Laboratory of Economics and Management
Sant'Anna School of Advanced Studies

Via Carducci, 40 - I-56127 PISA (Italy)
Tel. +39-050-883-341 Fax +39-050-883-344
Email: lem@sssup.it Web Page: http://lem.sssup.it

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NETWORKS, MARKET STRUCTURES AND ECONOMIC SHOCKS
The structural changes of Innovation Systems in Latin America

Mario Cimoli[*]

[*] ECLAC-UN, Division of production, productivity and management

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Introduction

On the basis of development economics theory, it is a well-known fact that trade and production internationalization was not necessarily neutral in the different countries' growth paths. Thus, some countries have selected a road that was characterized by increasing gaps or immiserizing growth. A general consideration, from the literature on development, is that trade liberalization and foreign investment flows are not the only elements that help to create a prosperous development path.

One of the point of departure recognise that local linkages between firms and sectors play an important role. The firm's and sectoral learning patterns as well as overall national capabilities are dynamically coupled via input-output flows, knowledge-spillovers, backward and forward linkages, complementarity and context-specific externalities. Simultaneously, they contribute to shaping the organizational and technological context within which each economic activity takes place. This has a direct link with the analyses that focuses on structural change and development (here, within a vast literature, contribution that comes immediately to mind range from Hirschman to Rosenstein Rodan, Gerschenkron, Chenery and Sirquin, among others).

A traditional statement of that reasoning is as follows: "A suggestion along this line was that development is accelerated through investment in projects and industries with strong forward or backward linkage effects. I argued that entrepreneurial decision making in both, private and public sectors is not solely determined by the pull of incomes and demand, but, is responsive to special push factors, such as the linkages, emanating from the product side. …By now, the various linkages and their interaction have taken on a new character and importance. They appear to constitute a structure that is capable of generating an alternative path toward development or underdevelopment for the different staple exporters. In other words, some of the principal features of a country's development in the period of export-led growth can be described in terms of linkages deriving from its staple." Hirschman (1977) pp. 70 and 80.

A general background of the discussion of "national innovation systems" is the observation that systematic linkages and interaction refers not only to firms, but generally among firms, organizations, and the institutional framework that each society is capable to develop as its own specific social arrangement. The concept of networks can be considered as a proxy and as an observation unit to understand if systematic linkages and interactions are really diffused or not in the innovation systems.

Moreover, we emphasize here that networks may be viewed as a way of embeddings linkages and interaction that support, at the meso and micro levels, the existence of external economies and increased returns. On this respect, this increasing recognition of networks is supported by the idea that no matter how much information and codified knowledge a society produces, if there is no linkage between the total amount of codified knowledge and the skills (and tacit knowledge) embodied in individuals and organizations, the country will be incapable of capturing the productive impetus of

knowledge in the form of innovation and a stable development path (Soete 1996, Dosi 1998, Cimoli and De la mothe 2001).

What all these approaches have in common is the idea that a sustainable pattern of development and virtuous revealed performance -in terms of production efficiency, rate of innovation and growth of income- need a necessary conditions for a "system of networks" to emerge, as an expression of industrial and institutional arrangements for the diffusion of local systematic linkages. For this reason, networks are a category that is increasingly important to understand and explain if a country is capable or not of generating an alternative path toward development or underdevelopment.

An issue proposed in this paper is that the concept of innovation system is not enough to understand the reasons and sources, at a micro level, of the increasing gaps in building innovation and knowledge capabilities. This paper recognises that firms are the central actors of networks because they are integrated in a large complex of links with other firms and institutions. It is important to notice that the modes of how a firm is integrated in a network determine its capabilities of capturing external economies and increasing returns. At a micro level, this highlights the central role of competition between firms integrated in networks as the more powerful factor in the explanation of the configuration and the structural change of an innovation system.

The structural changes of innovation systems in L. A. countries display a path that is strongly affected by generalized economic shocks. A key feature of these shocks is the timing and intensity of liberalization process and the incentives introduced by the set of international prices that have radically affected the structure of markets and the role played by the foreign and local firms. Think, for example, at the market power of subsidiaries of MNCs that with their hierarchy determine the local production pattern and further develop knowledge networks in more developed economies; at the cases of merger and acquisition of local firms and plants that scrap and under utilize local human resources and capital goods. In general, empirical studies have confirmed that technological and knowledge gaps have not been reduced.

The aim of this paper is to analyze which are the most important effects of these shocks on the competition processes and market structures; and, how innovation systems and local networks in Latin American economies have been recently affected. Particularly, based on both the literatures on innovation systems and networks, this paper will strive to answer the following questions. What is the influence of economic reforms and new technologies upon the innovation systems and networks? What is the market structure that result from the competition process between firms integrated in networks? Are the benefits provided by knowledge sources and networks increasingly captured in Latin American countries? Or, conversely, is the actual internationalisation of production in Latin American economies a source that helps to increase the demand for knowledge and network activities in the most developed economies?

Section I, introduces the concept of network as a micro and meso foundation of the national system of innovation. Hence, a brief survey of different definitions of networks

is here introduced. The timing and the modes of how the economics and technological shocks affected the Latin American innovation systems and networks are analyzed in section II. The following section analyses the competitive process between firms nested in networks and the resulting market structures after shocks. Here, it is showed how different market structures explain the sources and causes of network dynamics and why networks either follow a successful or failure path for the local generation of knowledge. Particular attention to the case of the automobile industry is dedicated in this section. Section IV is dedicated to the conclusions.

Networks: A Powerful Engine for Innovation Systems.

Recent studies compare the innovative activities in a number of different countries, and argue that the modes of achieving efforts, support diffusion and adoption of technologies explain a great deal about differences in national economic performance (Freeman 1994, Nelson 1998 and Cimoli de la Mothe 2001)[1]. For the purpose of this paper, let me just provide a brief summary of what we know about networks and national systems. In the concept of a national innovation system, as introduced by Freeman (1987) in the mid-80's and further developed by Lundvall (1993), Nelson (1993), Cimoli and Dosi (1995), Metcalfe (1995) and Edquist (1997), innovation is considered to be an interactive process. At a more aggregate level, innovation is seen as a social process that evolves most successfully in an intensive interaction between the suppliers and buyers of goods, services, knowledge and technology, including public sector infrastructure and organizations, such as universities and public sector knowledge producing agents. The steps that lead from innovation at the micro level toward a more aggregate analysis are numerous and complex. Nations are characterized by particular modes of institutional governance, which, to a certain extent, make them diverse self-reproducing entities. There is an element of nationality that is provided by a shared language and culture, and by the national focus of other policies, laws and regulations that condition the innovative environment.

Specifically, the main building blocks in a National Innovation System can be considered as follows (Cimoli and Dosi 1995). First, there is the idea that firms are a crucial (although not exclusive) repository for knowledge, to a large extent embodied in their operational routines, and modified over time by their higher level rules of behaviours and strategies (such as their search demeanors, their decisions concerning vertical integration and horizontal diversification, etc.) Second, the firms themselves are nested in networks of linkages with other firms as well as with other non-profit organizations (such as public sector agencies, etc.) These networks enhance or constrain the opportunities that each firm faces to improve its problem-solving capabilities. Third, national networks also entail a broader notion concerning how micro behaviours are embedded in a set of social relationships, rules and political constraints (Granovetter, 1985). Even at a micro level, the momentum associated with single technological

[1] A similar view is also emerging from the new growth theory. Indeed, as the new literature on endogenous growth has recently rediscovered, sustained economic growth can be achieved from diffused positive externalities, increasing returns mechanisms and knowledge transference that creates more value from a fixed set of input production.

trajectories is itself a largely social concept: "it points...to the organizations and people committed by various interests to the system, to manufacturing corporations, research and development laboratories, investment banking houses, educational institutions and regulatory bodies" (Misa, 1991). And, in turn, these linkages and networks are sustained by the increasing return and local nature of most learning activities.

At a meso level, the emphasis is displayed on the networks that define the linkages among firms, organizations and institutional context of each innovation system. Together, these linkages establish the opportunities and constraints that each individual process of innovation and knowledge flow faces. Among several available definitions on networks, within innovation system approach, let us start with a quite general albeit slightly one. A network is defined in terms of linkages, interaction and exchange of knowledge and information. Knowledge is embodied in individuals and their organizations, as stated above, and therefore it is obvious that agents and nodes that interact between them should represent a network.

In this context, firms search for linkages to promote inter-firm interactive learning and for outside partners and networks to provide complementary assets. These relationships help firms to spread the cost and risk associated with innovation among greater number of organizations, to gain access to new research results, to acquire key technological components of a new product or process, and to share assets in manufacturing, marketing and distribution.

In sum, firms do not compete in isolation, the competition is a process of firms integrated and interacting in a network. This is why networks are a category increasingly important to understand and to explain the functioning of innovation systems. Moreover, despite the specialization, a network seems to be the result of externalities (static and dynamic). In this context, the increased use of the term "networks" denotes an attempt to inspect the economic and social consequences of externalities and interdependence on the behavior of firms. At the same time, it makes explicit the complementary role of cooperation, co-ordination, and competition when analyzing the patterns of change and the improving of the economic performance.

Infrastructure and institutional setting

In an extreme synthesis, analysis of the effectiveness of the linkages and interaction, that support networks and, hence, the innovation process, are complicated by the presence of all those informal and formal types of relationships between organizations and institutions (and among both sets of actors) that in standard literature fall under the heading of “externalities, spillovers, feed back mechanisms, economies of scale”, etc. We would argue that many of the models constructed to explain growth under externalities and increasing returns mechanisms seem unconvincing. These models support the analysis upon an empty institutional system. Externalities and increasing returns are allowed to be created in specific institutional context and diffused through specific type of infrastructure. Institutions and infrastructure are different across countries.

Networks represent a socio-historical response or output that is developed and deployed in order to address the increasing complexities of economic interdependences. In other words, the existence of diverse networks and their modes of interaction determine specific social systems which present certain invariant characteristics over time that account for their phases of relative success and failure according to the capability to produce and transfer of knowledge. When organized appropriately, networks are a powerful engine that stimulates progress; poorly organized and connected, they may seriously inhibit the innovation process. Economies to scale and increasing returns, both characteristics of economic systems at the end of the millennium, are strongly conditioned by the availability of specific institutional setting and strategic infrastructure such as channels for information flows.

More recently, the analysis of networks focuses on the growing importance of the fast and generalized introduction of new information and communication technologies. Information and knowledge networks, much like the interstate highways in the 1950s or steam engines in the early industrial revolution, provide the basic infrastructure for the modern economic system. However, whereas earlier infrastructures were very physical in nature, today's new infrastructures are typified as being intangible. The economic system's static and dynamic efficiency, i.e., both the allocation of given resources to given economic functions and the development and diffusion of technical and organizational innovations, depends increasingly on access to advanced linkages between firms and knowledge flows in a particular institutional setting (Dosi, Tyson and Zysman 1990).

Cooperation and innovation process

More recently, evolutionary approach introduces the role of externalities (static and dynamic) in the microeconomic analysis of growth. In this context, the increased use of the term "networks" denotes an attempt to inspect the economic and social consequences of externalities and interdependence on the firms' behaviour. At the same time, it is explicit about the complementary role of cooperation, coordination and competition when analyzing the patterns of change and improvement in economic performance[2].

This approach " seems to confirm that belonging to a network not only reduces the cost of information, but avoids being subject to subsequent exclusion and entry barriers. Belonging to a network reduces entry cost while minimizing exit costs by limiting

[2] According to this statement, the economic mechanism that permits firms to capture the benefits of networks and innovation is cooperation. Experience tells us that cooperation is the key issue to understanding the diffusion of innovations. Cooperation does not mean abandoning markets(Colombo and Carrone, 1996.) At first sight the category of cooperation leads to thinking about non-market and non-competitive activities, such as societal and solidarity actions. Despite the fact that cooperative behaviour can be induced by economic or non-economic motives, both operate in the same way: through the sharing of knowledge to improve society's capacity to achieve welfare, via the establishment of transparent contractual rules (Antonelli 1992.)

internal irreversible sunk investments. A network provides access to the very process of standard setting, establishes agreed upon technological trajectories, and reduces duplicative research races, without reducing competition for alternative designs. But the sharing of uncertainties, risks, and costs by means of networks would, by itself, be insufficient to explain why networks of innovators are so pervasive, unless significant long-term benefits were expected to outweigh the immediate cooperation costs. The rest of the explanation must be the expectation of sizeable joint profits resulting from joint accumulation of technological know-how and joint acquisition of significant lead times. This aspect of joint rents has, as yet, been much less studied" DeBresson and Amesse (1991).

The general point here is that competition and global efficiency are not made by single firms, but by networks of dissimilar organizations, both public and private. Firms must adapt to rapidly changing market conditions or take the lead by innovating their products and production processes in a world where technological developments are taking place at an ever-increasing speed; at the same time, the rate of specialization (through division of labour) also is on the increase. It is becoming increasingly difficult for individual companies to produce all the relevant knowledge themselves and for them to translate this knowledge into innovative products or production process. To reduce risks and shorten the time to market, companies have to specialize. Consequently, for them to be successful in the innovation process companies are becoming more dependent upon complementary knowledge and know-how that comes from companies other than their own. Innovation is not so much the activity of a single company; it requires an active search process to tap into new sources of knowledge and technology and to apply them to products and production process.

Many alliances among firms in rapidly changing industries are set up to reduce "transition costs", that is costs that organizations incur when they seek to undergo a drastic restructuring to meet new challenges and implement new strategies (Ciborra 1991). The firms in knowledge-intensive industries must cope with higher levels of technological innovation, strive for the rapid accumulation of know-how and the immediate penetration of new markets.

If alliances are learning experiments, what are the learning processes that characterize them? To be sure, new knowledge is the product and the goal of the alliance. The alliance brings into the corporations' new expertise concerning products marketing strategies, organizational know-how, new tacit knowledge and modifications of products are the typical outcomes of such a process of incremental. A firm can learn how to set up and fine tune alliances per se. The result of such learning is the institutionalization of the organization's rules and routines aimed at managing alliances. For example, Japanese firms are, in general, more experienced in reaping the benefits from alliances because they are more accustomed to grow on the basis of externally generated technology and to exploit cooperative relationships with other firms in their own country (Teece 1989, Teece et al 1990).

Shocks and structural reforms Latin America

Economic shocks

In the recent period, the region faced a "radical shock" involving new economic reforms, in which the primary objective was to generate the conditions for faster economic growth and a new pattern of economic development. This "radical shock" should provide an effective way to retool economic activities, by combining a favourable environment in terms of relative prices with an improvement in the incentives for technology upgrades. Since the beginning of this liberalization period, Latin American industries have experienced a profound structural transformation, and one of the major consequence has been a steady internationalization process that is based on a change in the specialisation pattern.

Around the mid-eighties, the set of rules under which the Latin American economies operated changed dramatically, particularly, in the cases of Argentina, Brazil, Chile and Mexico. With different timings in the region, the economic shock refer to the new set of rules included in a different trade regime (determined by the elimination of many of the trade barriers adopted during the previous decades), the privatization of large domestic firms (particularly, in the service sector) and the deregulation of labour and financial markets (Stallings and Peres 2000). In general, the government adopted a more limited role in the development process that implied a modification in the management of the nation's macroeconomic variables. Furthermore, the country's geographical position and its participation in MERCOSUR and/or NAFTA are extremely influential factors.

Most of the Latin American production structure has gone through important changes from the import substitution period, through the new scenario characterized by trade liberalization, privatization of local services firms, deregulation and regional agreements. The largest economies, after trade reforms, have increased their participation in the world arena in terms of exports and imports. It can be also noted that the industrial industries that have expanded are: a) non tradable industries such as telecommunications or energy, b) natural resources processing industries producing industrial commodities such as pulp and paper, iron and steel, vegetable oil, etc, c) maquiladora industries (electronic equipment, TV and video sets etc), d) the automobile industry. Other industries such as shoes, garments or furnitures, and those producing engineering and knowledge intensive products (capital goods, agriculture machinery, machine tools, pharmaceutical) have reduced their participation in the whole continent (Capdevielle, Cimoli and Dutrenit 1997, Cimoli 2000, Katz 2000).

Within this general picture, one can observe that most Latin American economies have specialized on the basis of their abundance of factors endowments: natural resources and labour. Another relevant issue regards the role played by large domestic firms and the subsidiaries of MNEs which together have incorporated the pattern of international integration in terms of product specialisation and technology absorbed from foreign economies. Subsidiaries of MNC's, in which production mainly is concentrated on standardised products, particularly autos, other durable consumer goods and traditional

manufactures, have adopted the technologies developed by the parent companies in the industrialised countries. In the MNC's local subsidiaries, the technological flow between the subsidiaries and the parent firm influences the evolution of technological trajectories. The pattern of large domestic firms cannot be understood without considering their learning efforts during the import-substitution phase. During this period, these firms developed requested economies of scale to enable them to compete in the international market after the opening of the economy. This has implied the adoption of plans and blueprints and designs in the domestic market, as well as efforts to improve organisation and increase production capacity. Take for example, the case of some large groups in the chemistry, brewery, and glass containers sectors where not only it has been developed increasing production capacity, but have dedicated their R&D activities to support the knowledge-base of the firms during the import-substitution phase.

Nevertheless, the specialization shows the existence of two patterns: the Mexican Gulf and the Southern Cone. The Southern Cone countries (such as Argentina, Brazil, Chile and Uruguay) have intensified their specialization towards natural resources and standardized commodities. These are now highly capital intensive industries with low domestic value added. Firms producing for local markets -the labor intensive and the engineering intensive– are which suffered the most, as a result of trade liberalization and market de-regulation efforts. Conversenly, the image that we have is that countries such as Mexico and the Central American nations have greatly globalized their manufacturing and assembly activities based on the cheap labour; and, a new pattern of specialisation in the global production chain is emerging. At first sight, we can refer to the Mexican case as an important example in the region. In recent years, a new pattern of sectors and production lines has been created, and the economic activities are mainly co-ordinated and integrated across geographic borders. For example, Capdevielle et al (1997) argue that the maquiladora industry is a central actor in the new Mexican competitiveness. In fact, beginning in 1988 the importance of the maquiladora industries increased steadily: in terms of number of plants and workers employed. The maquiladoras phenomenon poses a problem in the present perspective, considering the effects of their presence on the dynamics of local industry.

A note on technological shocks

New wave, as ITC, provide a new environment characterized by technological uncertainty and new opportunities for networking activities[3]. Today, firm strategies and the institutional arrangement (between firms, research organization and government) is clearly challenged by a new wave of technologies. Firms are now often engaged in multiple strategic alliances (joint venture, acquisition and mergers) and changes in the location of production and research activities in the globalized economy. Most of these activities modified the configuration of networks across different type of industries: both the traditional and the more scientific based ones.

[3] In the case of information technology and telecommunication one can clearly observe the gadualy convergence of research pattern and outcome in: semi-conductors, computers, software, customer premises equipment, transmission, and switches.

These new technologies have important consequences for Latin American economies. In order to explain the effect of the technological shock we have to assume previously that most of the knowledge production centers are localized in advanced economies (research on new material, research centers on basic science, product design etc.). Under this scenario, ITC clearly allows a more easily and rapid information exchange, which not necessarily support the relocation of the above activities in Latin American economies. On the contrary, this technology facilitates the process of exchange of information and communication but not necessarily the local creation and diffusion of knowledge. For example, in the case of automobile industry quality control and certification are evaluated on-line with exchange of information from one part of the world to the other. More successful industries have de-verticalized with much more external subcontracting and outsourcing. MNCs and domestic large firms tend to operate in real time planing their production activities on line with their external licensors and technological services. A good example may be found in the engineering department of some Latin American firms. When a capital good and new technology is acquired to substitute the old one, the latter is scraped and replaced. Thus the skilled machine operators and engineers are redundant, these resources are now unemployed.

We have to insist that knowledge is much more sticky and institutional dependent than information. Consequently, tacit and local forms of knowledge play an important role in most of the innovative activities. Innovation process shares two different aspects of knowledge. These are a potentially public element and a tacit element. The public element consists of the available formal knowledge (which may be only potentially available due to the different ways of conceptualizing and, therefore, codifying knowledge). The tacit element is derived from a concept developed by Polany (1967) and referred to by Dosi as being related to “those elements of knowledge, insight, and so on, that individuals have which are ill defined, uncodified, unpublished, which they themselves cannot fully express, and which differ from person to person, but which may to some significant degree be shared by collaborators and colleagues who have a common experience”(Dosi, 1988.)

All of the preceding discussion confirms that industrial R&D reflects a private and a public dimension of knowledge and technology. It also now is possible to put forward a distinction between technology and information: information spreads across firms, whereas the technology includes tacit and specific knowledge that is not and cannot be written down in blueprint and cannot, therefore, be entirely diffused either in the form of public or proprietary information. The fact that such tacit knowledge is primarily embodied in individuals, organizations and networks is particularly important, and plays a major role in understanding the nature of the impact of new technologies.

Innovation systems and networks: their structural changes

These structural changes previously described have spread to almost all key variables that affect the innovation process, as well as the configuration of the local network

system. The "density of the local network" is represented in figure 1, which is understood as the number of interaction, the systematic linkages and the knowledge exchanged in Latin American economies before and after the process of trade liberalization. This figure explains that after the economic shocks, the local network activities and the density of local linkages have decreased. These results support the argument that the local positive externalities, the local diffusion of increasing return and spillovers tend to decrease also. At the same time, the density of networks and interactions increased with firms localized abroad and with centers of knowledge in more advanced economies.

Local densities of networks, product imitation and local engineering capabilities have been higher developed during the ISI period[4]. This model of industrialisation -largely diffused in Latin America- was characterised by strong protectionism coupled with facilitation to the entry of foreign technology (which, however, was mainly accessed by MNEs that hampered its diffusion into the system). The industrial sector was in this phase characterised by the coexistence of national private firms (producing consumer and intermediate goods), public enterprises (providing infrastructure), and MNEs (specializing in more advanced manufacturing branches). Let me introduce the main results that have emerged from the analysis of the capability to accumulate technology during the ISI period (Katz 1986, Cimoli 1988, 2000, Perez 1996, 2000); it suggest that:
1) a significant amount of technological learning and increment of innovation does occur;
2) there is no inevitability in the learning-by-doing process, which on the contrary requires adequate organization, both within each firm and each environment;
3) the sources of the industrialization process were established and a process of upgrading technological capability began through the following: the adaptation of plants and blueprints, efforts to improve the organization of production, increasing capacity to obtain full production, long-term R&D oriented activities and the imitation of products;
4) the degrees and direction of the accumulation of technology vary according to the nature of the firms, e.g. whether they are family, large domestic and multinational. In family firms, the technological upgrade during the initial phase is associated with the technical ability of the entrepreneur, who has transferred the technological knowledge, to build the equipment for production activity and the reproduction of the manufactured products. The effort of this type of firms were concentrated on product design activities; the quality of the product is improved, and attention is paid to product differentiation strategies. Conversely, the MNC's subsidiaries, in which production mainly is concentrated on standardized products, particularly autos, other durable consumer goods

[4] For example, there is a large literature on the recent development of production linkages in the Mexican industry. Sectoral case studies identify that linkages between producers and suppliers and interdependence are highly reduced after the trade liberalisation process, see: the studies on the motor car industry, Lifschitz (1985 and Lifschitz & Zottele (1985); and for the whole economy in Cervini (1993)). Moreover, the input-output studies confirm the above result. The observed trend show a reduction of intra and inter sectoral linkages, see Ortiz (1990) e where a linkage indexes has been constructed in order to stimate the forward and backward linkages.) These results are also confirmed in Capdevielle and Hernandez Láos (1999).

and traditional manufactures, have adopted the technologies developed by the parent companies in the industrialized countries. In the MNC's local subsidiaries, the technological flow between the subsidiaries and the parent firm influences the evolution of technological trajectories. Their efforts were addressed to adapt the blueprints and the equipment to the local environment through industrial engineering activities. In the large domestic firms, technological efforts were oriented to the imitation and specialisation in mature products, where the public support have played an essential role.

Figure 2 illustrate the differences between the two patterns of the innovation systems prevailing during the ISI and new regulatory framework. The general historical background of the discussion onf the innovation systems in LA incorporate, as I see it, the interaction of the following variables: local density of networks, modernization of production processes and capabilities in product imitation and engineering capabilities.

During the import substitution period, the sources of the industrialization process were stablished as well as a process of upgrade in technological capability through the adaptation of plants and blueprints, the efforts to improve organisation of production, the verticalization of production activities and the increasing capacity to obtain full production. However, during the ISI, products have been characterised by low quality standards, low R&D efforts and weak modernization efforts (Perez 1996).

Networks and Innovation Systems before and after economic shocks

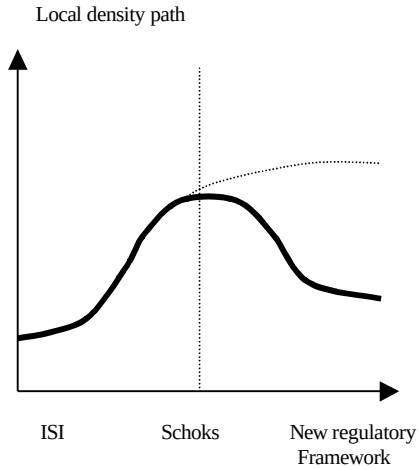


Figure 1

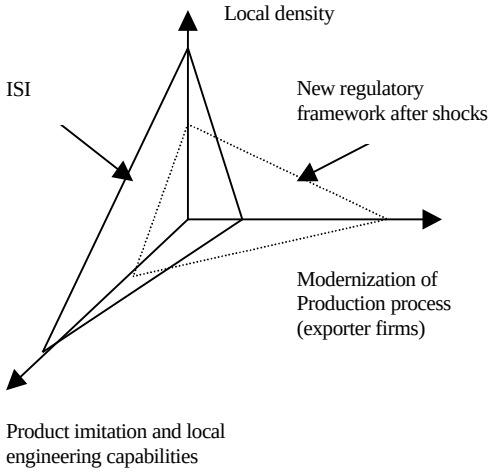


Figure 2

The stylized facts put forward here is that, after the economic and technological shocks, the industrial structure showed mayor weaknesses in the local linkages, lower activities in product imitation (and local engineering capabilities) and higher modernization of

most exporter firms. At the same time exporter firms have been modernized reducing the local interaction with other local firms and institutions. The recent modernization has occurred mostly within the firms reducing the systematic linkages established between local firms. Standardization of production activities and a better quality are a visible results.

There are two implications based on the above-mentioned changes: the first one, which already has been referred to, is the intense dependence on foreign technology in the development of new products and processes; the second is that firms have gained competitiveness through activities targeted at (existing) products and not at creating new ones. This pattern indicates that firms have modified their efforts and competencies. In the broadest sense, most firms have redirected their effort and competencies from an orientation towards new product imitation to the modernization and improvement of production process.

Access to international networks are important because they are the expression of cooperative exchanges between economic agents, and generate effects at the micro and meso levels. However, the meso and microeconomic divergence between Latin America and developed economies is supported by the most recent empirical evidences. From the empirical results, we can also detect a structural dichotomy in the Latin America manufacturing industry: on the one hand, there is a small group of modernised export firms; on the other, there is a much larger group of companies that are much less efficient. Furthermore, the modernised group, as mentioned previously, is becoming increasingly globalised in terms of the orientation of its production and its capacity to acquire foreign technology. More important, the liberalisation process mainly has provided incentives to develop networks with firms and institution located in other countries. This process has inhibited local networking activities.

From firms, networks and market structure to innovation systems

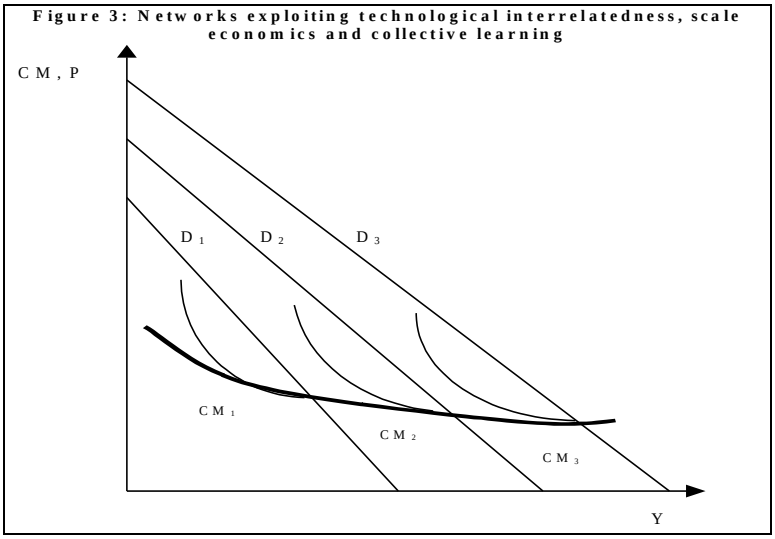
At the time being, we can observe that both type of shocks, economic and technological, has inhibited local networking activities (Cimoli and Costantino 2000). In others words, the production system has modernised a part of the economy, due to the effects derived from the opening-up of same; however, this process has not been accompanied by an increased effort to stimulate the creation of local networks, such as: non-market system of linkages and institutions that enable firms to interact among them.

Irrespective of the theoretical framework that is chosen in order to explain the above situation, it is necessary that the approach must incorporate explicitly positive external economies as a result of the firm-network interaction. Firms compete nested in a network that capture benefits related to the external economies generated in this. In practice, competition has not been seeing as competition between firms that act isolated. They are strongly integrated in a network of other firms, institutions and infrastructures. In the following, we deal with a decreasing function of unitary cost that captures the

behaviour of a firm nested in a network. Differences in cost schedules are here explained through the following properties.

1) *Technological interrelatednes and complementarities.* The linkages in product design and production process prevailing between the members of each network Technological interrelatedness are the different characteristics that are associated with the artefacts produced and used by the member of the networks (Arthur 1998). The dynamic path of the innovation in product and process of participator are dynamically interrelated and complemented according to competencies and specialization.. Still it is necessary to remember that each one of the artefecat, products and process has different costs and modes of knowledge share.
2) *Collective Learning by interacting and distributing*: The more that agents interact and distribute knowledge (and experiences), the more that can be learned from it and from that point to be developed, improved and new products can be introduced in the market. New technologies, particularly ITC can reinforce these mechanisms. In a sense, new demand can be achieved in those markets that can be recently open to international competition.
3) *Scale economics in production:* The cost of network participation decreased because the product is sold on a larger scale and is more used. Here, the globalization of the economy allows a process where the product can be more competitive in its price, as its use increases.

Figure 3: Networks exploiting technological interrelatedness, scale economics and collective learning



Another important assumption is required regarding the modes of introducing explicitly effects of the economic reforms; particularly, we assume that the process of economic reforms in various Latin American countries can be depicted with an increase of international demand. This process allows a reduction of the average cost in the long term as it is showed in figure 3. A demand function that passes from D1 to D3 allows an increasing of linkages of firms that participate in a network and reinforce is technological interrelatednes, complementarity, collective learning and scale of production. An increase of international demands determines a higher production of a

network that produces for the world market and, at the same time a deeper interaction and more stable linkage among the members of the network[5].

From D1 to D3, stable linkages and increasing interaction allows the average cost to show a decreasing curve in the long term. The average cost depicted with the wider line represents these dynamics. The graphical description of the process proposed here can be integrated in order to show its closeness to that described by Dosi (1984) who explains how unit costs decrease in accordance with a technologically determined learning curve, with competencies clearly possessing a cumulative character. Metcalfe (1994) describe a similar process and define it as a sort of Kaldor-Verdoon effect; the same could be explained adopting the concept of "virtous" and "weak" networks (Yoguel and Novick (2000)). These contributions assume that a decreasing cost schedule capture both internal and external economies with different proportions.

Thus, in a closed economy, and for an economy with low scale of production, externalities and increasing returns will be low. A key feature of this model is that once an economy is open to trade (and/or a liberalization policy take place) most of the above variables are reinforced by themselves and by an interactive process between them. In other words, the scale of production is limited by the world demand (thus, it emerges form the Vernon-Kaldor effect or the definition of a virtuos networks). In so doing, we further assume that, each firms and its related network are displayed in terms of their relative unit cost. Profit margins of the leading firms is a function of the difference in average cost function of the existing firms and those of the leading firms (the lowest cost). Thus, an increase in the discontinuity is associated to increase the profit margin of the leading firms and vice versa.

Endogenous market structure and shocks

After an economic shock that increase competition, research on networks has tended to ignore the study of why some networks dissolve, fail or determine a market structure with different hierarchies in production and knowledge diffusion. In sum, behind the conditions that explains competition, market structure and its consequences for innovation systems are:

First, price determination and profit gains in the local markets are affected by the possibility of entry of firms nested in networks developed in more advanced economies; particularly, when the international demand increase and the liberalization process reduce the protection for product and increase the investment opportunities.

[5] We assume here that an increase of international demand produces an increasing of scale of production. However, the firm can capture the benefit of the network without an increase of its production scale; in particular, the cost schedule can move downward on the left side. In this case, external economies are captured in the case of differentiated product for a market niche.

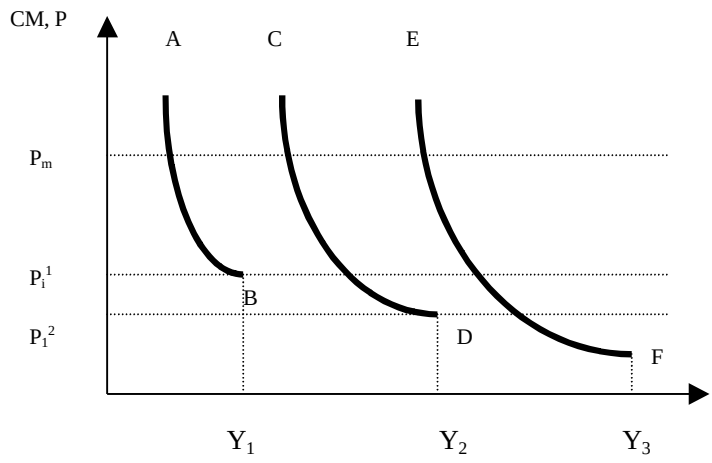
Second, as a consequence, entry barriers are built in a context where firms compete on the basis of their different capabilities of capturing: technological interrelatednes, scale economics in productions and collective learning by interacting and distributing. Competition between firms nested in networks is determined in a context of decreasing average cost. This type of competition defines different barriers to entry for one firm or another according to the advantage that each one of this networks is capable to develop in terms of its decreasing cost function and scale of production.

Figure 4 represents the effects of economic shocks on a competition process between a local firm and others included in globalized networks. AB, CD and EF represent the average cost for a same product, produced by firms nested in different networks with three different production process. Let us briefly outline an additional assumption; there are different production capacities for each firm: Y_1, Y_2 and Y_3. This assumption is based on the idea that scale economics in production is the cause of barriers to entry; similarly, to the structural model developed by Bain (1957), Sylos Labini (1962) and Modigliani (1958).

All these three average costs capture external economies trough technologically interrelatedness, complementarity, collective learning and scale of production. AB is the cost schedule of local firm. CD and EF are the costs schedules of foreign firms nested in networks developed in more advanced economies. Pim is the price of import commodities in a Latin American country (the same could be explained assuming quantity restrictions). For all the prices below Pim, local consumers consume domestic products. In this case the local firms will absorb the local demand, and the firm with the AB curve is going to predominate in the domestic market. The price of import commodities results to be the barrier to entry to avoid penetration of foreign firm in local market.

Once the restrictions are eliminated, domestic firms have to compete with foreign firms. When the protection of local market is eliminated, the firm with an EF curve becomes more competitive and a situation with asymmetry in market power dominates the competition process and market structure. The local market adjusts its demand to prices bellow Pim. In other words, more quantities are produced for the international market and a higher integration makes it possible to displace the local network and producer.

Figure 4: Competing firms in a Network after shocks: local vs Foreign



At this point, a first result indicate that the barriers to entry in local market for foreign firms has been eliminated; but, at the same time, local firms face now barriers to entry in both domestic and international markets. Moreover, given the differences in the schedules of average cost, a more unstable oligopolistic structure is likely to develop. A price between P_{im} and P_i^1 led to a oligopolistic structure where the local firm can survive with a residual demand according to the production fixed by the foreign firm. For a price below P_i^1 the local firm could be displaced by the production of the other two firms. And, finally, for price bellow P_i^2 the firm with the cost curve EF takes a monopolistic position absorbing the whole international demand.

Note that in this perspective, trade liberalization is a potent source of the sort of asymmetry in market power. Moreover, under our assumptions that competition is between firms nested in networks, the degrees of market power and the demand changes explain the resulting market structure after that the liberalization take place. Thus, we can assert that the assumption required for the achievement of a perfect contestable do not apply here; for example, among others, that the sunk cost must be completely absent, that the cost of financial capital must be the same for all competing firms and that the economy of scale and its achievement are reversible processes. However, within the approach on contestable market and its application to developing economies, it is recognized that in a situation of asymmetries in market power, countries have to adopt bounds for the price of firms. This view can be summarized as follows: "What all this means for policy in a developing countries is that such an economy using contestability as its guide can protect both consumers and smaller rivals of large firms without recourse to drastic and economically costly measures such nationalization or highly restrictive constraints on enterprise. If competitive behaviour is what the society wishes to achieve, it can attain this with the aid of some fairly straightforward rules, notably the adoption of upper and lower bounds for the price of firms considered to possess *market power*, bounds calculated with care to replicate the bounds that would be enforced by market pressure under the ideal state of perfect contestability" (Baumol and Lee 1991).

Our model describes market structure and asymmetries in market power after that a diffused process of trade librealization take place. There is an additional issue regarding the modes of producing innovation and transferring knowledge.

The hierarchy established by a market structure -where price and barries to entry are determined by the firms nested in networks with higher technological interrelatednes, scale economics in production, learning by interacting and distributing- determine how are distributed the production and knowledge activities across different economies.

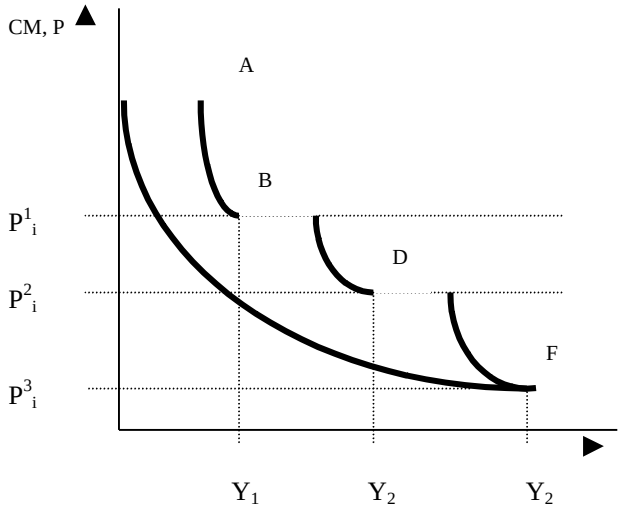
Self-reinforcing mechanisms in networking and knowledge gaps

We begin with an explanation of what are the effects of such of market structure upon the capability of generating networks and knowledge locally. Thus, at the beginning of this exercise, one can think that each curve is the average of curves for the local and foreign firms, respectively. In such a sense, we explain the competition process between the local and the foreign industries under the hypothesis of decreasing cost and economic of networks.

Figure 5 illustrates a outcome solution after the economic reforms. The DD is the curve of international demand and AF is the curve of average cost of the prevailing international network. This figure indicates that the network with larger production capacity can absorbs most of the international demand, and at the same time imposes high entry barriers to other networks. Thus, a new hierarchy exists where the industry with more market power in terms of networking interaction shapes and strategically decides the types and the modes of how knowledge is exchanged.

In general, one could reasonably introduce the following hypothesis: an industry (or firm) under a scenario of liberalization policy, higher potential demand and uncertainty assumes a defensive strategy and its firms are price maker. For a price bellow P_i^2 the firm with the cost schedule EF take a monopolistic position. As in a model of monopolistic competition, a frim “make” a price that maintain barriers to entry for existing firms and entrants. Since an international market is characterized by a continuous growth of the demand, other firms participating in a network can compete absorbing shares of such demand. In an extreme case, a such firm can fix the prices where the average cost is tangent to the demand (P_i^3). If such firm absorb the growing demand a process of self-reinforcing can be established. If the production capacity of the firm with higher market power is lower of the international demand, the local firm will remain in the market and the leader firm will obtain an extra profit given by the difference with the minimum average cost.

Figure 5: Self-reinforcing mechanisms



A paradigm-based theory of innovation and production seems to be highly consistent with the evidence on the patterned and cumulative nature of technical change and also with the evidence on microeconomic heterogeneity and technological gaps. Moreover, it directly links with those theories of production which allow for dynamic increasing returns from Young and Kaldor to the recent and more rigorous formalisations of path-dependent models of innovation diffusion. In the latter, interactions between micro decisions and some form of learning or some externalities produce irreversible technological paths and lock-in effects with respect to technologies which may well be inferior, on any welfare measure, to other notional ones, but still happen to be dominant - loosely speaking- because of the weight of their history (cf. the models by Arthur and David).

These evolutionary characteristics of the process of technical change are seen in a complementary perspective as responsible for the occurrence of what has been called “lock-in by historical events” and “self reinforcing process” (Arthur, 1989, Dosi 1999). Lliberalization and globalization of markets in a context of competing firms nested in networks under increasing returns mechanisms might even increase diversity across nations, if dissolution and inhibition of local externalities are not more than compensated by the diffusion of knowledge transferred (or diffused) by the globalised firms. Several empirical results support these analytical results, especially interesting are those concerning the dissolution of networks and knowledge gaps in Latin American countries.

1) As we have mentioned earlier both shocks (liberalization and ITC) have modified the local networks substituting them for another kind of networks where linkages and interaction responds to the asymmetries in market powers. The above empirical

evidence shows that macro convergence of liberalization process does not mean equality of the members, yet imply different capabilities of capturing the benefit of networking activities. Thus, in Latin America, linkages and interaction among the members of the network is related to price and quantity signals. Therefore, the sharing of knowledge through other mechanisms is very reduced. Second: as prevails in developed countries, the sharing of knowledge, uncertainties, risks, and costs by means of already existing networks would, by itself, be sufficient to explain why already existing networks take the advantages from the increasing of the international demand.

2) In recent years, a new pattern of sectoral and production chains has appeared, while at the same time economic activities are coordinated and integrated across geographic borders. In fact, production activities now are widely recognised to be the center of gravity for the Latin American economies' increased participation in the new "world specialisation." This new globalised scenario has increasingly modified the nations' competitiveness, as well as their integration in terms of production capacities across firms, industries and nations. Industries and firms now are integrated in an international network according to different types of linkages designed as networks of contractors, or they have formed more coordinated, integrated and organized production chains in different sites around the world. Many other factors give specific shape to these networks; one specific factor involves the rules of action for NMEs as they decide whether to invest locally or export, based on the trade off concerning proximity of trade for local investment compared to the gains in concentration or scale that come with exporting.

3) With a difference in timing, it is possible to infer that an "optimal cycle" of globalisation, which relates growing production capacities to dynamic and higher technological efforts, will prevail in the long term. At the beginning of this process, foreign firms start their production activities in a domestic location, adapting organization equipment around their main headquarters-based business. Manufacturing activities mainly are located on the basis of labour costs and local markets that have specific regulatory frameworks (think of NAFTA as introducing a new regulatory framework.) For some authors, local technological competencies become an early ingredient in persuading multinational enterprises (MNEs) to establish subsidiaries in a large range of industries (Eaton, Lipsey and Safarian 1994.) However, in general, in the following stages, local firms are expected to develop their own technological competencies by adapting the production organisation/processes and product designs. In the last stage, R&D is expected to move ahead, establishing research centres and linkages with local centres that specialize in the production of applied research and the formation of human capital.

This last phase, associated with the new phenomenon in the globalization of industrial research activities, generally has occurred throughout the most industrialized economies in the OECD area, as more of the multinationals' investment is directed toward research abroad and the acquisition of laboratories. Nevertheless, recent evidence on the large multinational firms' contribution to the world's technology shows that, in spite of increasing talk about the globalization of large firms technological activities, they

remained remarkably oriented toward domestic activities. MNEs prefer to keep technological activities at home, in contrast to their attitude toward production activities (Cantwell, 1997). For foreign firms, the overall evidence seems to point to the contrary of the expected convergence. Technical literature cites international evidence about large MNEs keeping most of their technological activity at home (Pavitt and Patel 1995, Chesnais (1995), Freeman and Hagedoorn (1995)).

In fact, analysis is carried out through empirical studies at the meso and micro industry level in most Latin American countries (such as Argentina, Brazil and Mexico) has shown that this hypothetical phase remains as a "dream" for most of these countries. Under these circumstances, direct foreign investment (DFI) refers to the activities and decisions that MNEs make. These activities and decisions, developed considering international production, exert a strong influence on the direction of trade flows, scale and content as well as on trade specialisation, competitiveness and the host and home countries' foreign trade balances. This is the case of most host countries in Latin America. In fact, to a significant degree, Latin American patterns of trade specialisation and performance (for example, international competitiveness) then can be analysed as the outcome of the processes that are the result of the MNEs' decisions concerning the location and quality of direct foreign investment. In this context, regional integration through NAFTA and MERCOSUR have played a crucial role as an institutional regime or framework that has supported incentives for the MNEs. Today, technological development occurs mainly in the MNEs' home bases, and only a small portion is transferred to Latin American countries.

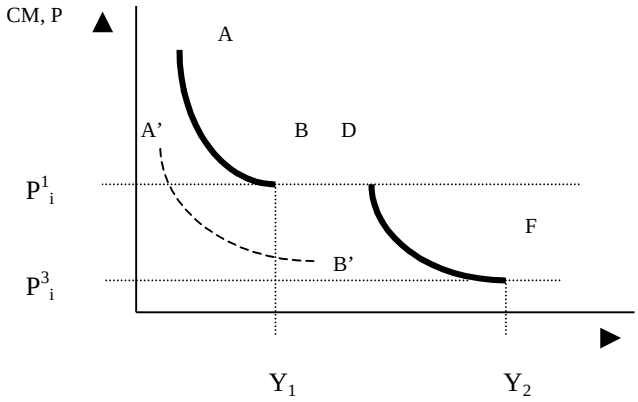
This process determines, on the one hand, that Latin America does actively participate in the globalization of production and, on the other hand, that its participation in the globalization of scientific and technological activities is very poor. As companies transfer only some of their R&D activities to Latin America, we can expect that the present concentration of corporate R&D will by and large lead to an even stronger international divergence of technological development. The internationalization of R&D is carried out within developed economies and regions with already-proven technological advantages. Technological cooperation between firms seems, in practice, to exclude firms that do not already have an established reputation within the developed economies. This view supports the results obtained by empirical research on the organization of research activities in multinational firms; here, it is clear that even multinational companies perform most of their innovative activities in their home country (Patel and Pavitt (1991), Cantwell (1997), Cimoli 2000).

Mergers and acquisitions

One can observe that the cases of merger and acquisition can result from the following cases: 1) the production capacity of the firms with higher market power is not enough to cover the domestic and international demand; 2) the local production plants show opportunities for pushing a modernization process leading for the foreign firms; 3) the local firms control a diffused and articulated network for product distribution in the

domestic market; and, 4) the local firms maintain privileged nexus with the local political establishment .

Figure 6: Acquisition and modernization of local firms



Only for P_i^1 the local firm and its network can survive with non-profit. From prices bellow P_i^1 the foreign firm is able to absorb the local and the international demand. If one of the above conditions prevail firms of an international network can acquire or merger with local companies.

In general the practice most diffused are the acquisition; moreover, even when mergers seem to be developed between equal patterns, most are acquisitions with the foreign firm controlling the local one. In this case, P_i^1 is the price that allows the coexistence of the local and foreign plants. This is frequently the case that can be observed in the Mercosur or NAFTA, subsidiaries of multinational corporations can achieve shares of the regional demand and at the same time can exploit the advantage achieved in terms of their own network.

However, a process of modernizatin of local firms can take place in the case that local firms are acquired (or merged). Figure 6, describe the case of modernization after that a process of acquisition has taken place; a successful effort to modenize the local firm would cause an downward shift in the cost schedule AB. Thus, the new schedule A'B' can be see has a new plant in the in the international network controlled by the firm with higher market power. This new market structure explains that firms that gain in market power are those that hierarchically and strategically decide where innovation are created and diffused. In Latin America there are main facts that explain why this hierarchy and decisions are simply not functioning to improve R&D efforts, as well as the linkages with the local institutional framework.

First, regarding the production side, we can see that during the ISI period, Latin America production capacity and sectoral linkages enjoyed considerable growth, to later enter into a transition phase where there is no clear trend regarding these indicators, although the linkages do start to decrease. Well into the new regulatory framework, competitiveness and production capacity follows a trend of growth. The linkages

between domestic firms, however, continue to decrease. Nevertheless, the fact is that it is precisely in the large firms that are focused toward the export market that both competitiveness and production capacities are growing. This growth should not be overlooked. Furthermore, the decrease in domestic intra and inter sectoral linkages among firms shows that these increasingly are replaced by an international integration process (e.g., globalisation). In fact, together with this process, we can see a dramatic loss of articulation in the existing linkages between those firms producing export goods and their domestic suppliers of inputs (which represents a much lower degree of knowledge and technology diffusion). We should not forget that several of these firms' comparative advantages are due to the particular allocation of production factors, such as the low cost of labour and relative abundance of natural resources.

Second, the imported equipment used throughout the companies acquired, replaces the learning capability that could be accumulated in specialized domestic suppliers of equipment in a well integrated industrial system. The main changes can be observed in the modes of how sectors and the type of firms (considering Foreign Firms and Non-Foreign Firms) are inter-inked with foreign production networks and sources of technology. Specifically, the pattern related to R&D efforts and other modes of technology transfer has mainly been replaced by greater integration with imported inputs, stronger linkages with foreign engineering services and institutions (such as universities and other research institutes) for the most successful export sectors. Their direct contribution to R&D and technology transfer is not substantial. The evidence on R&D activities and technical collaboration (technology transfers) shows that the efforts and local interactions for this kind of activities are scarce and scattered (Cimoli 2000)

Third, the personnel employed in activities such as R&D, quality control and local adaptation of design mainly interact within the multinational firms where they work and, furthermore, those firms are characterized by reduced linkages with the domestic higher education institutions, local research centres and laboratories. In this context, for example, universities show increasing efforts to improve and create linkages with the production system. However, those efforts are inhibited by two main factors: first, the bureaucratic organization in most public universities, and second, the more modernized industrial sector and the science-based sector's demand for knowledge from institutions and research centers abroad.

Four, on the other hand foreig firms are localized in economic activities that are co-ordinated and integrated by large MNEs across the geographic borders with highly integrated linkages in production and innovation processes (see the automobile industry). For example, within this category we have the 'maquiladora' industry characterized by linkages that are highly integrated to intrafirm imports rather than to domestic production capacities (as in the modern science based sectors of computers and telecommunications led by foreign firms). For example, in Mexico and Central America, maquiladora operations dominate the production of science-based components, thus allowing very limited links and flows to other domestic suppliers of intermediate goods. Analysis development for the most recent years, seems to confirm that the maquila industry is one of the leading actors in the industrial modernisation.

The diffusion of this type of industry introduces only very weak connections with the domestic productive firms and institutions. The "maquila innovation system" mainly supports and stimulates networking activities in the firms and institutions located abroad, thus, reinforcing the knowledge and technological advantages in the developed economies.

A closer look within networking and innovation activities: the automobile industry

The importance of technological convergence among the different sectors is well perceived throughout analysis of the different activities related to vehicle production. Cimoli and Costantino (2000) analyze the different pattern of convergence in Mexico and the developed countries. The co-evolution of the steel and alloy sectors with automobile manufacturing firms is readily seen in a world-class industry, which produces engines, parts for the suspension system, parts and accessories for the brake system and chassises, among other parts and accessories. The steel and the automobile industries share a common path characterized by an interactive convergence process in which the disequilibriums, improvements or technological innovations that take place in one sector affect the path of the other. This process has its roots in the import substitution period, when both industries developed initial capabilities and local networks.

Despite its importance, the pattern of convergence is asymmetrical with respect to the developed economies. In this economies, the technological convergence of the automobile industry is mostly related to the science based sectors, such as electronics and new materials and research institutions. R&D activities within firms and collaboration patterns with private and public sector centres are more intense. Under these circumstances, important differences in the pattern of network creation and demand for knowledge should be observed. Design, prototypes and the introduction of new material are developed in the advanced countries. The production process in Mexico has a high demand for knowledge from research and for network activities between firms and institutions that are located in the developed economies (from design to each activity related to quality control and standardization).

The current production structure in the Mexican automobile industry can be described as a semi-linked umbrella. At the top of the structure, there is a pool of motor vehicle manufacturers and assemblers and below them is a completely dissimilar set of auto parts and components producers. At this same level of the structure, it is feasible to find three different kinds of auto parts and components suppliers. The first is formed by the pool of automobile assembly subsidiaries. The second group of auto parts and components producers is formed mainly by foreign conglomerates that are specialized in auto parts and components suppliers. This segment of firms is characterized as large enterprises and world class companies that are already integrated into a network with the assembly firm. The third group of auto parts suppliers is the foreign-made component producers. All these three different types of component suppliers correspond to the category of top level auto parts and components agents or primary agents.

The main important link identified are those that connect with the pool of primary agents producer of components. Those enterprises constitute the linked and integrated cluster in the Mexican automobile industry. There is a secondary level of autoparts and components suppliers. This level basically is formed by medium and small-sized Mexican companies. Those firms act as suppliers for the primary agents, and they maintain limited linkages with the rest of the cluster. Finally, at the bottom of the structure comes the imported parts segment which provides inputs to the secondary and tertiary producers. In a precise sense, this fragment of the automobile sector is completely detached from the Mexican cluster structure.

In accordance with the previous statements, the Mexican automobile industry (as well as in most of the Latin American countries) presents a dual system.

The first, or hard nucleus, is built through the bi-directional and regular exchanges of information and knowledge between the automobile manufacturers and assemblers and the pool of primary foreign suppliers. Naturally, this small group does not have an extended form of cooperation and the sharing of enterprises. The second , or residual firms are characterized by a type of interaction, or soft outline, that is constructed around the limited exchanges among the pool of secondary suppliers and the hard nucleus. Indeed, the number of enterprises in this segment is the largest. In the hard nucleus, there is an intense cohesion.

Parallel to the analysis of the automobile industry in Mexico, Posthuma (2000) provides a description of networks in the Brazilian case. The liberalization of the Brazilian economy and the increased entry of the multinational firms, both in the assembly sector and specially in the auto part sector (via mergers and acquisitions of the existing firms, as well as direct foreign investment in new companies) has increased the insertion of automobile production into global patterns of production and specialization. The automobile production chain can also be represented in a pyramid structure where some part of the firms are situated as a “first tier” supplier located above others “tiers” producers of more simpler parts.

This leader tier suppliers must take greater responsibility and risk because their main activities are related to the assembly of different parts and components. Hence, the first tier firms became responsible for managing the supplier change, and takes on many activities which formerly corresponded to vehicle assemblers. In a large sense the structure of the interaction between firms is characterized by a hierarchy where the vehicle assembler and the first tier supplier determines the type and density of interaction between the different firms that participate in the automobile industry.

Moreover, the first tier suppliers are local old firms acquired by multinational producer firms of components and autoparts (for example the recent case of Fiat with Magnetti Marelli). The kind of interaction and the knowledge exchanged between the assembly and the first tier supplier firms reproduce the same type of exchanges: in terms of quality, coordination, information, and human capital requirements for the technical staff. The interaction with the other suppliers, the second and the first tier, is the

traditional price based model of contracts biddings, by which the firms request bids from several suppliers for the same parts in order to force down prices, is still widely used as a common practice.

It is impressive to note the surprising more elevated percentage of workers with a technical degree in the local firms, and the somewhat lower levels in the multinationals subsidiaries. This finding is congruous with the position demonstrated in the literature regarding the conduct of multinational subsidiaries, a subsidiary that receives its technology package from the overseas headquarters has less need to develop a strong in-house technological aptitude, while a national firm must invest in the skilling of its technical staff and in its technological base in order to accomplish endogenous technological knowledge.

Through an examination of the courses and activities developed by technical workers, it was feasible to confirm that the level of investment in technical courses is much larger for this level of employees than for workers in shop floor production. It is concluded that the firms with bigger levels of technological refinement (in process technology and product technology) will have a greater substantive context of technological know-how concerned in its activities, in the engineering and R&D areas, as well as in some of the productive areas. The investigation results indicate that production workers are not receiving the level of investments in training and technical capabilities that would bring about an important upgrading in skills. Likewise, the organisation of production in most of the firms was not being controlled in a way that would activate the creativity and the skills of shop floor workers.

Empirical findings on the Argentinian automobile industry are reviewed in Yoguel and Novick (2000). The study suggests that networks can be distinguished and clasified according to the type and intensity of the interaction among firms. Three type of networks are introduced: “virtuos” and “weak”. The investigation performed on the Argentine automobile complex during the last years (Kosacoff et al, 1999; Motta, 1999; Novick and Buceta, 1998; Novick and Yoguel, 1998, Bastos Tigre et al 1999), present a particular similarity of conclusions. All these papers tend to inquire the very reality of the network (and/or to distinguish the interfirms linkage models) as hierarchical, heterogeneous and weak. From the viewpoint of the linkage style configured, competition association prevails over those of cooperation, complementary spaces between plants, both vertical and horizontal are not common and the no-price exchange indicator reaches a reduced level. Most of the results of the studies carried out in Latin America (Novick y Gallart, 1997; Leite, 1999, Carrillo, 1997; Atenburg y Meyer-Stammer, 1999), indicate that the most usual situation in the region is the presence of networks close to the “weak” model. This obviously places it far from the “virtuous” network characterized by: a mutual dependence and a powerful exchange of intangible assets, a support to information and knowledge flows in product and process developments, a similar administration of human assets etc.

Modernization of local firms and industrial districts

Empirical evidences suggest that liberalization introdue a more competitive environment which has allowed (an facilitated) the modernization of some local firms. However, the incentives of pushing a modernization process is a function of those elements that support, on one side, the realization of increasing returns and, on the other, the abundance relative of natural resources and labour. This is the case of large local firms that in most cases are specialized in the production of commodities based on natural resourses or their production process requires labour as the main input.

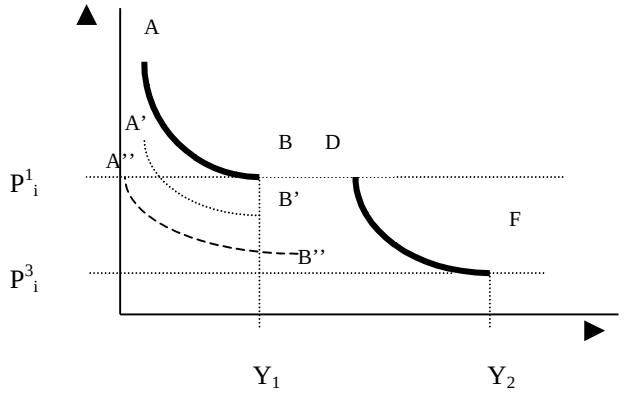
During the import substitution period, these large local firms developed economies to scale that enabled them to compete in the international market, once they faced an open economy. At the begining of this period, this implied adapting plans, blueprints and designs in the domestic market, as well as an effort to improve organization and increase production capacity. However, some of these firms also developed R&D activities in order to generate their own knowledge base. After the shocks, modernization has occurred mostly within large exporter firms[6]. The pattern of large domestic firms cannot be understood without considering some main historical facts that explain the nowadays performances: i) their learning efforts, scale of production gained and the public support during the ISI period; ii) their efforts to gain higher productivity and quality through the modernisation processes in the nineties; and, iii) their strategy that have look for an continuos expansion of their export.

Another successful case of competition and increasing capabilities of capturing international market shares is that one resulting from clusters specilized in clothing products, footwear, shoes etc. The general evidence support that for the existence of whatever cluster (and district) some kind of positive externalities and collective action need to occur among agents. A cluster is defined as an industrial and spatial concentration of firms that interact between them; thus, this interactive process benefit of positive externalities and of sharing costs and innovation risks.

There are two fundamental aspects that support the explanation of why a cluster exist in a Latin American country: 1) a relatively long history of cooperation among firms from the ISI period; and, 2) a regional and territorial policy oriented to promote collective action between firms and institutions. Most of this argument support the idea that some kind of collective action that allow the diffusion and absorption of externalities through the cluster is one of source of competitiveness.

[6] On the basis of the sectoral analysis and from the results of several surveys a picture of the historical path of each sector can drawn. Examples include the chemistry, brewery and glass containers sectors, in which R&D activities have been predominantly re-oriented toward quality, cost reduction, standardisation requirements and utilisation of imported machinery and equipment.

Figure 7 Industrial districts: collective learning vs input costs



This conventional view of cluster (and industrial district) clearly regards firms that do not compete isolate; conversely, they are integrated in a network of other firms and institutions. Thus, some kind of collective action with some kind of efficiency is obvious. Thus, a more general point regards how much this competitiveness is explained by the external economies generated in a network or by differences in input cost –labour, raw material, environmental control etc- and/or the protective policies. One can take the case depicted in figure 7, the cost schedule AB is associated to a local firm integrated in a network (and/or a cluster). The scale of production and the location of that curve in the C-Y area represent the external economies generated for that network. The CD schedule indicates the external economies generated in a foreign network.

We observe that the differences between them indicate the gaps in developing positive external economies and economies of scale. In this case, only a cheaper input cost (or a devaluation) explain why the local network, with a reduced capacity of developing external economies, can compete with the foreign one; in this case, more competitiveness is gained with a downwards movement of the AB schedule to A'B'. A competitiveness gain through external economies and an increasing of scale of production is depicted with the movement of the schedule A'B' to A"B". Thus, the mechanisms that produce some kind of positive externalities in Latin American cluster has to be reconsidered at the light of other traditional elements that explain comparative advantage in the market factor prices. Most, of the cluster and district of the regions support their competitiveness and market shares on inputs prices and relaxed legislation on the environmental issues.

Conclusions

The literature on networks has insisted that firms reduce the irreversible commitments and sunk costs, and generally provide more flexibility than can be achieved through internalization. When networks faces shocks so radical and deep as the ones observed in Latin America, the local and foreign firms changes their opportunities and increases systematically the local uncertainties to create long term linkages.

In this paper, a network has been treated as an important element in the explanation of how a innovation systems is configured. At a micro level, it is suggested here that the competition between firms nested in networks is the main factor in the explanation of that configuration and its changes over time. The bulk of the model reported in this text deals with the impact of competition and market structure upon innovation and knowledge diffusion. The differences in market structure are explained according to the demand expansion, the external economies developed in each network and the scale of production. A first result of this simple model regards that the resulting market structure, after the economic shocks, produce the so called self reinforcing mechanisms that increase market power and hierarchies in favour of foreign firms.

Asymmetry in market power and hierarchies explain the distribution of production and knowledge activities. Thus, it is showed how the large disadvantages of local firms, in term of their capability of creating knowledge and diffusing innovation, can basically traced back to the resulting market structure under the reinforcing mechanisms generated in networks.

In general, the overlapping impact of the economic reforms (trade liberalization) and new technologies (information technology and telecommunications) is a cocktail that facilitates the linkages with the global production system. However, countries and firms do not begin from the same starting line. Failure, as a result of destruction and inhibition of local networks may come from the competition with firms nested in more developed networks that generate: deeper technological interrelatedness, larger economies of scale in production and proper processes of collective learning. For example, in the case of a foreign firm, the most immediate costs that can be reduced are those of coordination, it is easier to establish a continuous linkage with other subsidiaries of the MNCS. Therefore, the internal coordination costs are considerably reduced. Domestic large and small firms have very different expectations and powers in such network relationships. Regarding the main effect of shocks, it can be summarized that the benefits generated by the networks that support knowledge and innovation are not equally distributed. This argument survives also, with qualification, in the case of acquisition and merging with local firms. More suprisingly, the successful modernization of some local firms and their strategies of neutralising the asymmetry in market power have been allowed by the capability accumulated during the ISI period.

Moreover, the actual specialisation of production and knowledge support a system of linkages and networks in which the demand for knowledge and innovation is continuously focused towards the advanced economies, thus increasing their capability to capture the benefits and advantages. At first sight appears as a contradiction between: (1) the theoretical vision that supports the idea that countries capture with the same opportunities the benefit of trade liberalization; and, (2) most empirical evidence on the increasing gaps in the capability to capture the benefits of innovative and networking activities.

It is largely recognised that one of the features of the emerging pattern in Latin America is the disruption of the local production chains and networks. This situation is expressed in the breaking of domestic links, particularly for the production of intermediate commodities and capital goods. This structural divergence could be viewed as a different capability from Latin America and the developed world, of creating local positive externalities, of diffusing increasing returns mechanism and spillovers between firms and institutions that create knowledge. At the end, this micro and meso divergence established the differences in all that mechanisms that explained a sustainable pattern of development.

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