen through a microscope of specific studies, not though the lenses of macro-statistical analysis. Technological learning, either internally or through technology transfers is basically a process that is influenced by the idiosyncratic nature of the firms. Depending on the type of company, the type of market, the type of technology, a different process can be achieved, even in a same industry. Textile is a good example: you will find large firms, SMEs, firms linked to foreign investment and companies living on their own market. Successful companies are not necessarily the all located in electronics or telecommunications, even if the more dynamic nature of the technological sectors is proving to be more "technology-pushing" than textiles. In Guangdong, in the south of China, the city of Nanhai has been promoting actively textile and clothing industries. In Xiqiao, a technology center has been set-up that promotes up-grading of technology in processes, in marketing, in stock-.management, in logistics, in informatization, in CAD design (Arvanitis et Qiu, 2004). The "Innovation center" of Xiqiao has a record of three successful years of technology promotion that has been oriented towards more than 1000 local SMEs in textiles. They are becoming dangerous to, say Morocco or Mexican firms, not so much because of low costs of the workers but also because of a strong management practice centered on technology. Chemical products are another good example. In Mexico, we reviewed some 130 firms in textile through a survey and in-depth interviews (Arvanitis et Villavicencio, 2000). What we learned there was that companies that are successful in technological learning have a longer and more sustainable growth. They are not the most financially efficient firms; they are the ones that stay longer on the market. We also learned that the external linkages of the firms are of paramount importance and should be cared for by policy-making. Linking industries to technology providers is always a difficult task and strategic alliances are rare in developing countries (Arvanitis et Vonortas, 2000). In Latin America, the message apparently has gone through (Vonortas, 2002), since a large variety of experiences now exist that promote cooperation agreements, local promotion of innovation, the creation of industrial clusters and so on . The comparison of Malaysia and Brazil (Manaus) is also interesting since it shows that policy does have an impact on the creation of industrial clusters, mainly because firms are responsive to measures that make their economic environment more profitable (Ariffin et Figueiredo, 2001).
The methodology conclusion is that we need an army of researchers that go into the firms, the technology centers, the technology transfer units in Universities to understand the specific situation in each location.

The measurement of innovation is another topic that has been greatly advancing in Europe. Since the Manual of Oslo and the Community Innovation Surveys have become common knowledge, I will not expand on the necessity to do innovation surveys in companies. Nonetheless let me just remind that one result of the comparison of the innovation survey data shows a very fundamental difficulty. It is difficult to grasp, or to benchmark, industries. This is even more so in innovative industries, because the technology frontier is moving. Nonetheless, surveys are the first step n measuring innovation and there is no other way at hand to do this. To my knowledge in MED countries only Jordan and Morocco have been proceeding to such an innovation survey.

I have been involved in many such surveys, specifically in Mexico and Venezuela, and my proposal is based on this experience. A survey result has an absolute value that is very slim. The real value of innovation survey data lies more deeply, in identifying types of firms, types of technological behaviour (Arvanitis et Villavicencio, 1998). Technically that means that we need a secondary treatment of innovation data in order to classify the firs along some basic variables. The first time we proceeded to such an exercise in Venezuela, we produced a taxonomy of technological firms that has been very robust even after the collapse of the industry we were reviewing (Pirela, Rengifo, Arvanitis et Mercado, 1993). In fact, companies that were "technologically active" in our sample went through the crisis with less difficulties that other types of companies. Moreover, the ones that sticked to a strategy based on continuous technological up-grading have been successful in overcoming obstacles that were provoked by external economic forces. The same was true in Mexico. In a rapidly growing economy like the South of China, this sustainability might not appear so evident and straightforward; nonetheless our reviewing of many industrial clusters in the south of China makes us believe that the promotion of very local R&D, basic technological training and up-grading is defining the contours of the Chinese industry of the future.

Finally, the measurement difficulties might be partially overcome by coupling survey results and specialization analysis that has become a standard tool of economic analysis. The advantage of the specialization analysis is that it is based not on aggregated data of an industrial sector but on the import-export figures at product level. Nonetheless, these analysis have been challenged on the argument that a lot of international commerce goes through unofficial channels so that the customs have no way to measure 100% of the import-export flows.

The methodology conclusion is that more innovation surveys are needed and more secondary statistical work is necessary on the survey data in order to create taxonomies or typologies of companies based on the technology behaviour of respondents.

4. Where do we go from here?

I am the coordinator of ESTIME and I have been involved in setting-up partnerships in eight MED countries. One basic argument of ESTIME is to describe the institutional set-up on the uses of research and the innovation world. ESTIME has no budget for surveys which should be done by local economic and sociological teams. But it can promote the secondary analysis of surveys. Moreover, ESTIME should be used in order to organize in a standardized way the data we already have at hand on innovation in the MED countries.
(see http://www.ur105.ird.fr/estime/)

How can policy profit from the exercises I just presented? First, policy needs to identify its target populations. The basic trial-and-error process might not be sufficient. A lot more R&D happens that is not labelled as such, a lot more of technological up-grading is going on in firms than what a review of statistics would suggest. Finally, a lot of the partnerships, technical alliances and networking activities of the firms are invisible in economic terms although it is the basic engine of growth of many companies and of what has been pompously labelled "knowledge economy".

Finally, a scoreboard of innovation would be important. But more importantly would be to set-up a network of scholars, experts, engineers, business operators, local authorities and national authorities that want to promote innovation and technological development. This is a

long-term exercise and I hope the EU and the MED countries will continue this endeavour in the future.

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Table 1. Internal learning experiences and effects on capabilities of the entreprise

Learning activity	***Effects***
Information management	Opening to external learning, knowledge management, strategy
Adaptation of processes	Productive capabilities
Maintenance, internal fabrication, including quality management	Productive capabilities and knowledge management
Adaptation & improvements of products	Productive capabilities, technological know-how
Design of new products	Productive capabilities, technological know-how, knowledge management
Adaptation improvement of processes	Productive capabilities, technological know-how
Design of new productive processes	Productive capabilities, technological know-how, knowledge management
Management of R&D and Engineering activities	Knowledge management, information, strategy (strategic capability)
Based on (Pirela, Rengifo, Arvanitis et Mercado, 1993; Villavicencio et Arvanitis, 1994; Arvanitis et Vonortas, 2000; Villavicencio et Salinas, 2002)**.**	

Table 2. Effects of different forms of technology transfers on technological learning

Technology transfers modes	*Effects on technological learning*
Sales of equipment with technical documentation for installation	The interaction is a market relation. Passive providers. No learning by interaction; the user does not learn from the providers. This relation is not favorable for tacit knowledge.
Technology transfer contract, with the license of the technology, technical assistance, engineering, production assessment, management contract, all inclusive contracts	The relation is a hierarchical relation, based on the situation of the market. Depending on the nature of the contract, the providers can be active and learning by interaction can happen. But limited technological learning. Also, contract can prohibit explicitly certain types of learning procedures. Tacit knowledge can be learned depending on the degree of interaction.
Contract with a client (or, less formal, long-term relation with client)	The relation is market-based and unstable. No formal technology transfer, but the providers of technology are clients, specifically transmitting quality specifications and productive procedures. Favourable for tacit learning
Sub-contracting, co-production, OEM or ODM	Rather hierarchical relation between users and providers, even if some element of market is included. The more long term is the relation, the more active are providers (they transmit larger parts of their know-how). Specific mechanisms in order to grow up the value chain are devised (for example learning by monitoring) where users can begin a technological learning by interacting on a more permanent basis with their providers. Favorable for learning tacit knowledge.
Foreign Direct Investment: all kinds of joint-ventures, contractual common entreprise	A hierarchical relation between providers and users of technology. Providers will be more active depending on the degree of their investment. The larger their financial investment, the more active the providers. Internalized relation similar to that between a subsidiary and headquarters. Technological learning is a process controlled by the headquarters. If the mother firm is willing, the affiliates will learn a lot. Very favorable for tacit learning.
Strategic alliances, R&D alliances, technological cooperations (rare in developing countries,)	The relations are like an organized market. Providers and users are sharing competencies and have complementary abilities. Both parts are active. Tacit knowledge is acquired from both sides.

Based on Tidd, Bessant and Pavitt (2001), Radosevic (1997), Richet (1998), Huchet (1993) and our own analysis.