Diffusion and appropriation of knowledge in different organizational structures

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Abstract:
This paper discusses the relationship between diffusion and appropriation of knowledge in terms of the construction of competitive advantages in different organizational structures ranging from isolated firms to knowledge networks. The main hypothesis is that there is an inverse relationship between diffusion and appropriation, which depends on the joint interaction of technological specificities, knowledge management and prevailing market forms. The creation of competitive advantages depends on the development of agents’ cognitive capacities, which enable the management of tacit and codified knowledge, thus raising the minimum barriers to a level that makes possible the appropriation of this knowledge. These barriers may be related to the minimum decodification capacities restricting the entrance of new firms.

Introduction
Innovation has traditionally been viewed as a mechanism for acquiring temporal (Schumpeter, 1912) or permanent quasi-rents (Schumpeter, 1942) and as a key element in economic development. These ideas were explored by Arrow (1962) and Nelson (1962) and revisited by neo-Shumpeterian and evolutionary thinking in the last 20 years (Freeman 1994, Nelson and Winter 1982, Dosi et al 1988, Metcalfe et al, 2003, among others). The latter have enriched the analytical framework by highlighting the importance of knowledge in networks, territories and institutions in the framework of technological, organizational and institutional change (Langlois, 2003).

For firms and other organizations, the technological revolution has underlined two central issues: on the one hand, the endogenous character of knowledge in economic activities and, on the other, the growing importance of intangible assets in the generation of dynamic competitive advantages in the context of imperfect market forms. Likewise, the loosening of organizational structures associated to the new technological paradigm, stressed the importance of the conversion of individual firms to schemes that place competition in the framework of local systems, global chains, clusters and production networks.

The literature on knowledge has made a great attempt at focusing on these topics from the point of view of firms and sectors. Except for a few cases, (Cohendet, et al, 1999; Ernst and Lundvall, 1997), it is rare to find contributions linking the development of production networks with knowledge generation or the building of competitive advantages and associated market structures in developing countries. A significant part of these previous discussions has focused on differentiating codified from tacit knowledge (Cowan, et al 2000, Johnson et al, 2001) and on identifying and characterizing the different dimensions of knowledge for the purpose of capturing its complexity (Nightingale, 2003). Only a few discussions have included the factors involved in the process of knowledge transformation (Nonaka and Takeuchi 1995) and some have only marginally dealt with aspects connected to its generation (Ancori et al, 2000; Nonaka and Takeuchi, 1995, Nonaka and Toyama, 2002). In fewer cases yet, has the role of demand been introduced in the discussion as a key factor to explain knowledge metabolism and the prevailing type of technological regime (Malerba and Orsenigo, 2000).
In this sense, the literature about knowledge has made an important effort to explain the processes behind the creation of competencies, working on the distinction between tacit and codified knowledge, of learning mechanisms and the generation of competitive advantages in individuals, organizations and productive systems.

From different perspectives, most of the subsequent contributions have agreed on recognizing the tacit and codified dimensions of knowledge thus enriching the previous notion which simply equated knowledge with information (Lundvall, 1996; Ernst and Lundvall, 1997, Antonelli, 1999, Nooteboom, 1999, Ancori et al, 2000; Cowan et al 2000; Malerba and Orsenigo, 2000; Johnson et al, 2000; Nonaka and Toyama, 2002; among others). This wide literature has focused on, among other things, ways of learning, types of knowledge, and the transformation of one form into another, which explains the creation of new knowledge and the development of competitive advantages. Moreover, works produced in other disciplines and fields, such as anthropology (Bloch, 1991; Goody 1977) and the cognitive sciences (Brown and Buligid, 2000; Rogers, 1962) has made it possible to reinterpret the above mentioned literature by emphasizing the existence of logics which are specific to each knowledge dimension and which condition the possibilities of (i) transformation and diffusion, opening up the discussion on knowledge creation by including the development of cognitive capacities; and of (ii) exclusion and appropriation sustaining competitive advantages.

The existence of a different logic to each form of knowledge implies complementarities among the different types rather than processes of conversion. In this sense, the problems derived by the processes of transformation of tacit knowledge into codified and vice versa show that the characteristics of knowledge are partly responsible for defining the limits of their diffusion. It is expected that the more codified the knowledge generated by the diverse organizational forms, the greater the diffusion and, therefore, the higher the risk of not appropriating quasi-rents derived from the development of cognitive capacities. Thus, the circulation of knowledge inside organizations or productive systems depends both on the degree of complexity of cognitive capacities and on the type of protection that can be constructed based on those same capacities. Consequently, the idea of knowledge as a public good is relativized. In one extreme, we find that where barriers to entrance are low, less cognitive skills are required for de-codifying the knowledge and information necessary to undertake production. At the other extreme, knowledge circulates only inside the network or epistemic community that produces it, being a club good. As a consequence, the possibilities of appropriating economic profits that this knowledge generates will depend on the efforts carried out by the agents to restrict their circulation inside the limits of the organizational form in question (Erbes et al, 2005).

In this framework, the central question of this paper is: what are the dynamics between knowledge diffusion and appropriation in the framework of the new techno productive paradigm. Connected to this question we will make reference to the following issues: to what extent does the recent literature on creation and circulation of knowledge contribute

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2 In this paper, the term diffusion is applied to the leakages of key knowledge necessary to create competitive advantages in a certain organizational form.
to the explanation of the dynamics between diffusion and appropriation? Does the underlying logic which is specific to tacit and codified forms of knowledge have a bearing on diffusion and appropriation dynamics? Can the creation of cognitive capacities at the organizational level be understood as a relevant form of protection in the economy of knowledge era? Given that the literature on technological change has emphasized the role of technological regimes and of different market forms to characterize the sector’s competitive environment in which firms go about their businesses, is it relevant to think a knowledge management regime which underlines the knowledge creation process and the development of cognitive capacities independently of the two other regimes identified? To what extent can knowledge diffusion and appropriation processes be understood from the interaction of these three dimensions? How does this interaction manifest itself in the wide spectrum spanning from individual firms—in which relations are circumscribed solely to a mercantile interchange—through networks in which there are strong interactions and knowledge flows amongst the agents? What specificities do these questions have in less developed countries where specialization profiles are less knowledge intensive?

From a methodological point of view, the questions posed in the three dimensions considered (technology, knowledge and competition) are visualized as regimes. The notion of regime refers to a systemic approach which incorporates a set of norms and rules that explain and give consistency to agents’ behavior. The notion is underlined by evolutionary and neo-Schumpeterian thinking such as path dependency, indetermination, multiple equilibria and lock in effects (Metcalfe et al, 2003).

The objective of this paper is to discuss the connection between knowledge diffusion and appropriation as construction of competitive advantages in different kinds of organizational structures. The main hypothesis is that there exists an inverse relationship between diffusion and appropriation; the relationship depending on the simultaneous interaction of technological specificities, knowledge management and prevailing market structures. We believe that the creation of competitive advantages rests on the development of agents’ cognitive capacities, which enable them to appropriate a larger portion of the knowledge they generate. The development of these cognitive capacities permits the management of tacit and codified knowledge, which raises the minimum barriers needed for its appropriation and which acts as a barrier to decodification and as such restricts the entrance of new firms.

The first section proposes a taxonomy of firms based on the relative importance given to knowledge as a source of competitive advantages on the different organizational forms of production. There will be an evaluation of each type in terms of technology and knowledge management and market structure. The presentation and discussion of the taxonomy makes it possible to explore two central ideas of this paper: the existence of different logics between tacit and codified knowledge, on the one hand, and, on the other, the idea that not only technology must be thought from the perspective of certain sectorial irregularities (as elements of coherence within each sector), but also knowledge and competition. The second section analyzes the connections between knowledge diffusion and appropriation as a result of the simultaneous interplay amongst the three regimes. Finally, the third section draws the conclusions and presents some policy recommendations.
1. Knowledge and different organizational forms: effect of technology, knowledge, and market regimes

We have already mentioned the existence of different logics underlying each type of knowledge. This stresses the idea that the development of cognitive capabilities at the organizational level is more closely linked to the type of integration between both forms of knowledge than to the predominance of some of them, thanks to which the dynamics of diffusion and appropriation of knowledge can be explained.

Some scholars have made important contributions to the development of typologies related to technology (Malerba and Orsenigo, 2000) and to regimes of competition (Metcalfe et al, 2003) in order to explain innovation dynamics and the way it manifests in different sectorial and institutional contexts. In this section, the idea of knowledge regime is added, which along with the regimes already mentioned, will contribute to explain, in the third section, how the relationship between knowledge diffusion and appropriation work. In this sense, the principal hypothesis is that the generation of cognitive capacities in individual agents or in networks is associated to the creation of quasi-rents which depend on the kind of technology, competition and knowledge regimes.

In this context, we have developed a taxonomy of agents which combines in a binary way both the importance of the interactions and articulations between agents and the importance of knowledge as source of differentiation. Thus, four extreme cases can be identified: firms in knowledge production networks, firms in networks where knowledge is not a key source of differentiation and, finally, isolated firms independently of the importance of knowledge (see Table Nro 1). It is an heuristic device that, through the identification and characterization of certain ideal types, enables us to test the idea that competitive advantages are acquired in a framework where the three regimes (technology, knowledge and competition interact).

<table>
<thead>
<tr>
<th>Importance of production networks</th>
<th>Importance of knowledge as source of firm’s differentiation</th>
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<tbody>
<tr>
<td>Low</td>
<td>Low</td>
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<tr>
<td>High</td>
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<tr>
<td>Low</td>
<td>Isolated firms</td>
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<tr>
<td>High</td>
<td>Knowledge islands</td>
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<tr>
<td>Bureocratic production networks</td>
<td>Knowledge production networks</td>
</tr>
</tbody>
</table>

Source: own elaboration

3A similar exercise is carried out in Ocampo (2005). This author proposes a sectorial taxonomy for developing countries using two dimensions, the innovation process associated to learning and the complementaries (linkages, economies of conglomeration and specialization and spillovers) among the agents that in the virtuous cases generate dynamic economies of scale. According to this author four groups can be built: (i) Deep (strong learning processes and complementarities), (ii) Shallow (weak learning processes and complementarities), (iii) labor absorbing (weak processes of learning and strong complementarities) and (iv) Short Breath (strong processes of learning and weak complementarities).
(i) Isolated firms.  
In these firms which do not operate in networks, the importance of the generation and circulation of knowledge is reduced in order to raise the value of the business. The relationships with other agents are limited to commercial transactions, and these exchanges do not always take place amongst the same agents and thus are not recurrent in time. This pattern limits the development of linkages that favour the circulation of knowledge and the emergence of transfer processes. Therefore, there are no collective mechanisms for reducing uncertainty. Saxenian (1994) calls this kind of firms independent. They have limited capacities of innovation because they work in a closed context where interactions are weak with other firms or institutions.

(ii) Burocratic networks. These networks are made up of firms which attach little importance to the generation and circulation of knowledge produced at the local level. Marin and Bell (2005) define a similar category to identify an important group of subsidiary businesses of multinationals in developing countries (the “shallow” type in Ocampo, 2005). Whereas technical progress is incorporated in capital goods, there tend to be little “knowledge” connections between subsidiaries and headquarters. For example, in the case of the automobile sector, several authors qualify as “weak” the existing networks in developing countries, where commercial type relations are dominant (Novick and Gallart, 1997; Motta 1999; Cimoli and Constantine, 2000; Albornoz and Yoguel, 2004, Albornoz et al 2004 and 2005).

(iii) Knowledge islands. Although these firms do not operate in networks, their competitive advantages are based on the transformation of knowledge from an important accumulation of endogenous competences (innovative and entrepreneurial capabilities). Their isolated character neither lets them get synergies from the environment they belong to nor do they generate strong spillovers. This kind of firm is quite similar to those called “short breath” by Ocampo (2005). Some advanced software and biotechnology firms in developing countries belong to this group (Erbes et al, 2005b).

(iv) Knowledge networks. This group is made up of firms operating in networks in which the importance of the generation and circulation of knowledge and the technological interrelations and complementarities among agents are key factors for the production of increasing returns, dynamic competitive advantages and quasi-rents (Cimoli, 2005). In this sense, these firms create their own markets where buying and selling relationships are accompanied by significant flows of knowledge. The utilization of the knowledge generated allows them to compete from an oligopolistic position. Saxenian (1994) defines this organizational form as an industrial network-base system, and associates it with the businesses of Silicon Valley and Route 128 in Boston, US (Power and Lundmark, 2004).

In the following pages each of these groups is characterized in terms of: (i) the technology regime (see Table 2), (ii) the knowledge regime (see Table 3) and (iii) the competition regime (see Table 4). From a given configuration of a technological regime, the knowledge regime conditions the learning processes needed to generate dynamic competitive advantages. As opposed to the idea of the well-known paradigm of structure-conduct-performance, the joint action of the two first regimes condition the capacity of the different
organizational forms to operate in a market structure that facilitates their appropriation of quasi-rents.

**Technology regime**

Following Malerba and Orsenigo (2000), by technology regime we understand the set of characteristics that refer to the accumulatively, appropriability, opportunity and knowledge base that define a technology. The combination of these characteristics configures a pattern of sectorial behavior in the case of developed economies under the assumption of intragroup homogeneity. In terms of the technological regime, two different behaviors associated with a Schumpeterian perspective can be found in the literature. Both the isolated firms and those belonging to the islands of knowledge group develop in a context close to a Mark I pattern. Thus, there are different gradients of free entrance of businesses, constantly challenging the incumbent agents in the market. In such a pattern, the continuous changes in production, organization and distribution cause the destruction of quasi-rents. In the opposite extreme, both the knowledge and bureaucratic production networks, with a key role of large multinational and big national businesses, operate in a context where the characteristics of Mark II regimes are dominant. In this case, high barriers to market entry prevail, limiting the participation of new agents. In this case, there are functions of decreasing costs as a result of a curve of learning determined by technological cumulative factors, the development of externalities and complementarities among agents (Cimoli, 2005).

For isolated firms, the accumulativity is reduced because of the limited knowledge metabolism that can be developed outside of the limits of the firms. This is a consequence of a scarce accumulation of knowledge and the absence of formal and informal networks along with the knowledge circulation. In this sense, the accumulation of knowledge is expected to be derived mainly from incorporated technology and licenses. On the contrary, in knowledge networks a high accumulativity derived from important endogenous efforts in the construction of competences is present. In these networks, there are many significant linkages both inside and outside firms; these linkages connect organisations with technological and scientific systems. This pattern explains the virtuous character of these kinds of networks. The strong knowledge accumulativity, reinforced, at the same time by the incorporation of capital goods gives rise to radical and incremental innovations.

In the less virtuous extreme, the appropriation appears quite weak, since market structures in which these firms operate inhibit them the protection of their innovations form the copy of external agents. On the contrary, knowledge networks are characterized by a high appropriation of the innovations they are able to create because these innovations are solely appropriated by the agents that belong to the network.

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4 Based as much in market regulations as in the development of cognitive capacities.

5 The accumulativity refers to the existence of a path in the accumulation of knowledge carried out by a firm belonging to a certain sector. The implicit issue in this idea is that the present learning is the result of prior efforts that permitted, at the same time, to build a knowledge base.
In terms of technological opportunity\(^{6}\), the performance of isolated firms is reduced and only centered upon static competitive advantages, coming fundamentally from natural resources, location advantages and the exploitation of internal markets. Therefore, in this kind of firms there are little stimuli to the development of innovations based upon R\&D activities. In the case of knowledge networks, technological opportunity is derived from the exploitation of scientific knowledge of great complexity drawn from endogenous developments and interactions among very heterogeneous agents that relate through complex mechanisms of translation. In this sense, these dynamic opportunities are constantly renewed.

Finally, in the case of isolated firms, the knowledge base\(^{7}\) is characterized as firm specific and has low complexity because the firms operate in contexts in which neither the knowledge nor the production networks are a prominent factor. In the opposite extreme, given the complexity of the innovations carried out, the high specificity of the knowledge base is emphasized. Nevertheless, in this case, generic knowledge is also relevant because it allows the firms to share structures and activities with other firms in terms of networks.

Beyond these extreme situations, there is an array of intermediate situations in terms of the characteristics assumed by the appropriability, accumulativity, opportunity and knowledge base for the development of innovations. The first of these intermediate groups (bureaucratic networks) is characterized by an average accumulativity acquired by means of external technological flows coming almost exclusively from multinational firms’ headquarters located in developed countries; lower-middle appropriability as a result of a specialization pattern based on non-differentiated goods; average opportunity in terms of the productivity generated by non-radical innovations; and generic knowledge base of average complexity transmitted through hierarchical network structures. Finally, in the islands of knowledge what predominates is a high accumulativity, which comes from external sources, such as basic science; average appropriability and, therefore, limited possibilities of imitation; high technological opportunity as a result of the use of scientific knowledge; and a base of specific and generic knowledge of high complexity.

A complementary issue related to the idea of technological regime, which additionally characterizes each group, is the focus of technological activity. In the case of isolated firms, it is centered on the reduction of costs. They are mainly mature industries where there are very few possibilities of introducing innovations, which often relate to processes and improvements in machinery and equipment.

In this case, innovations are developed in other sectors identified by Pavitt as suppliers (Pavitt, 1984). In the opposite extreme (knowledge networks), the objective of technological activity is also the reduction of costs not just in individual firms but in the the

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\(^{6}\) This dimension reflects the capacity to innovate in terms of the productivity performance of R\&D expenditures.

\(^{7}\) The knowledge base refers to the key dimensions of knowledge that are relevant for the development of the innovative activity of an industry.
network as a whole. Between these two extremes, two intermediate situations mentioned above also appear. On the one hand, bureaucratic networks undertake technological activities in order to develop products that make it possible to compete in dynamic markets. In terms of sectoral presence, what stands out are mature sectors and some basic industries, with little importance given to quality, design and the price of the product. In the other intermediate situation (knowledge islands) the focus of the technological activity is centered upon both enlarging the market share and generating extraordinary benefits.

Table 2. Taxonomy of firms and technological regime

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Type of firms related to the importance of network and learning process</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Isolated firms</td>
</tr>
<tr>
<td>1. Technological regime</td>
<td>Mark I</td>
</tr>
<tr>
<td>1.1 Accumulativity and origin of technology</td>
<td>Reduced, Idiosyncratic and external</td>
</tr>
<tr>
<td>1.2 Appropriability</td>
<td>Reduced</td>
</tr>
<tr>
<td>1.3 Opportunity</td>
<td>Reduced, static advantages, low incentives to innovate.</td>
</tr>
<tr>
<td>1.4 Knowledge base</td>
<td>Firm specific, low complexity</td>
</tr>
<tr>
<td>1.5 Main focus of technological activity</td>
<td>Reduction of costs</td>
</tr>
</tbody>
</table>

Source: Own elaboration based on Malerba and Orsenigo (2000)

The collective action of the five attributes taken into account by this regime in each organizational form, will define different levels of associated risk of knowledge diffusion. In short, while in firms characterized by a Mark I regime the diffusion of knowledge is associated to a greater risk, in those in which the predominant regime is Mark II, the diffusion beyond the immediate network is less risky. This pattern can be explained as a by-product of significant developments of cognitive capacities and the predominance of club goods. Therefore, the risk of appropriation of knowledge by means of external agents is also more reduced.

**Management knowledge regime**

The second dimension, the management knowledge regime, explains how the knowledge produced by an organization constitutes an entry barrier and becomes a source of quasi rents. The relevance adopted by knowledge as an entry barrier will depend on (i) the sources of knowledge, (ii) the source and modality of the learning process, (iii) the
organization’s absorption capacity, (iv) the integration between tacit and codified knowledge -determined by the cognitive capacities reached by the firm- and (v) the way that economic benefits of knowledge are appropriated.

In isolated firms, the management knowledge regime shows blockades in the integration between different levels of knowledge codification. This can be the result of the joint action of: (i) a very rigid organizational structure, (ii) difficulties in appropriation, (iii) less complex learning sources, and (iv) informal and idiosyncratic learning process. The absorption capacity in these firms is low and it is limited to the acquisition of capital goods and limited efforts associated to learning by doing, producing and using. In isolated firms, the driving force is the reduction of costs due to competitive pressure.

At the other end, in knowledge networks, the learning process does not present obstacles in knowledge generation and circulation because of the hypertext organizational structure (Nonaka and Takeuchi, 1995; Nonaka and Toyama 2002). This kind of structure has a very high absorption capacity, which is not restricted to the incorporation of capital goods but also takes advantage of advances in basic and applied science. Absorption processes can also be the result of takeovers. Some of the firms belonging to knowledge networks usually become involved in merger and acquisition processes with knowledge islands. In this way, the knowledge networks can reduce the R&D costs incurred by the firm commanding the network and increment the success innovation probability, via uncertainty reduction and decentralization of innovative activity in multiple starts-ups, which increases the diversity and unleashes more efficient selection mechanisms than the market.

The management knowledge regime of these networks can be called intern-extern flex, because it not only develops high endogenous competencies but also coordinates and absorbs developments made by other firms in other networks and institutional systems. Thus, the advantage of having highly developed organizations with resources and departments specialized in legal issues, permits the bureaucratic networks to advance in the utilization of these resources with greater capacity than isolated firms. In turn, in knowledge networks, the development of learning processes appears to be in continuous innovations and the possibility of excluding by means of displaced code books that are incomprehensible by other concurrents in the market. This kind of network can be assimilated to an epistemic community. The learning process is generated fundamentally from research and formal development and combines different types of learning with special emphasis on the development of networks themselves.

The bureaucratic networks have an hierarchical knowledge management-style since most of the learning process is dominated by the nucleus. The remaining firms in the network have little freedom. In the case of developing countries, these networks can be identified with multinational businesses and often the processes of learning stem from their headquarters. Knowledge is generated in the nucleus of the network, being more prominent the phases of integration, related to codified knowledge, appropriation types associated with secret and incremental innovations as well as intellectual property rights for networks with a reduced innovation velocity. The capacity of absorption is high in the nucleus and attempts at improving processes, management and technologies. In the remaining network firms, the capacity of absorption is induced by the nucleus and peers’ competitive pressure.
<table>
<thead>
<tr>
<th>Attributes</th>
<th>Type of businesses in terms of the importance of networks and learning processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isolated firms</td>
<td>Bureaucratic networks</td>
</tr>
<tr>
<td>2. Management knowledge regime</td>
<td>Weak</td>
</tr>
<tr>
<td>2.1 Organizational structure</td>
<td>Hierarchical</td>
</tr>
<tr>
<td>2.2 Learning sources</td>
<td>Technology incorporated.</td>
</tr>
<tr>
<td>2.3 Learning style</td>
<td>Learning by doing, and producing</td>
</tr>
<tr>
<td>2.4 Absorption capacity</td>
<td>Low and limited</td>
</tr>
<tr>
<td>2.5 Integration among tacit knowledge and codified which generates different levels of cognitive capacities</td>
<td>Limitations to integrate and to develop know-how</td>
</tr>
<tr>
<td>2.6 Appropriation style</td>
<td>Idiosyncratic</td>
</tr>
</tbody>
</table>

Source: own research
Note a/ The hypertext organizational structure alludes to the existence of three simultaneous levels in the organization (hierarchy, project teams and knowledge base that facilitate what Nonaka and Takeuchi (1995) call the metabolism of knowledge.

In the knowledge islands, there are horizontal structures that allow a complete development of the knowledge integration process and different forms of learning that can be simultaneously used. For this reason, this type of knowledge management can be called internal flexibility, since they have reduced and informal bonds with other businesses and institutions. In this sense, there is a predominance of a post-fordist organization style and the sources of learning are, fundamentally, internal R&D and the interactions which take place inside the organization. In addition, knowledge islands learn from the developments of basic science, “blueprints” and informal interactions with clients and other agents in the institutional system. The need to maintain secretly its developments can be thought to reinforce the isolation of these firms before the commercialization of their products.

The seven attributes of knowledge management regimes describe an inverse relation between risk and development of cognitive capacities. A weak type is associated to a low development of cognitive capacities and, therefore, to high risks. Subsequently, an “internal
flexible” regime can be considered, which implies the development of complex cognitive capacities but which are circumscribed to the organizational level and find it difficult to become integrated with the remaining science and technique systems as well as with other similar firms -upstream or downstream-. The associated risks of this type of regime are smaller than those of the weak but clearly superior to those of the hierarchical, where development of cognitive capacities transcend the organizational level, but are of low complexity. Finally, in the internal-external flexible regime, the creation of advanced capacities at the level of networks is associated to a reduction of the risks by circulation of knowledge under the form of “club goods”.

**Competence regime**

The competence regime makes a big contribution to the differentiation of firms operating under different organizational structures. This regime is associated to the sector the firm belongs to (Pavitt, 1984, Reinert, 1995). According to the firms’ taxonomy already presented (isolated, bureaucratic networks, islands of knowledge and networks of knowledge), the possibility to affect the working environment of the firms differ significantly.

As a consequence, this view of competence regimes is opposed to the conventional analysis of market explained by the paradigm: structure, conduct and performance. In this framework, where the behavior of an economic agent is determined by the market structure, the options are reduced basically to pure types (perfect competition, monopoly, monopsony) that determine firms’ economic performance. Therefore, given the structure, the behavior and the performance are defined using the common hypothesis of perfect information and rationality of agents, which leads to the existence of identical agents.

In opposition to a world of pure structures, absence of uncertainty and rationality in the performance of agents, the firms work in an innovative environment characterized by the uncertain nature of technological change. The specificities adopted by the technological and knowledge regimes in different kinds of firms affect the environment where they interact, causing diversity even inside the groups. This diversity, which is an essential characteristic of firms, has a strong influence on (i) the differential capabilities for innovation, (ii) the firm-specific search processes associated to the particular technological paths derived from firms’ own organizational history, and (iii) the business strategies (in terms of the nature of investment, decision of prices, R&D, etc.) that guaranty a diversity of behaviors. Likewise, diversity is not only present at the organizational level, but also at the level of the linkages among organizations. Contrary to conventional perspectives where economic relations are limited to buying and selling, in an evolutionary environment, linkages allow the reduction of uncertainty and generate learning processes that lead to the

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8Nelson (1999) showed how the main stream in economics was opposed to business experts’ thoughts, whose own existence derives from the idea that similar firms are able to develop very different strategies. In other disciplines as anthropology or geography, there is a more advanced discussion related to the advantages and problems to emphasize or to eliminate the differences among agents.
development of cognitive capabilities. In this direction, linkages developed by different groups define the way they face the competitive pressure to which they are exposed.

This diversity of patterns faces selection and learning mechanisms that validate the specific paths of individual firms and of whole production networks. The mechanisms of selection allow different organizational forms with specific innovative capabilities to achieve differential results in terms of profits and market share. The mechanisms of learning (derived from the knowledge regime) supply the temporary dimension and are able to affect outside competition. In this sense, the regime of competition conditions the kind of barriers for entry to the market according to the comparative advantage each organizational form is able to build, which is manifested in specific comparative advantages and costs. At the same time, the construction of these advantages will depend on the differential capacities to capture technological interrelations and the generation of economies of scale and to incorporate collective learnings from the interaction and distribution of know-how (Cimoli, 2005).

Isolated firms have a classical competitive scheme, which in the extreme, can be associated to the pure type of perfect competition. In this case, entry barriers are reduced and the elasticity price of the demand is very high. The products these firms make are of low or null differentiation and thus competition takes place through prices. Entry barriers are thus associated to static advantages. Given these firms characteristics—both in terms of technology or of knowledge management regimes— they make limited innovative efforts (many times linked to the adoption of technologies incorporated in capital goods) to be circumscribed to cost reduction. In this case, the benefits of technological progress can be seen in price reduction in agreement with classical thought (Reinert 1995). The predominant size of agent is the SME’s, which is associated with a low market concentration. This can be interpreted as a consequence of the difficulty of these organizations to generate and maintain quasi-rents for a long period of time.

The remaining groups are associated to oligopolistic market forms with either greater or smaller degree of competition in each case. Particularly, bureaucratic networks adopt the specific form of oligopolistic or monopolistic market with a low level of competition. They are made up of firms that usually operate in mature sectors, where the innovations by differentiation are limited and the degree of standardization is high. In the present organizational and technological context, the productive flexibilization tends to delocate production, expanding the reach of global networks with the primary objective of reducing costs. In this way, the origin of quasi-rents is centered on the scales of production, the regulations in the target countries, and the learning processes transferred from headquarters. In bureaucratic networks, the development of a quasi-market permits the nucleus to reduce uncertainty through the operation of networks with a strong stability in the hierarchy and a low rate of entrance.

In the knowledge islands group, the predominant market form is the competitive one for those agents that are able to overcome the required knowledge entrance barriers. This

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9 As the learning processes play a key role, the evolutionary theory is more associated to Lamarckian than Darwinian theories, where the random mutations are the diversity creation mechanism.
constitutes a strong difference with regard to isolated firms. The agents that dominate this group are of small and medium size, many times start-ups, and show an average market concentration. These firms tend to be absorbed by the fusion and acquisition processes carried out in knowledge networks. In this sense, remaining market time is reduced, either because they are absorbed by more successful firms or because of bankruptcy. These companies are exposed to a high degree of uncertainty because they operate in very dynamic sectors with high volatility, which is perceived in the temporary character of the quasi-rents generated from innovation processes.

### Table 4. Firm’s taxonomy and competence regime

<table>
<thead>
<tr>
<th>Attributes</th>
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<td></td>
<td>Knowledge networks</td>
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<tr>
<td>3. Competition regime</td>
<td>Competitive, low entry barriers</td>
</tr>
<tr>
<td></td>
<td>Oligopolistic, high entry barriers. High fix cost.</td>
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<tr>
<td></td>
<td>Competitive, high knowledge entry barriers.</td>
</tr>
<tr>
<td></td>
<td>Oligopolistic, high epistemic communities entry barriers</td>
</tr>
<tr>
<td>3.1 Firm size</td>
<td>SMEs</td>
</tr>
<tr>
<td></td>
<td>Big</td>
</tr>
<tr>
<td>3.2 Market concentration</td>
<td>Average</td>
</tr>
<tr>
<td></td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>Average-high</td>
</tr>
<tr>
<td></td>
<td>Very high</td>
</tr>
<tr>
<td>3.3 Continuity</td>
<td>Scarce stability with agents that travel toward bureaucratic networks</td>
</tr>
<tr>
<td></td>
<td>Very high</td>
</tr>
<tr>
<td></td>
<td>It is reduced. Firms tend to be absorbed by knowledge networks</td>
</tr>
<tr>
<td></td>
<td>High. Combination of accumulation and creative destruction.</td>
</tr>
<tr>
<td>3.4 Quasi-rents stability</td>
<td>Reduced</td>
</tr>
<tr>
<td></td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>Temporary</td>
</tr>
<tr>
<td></td>
<td>High</td>
</tr>
<tr>
<td>3.5 Quasi-rents sources</td>
<td>Advantages static, natural or locating.</td>
</tr>
<tr>
<td></td>
<td>Regulations</td>
</tr>
<tr>
<td></td>
<td>Innovation</td>
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<td></td>
<td>Club goods development</td>
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<tr>
<td>3.6 Surplus distribution</td>
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</tr>
<tr>
<td></td>
<td>Hierarchy</td>
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<td></td>
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<td></td>
<td>Distribution of surplus as incentive to innovation</td>
</tr>
</tbody>
</table>

Source: own research

Finally, in the case of knowledge networks, the predominant market form is oligopolistic. There are high entry barriers and knowledge circulates under the forms of epistemic communities and club goods. This allows all of the firms in the network to take advantage of technological interrelations, knowledge complementarities, and increasing returns. The nucleus firms are predominantly large with high continuity in markets of high concentration but in continuous dispute by new radical innovations that are presented in a combination of accumulation and creative destruction. In consequence, the degree of stability of the quasi-rents generated by the processes of integration of knowledge is greater than in the previous groups. Although they operate in sectors of strong technical progress and instability, working in networks these firms are able to decodify to a large degree the uncertainties of the environment. These networks are characterized by different forms of surplus distribution. In most “democratic” cases what prevails is the distribution of gains associated to each firm innovative capacities.

The competence regime determines the position of organizations along a positive relation between the amount of development of cognitive capacities and the possibilities of appropriation of knowledge. This relation will be determined by two extreme situations:
one linked to the competitive situation and free entrance; and another to the predominance of imperfect market forms with hard barriers associated with the concentration of capital and with the accumulation of competences and cognitive capacities. It is important to point out that both in bureaucratic networks and in networks of knowledge there are hierarchies and rules of governance. They are shown in the existence of high heterogeneity among the agents and in an uneven distribution of quasi-rents.

2. The relation between knowledge diffusion and appropriation as a result of the joint action of technology, competition and knowledge regimes

The form adopted by the three regimes taken as a whole contributes to explain the different possibilities of access to permanent quasi-rents derived from the generation of cognitive capabilities, which is associated to the possibility of implementing protection mechanisms that avoid both the imitation and the reduction of excess profits. It is important to emphasize four basic protection forms: (i) legal means, (ii) technological restrictions, (iii) forms derived from the application of technological packages, and (iv) forms associated with a major speed of innovation that lead to the generation of cognitive capabilities for the purpose of an efficient articulation of tacit and codified knowledge and of raising the barriers that prevent diffusion and copy. All the above organizational forms can use in a different way each of the four mechanisms of protection already mentioned. However, in the extreme case of the knowledge networks, there is a prevalence of the third and fourth forms in comparison with the remaining groups.

In this context, the objective of this section is to deduce the relationship between the appropriation of quasi-rents generated from the development of cognitive capabilities and the diffusion of knowledge, considering the interaction among the regimes previously presented.

The idea of diffusion makes reference to knowledge leakages originated in individual agents or in networks. This knowledge represents a central source of their competitive advantages. A conventional conception of risk is used in the analysis: it is made up of a gradient of situations that show the probability of business failure associated to the emergence of imitators capable of limiting the appropriation of quasi-rents. The development of cognitive capabilities at the organizational level depends on two factors: the interaction between the creation of individual cognitive devices on the one hand and the path of the company, the sectoral specificity and the set of factors already considered in the definition of the management of knowledge regime, on the other hand. Finally, appropriation alludes to the possibility of obtaining quasi-rents derived from the cognitive capabilities developed by the agents.

Diffusion should not be taken as a dual situation. On the contrary, it is necessary to interpret it as a non-continuous gradient of situations corresponding to different possibilities of appropriation associated to the contextual parameters mentioned above. In

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10 As indicated in the previous section, some quasi-rents of the rent-seeking type can derive from regulations, as in the case of bureaucratic networks.
spite of this, the diffusion process can imply, in an extreme, that knowledge might turn into a public good—its consumption being non-rival and non-excludible.

To consider knowledge as a public good implies that all the agents either possess or can develop the necessary cognitive capabilities to apprehend the knowledge they did not have in the first place. On the contrary, when the circulation of knowledge remains inside a group, an organization or an epistemic community, cognitive barriers affecting the external agents of a particular organizational form are generated. This situation allows uncertainty reduction and therefore the risks of imitation and loss of quasi-rents. In the first case—knowledge as public good—it usually acquires a codified form, whereas in the second, it combines codified and tacit elements that are effective for the circulation inside the group and are perceived as tacit by external agents. This situation can be compared to what Cowan et al. (1999) denominate displaced code book and epistemic community.

Between these extreme situations, intermediate positions of diffusion exist in terms of barriers to entrance that derive from the use of previous cognitive capabilities, which makes decoding possible and also lowers risks. As it becomes a public good, the barriers to entrance diminish because of a reduction of cognitive requirements. That is to say, knowledge is compiled in a code that is more and more widely accepted and, therefore, the understanding of this code occurs in an ample sense increasing the imitation and the level of risk.

Diffusion and appropriation

The inverse association between knowledge diffusion and appropriation in terms of quasi-rents arises as a result of the three relations linked to each of the regimes considered in the previous section. This relation works in different forms in the four classes of organizations discussed throughout the paper (see figure 1).

The first quadrant reflects the technological regime, which emerges as a positive relation between diffusion and risk. The points nearest to the origin correspond to regimes of the type Mark II, since they imply a low level of risk derived from little knowledge diffusion. From the organizational point of view, this corresponds basically to knowledge networks and, less relevantly, to bureaucratic networks. In opposition to this situation, the most remote points correspond to a Mark I regime, which is characterized by high levels of risk and the use of knowledge as public goods.

The second quadrant, describes the regime of knowledge management through a negative relation between risk and development of cognitive capabilities. The points nearest to the axis are related to internal and external flexible regimes, and to positions of low risk and high cognitive capabilities. The movement of the curve towards the opposite end corresponds to the appearance of the hierarchic, flexible border and weak forms; each one implies larger degrees of risk and a limited development of cognitive capabilities.

The third quadrant depicts the competition regime, where the points nearest to the origin correspond to situations near free entrance, with low development of cognitive capabilities.
and reduced appropriation possibilities. On the contrary, at the end of the curve, the importance of imperfect market forms increases, with a regime that has opposite characteristics to those previously mentioned.

Figure 1. Scheme of relations

As a consequence of the relations shown in quadrants I, II and III, an inverse association can be identified between diffusion and appropriation. On this inverse relation the four typologies of companies considered can be located. In an extreme, the use of knowledge of greater diffusion and smaller appropriation corresponds to the isolated companies characterized by technology regimes Mark I: weak forms of knowledge management and competitive regimes with low barriers to entry. The opposite situation corresponds to the knowledge networks characterized by a technological regime Mark II: a regime of internal and external flexible knowledge and a regime of competition near oligopoly or monopoly. In the latter case, the smallest diffusion and the greatest appropriation of the knowledge generated inside the network are reflected in quasi-rents that are superior to those associated with the rest of the organizational forms, which are distributed between the agents depending on the governance characteristics of the network.

All these relationships can be conceived in terms of a series of points that describe the relations between the dimensions rather than as some continuous variables and bidirectional associations.
Curve displacement

Beyond the movements discussed in each of the curves – which are strongly associated to the forms of the three regimes –, we analyze whether the displacements of every curve could be tied to the institutional framework and the profile of productive specialization in countries with different levels and types of development. As different authors have indicated (Rosenberg, 1982; Reinert, 1997; Rodrik, 1999), the kinds of goods and services produced define a set of dimensions associated to: the importance of knowledge, the type of scale returns, the generation of competitive advantages and the predominant market forms.

It is possible to think that a turn in the specialization profile of a country or region towards more knowledge intensive activities is associated to a displacement of the relation diffusion-risk towards the right (first quadrant). At the same time, a more complex national and local system of innovation moves the curve that ties risk with the development of cognitive capabilities, towards the right (second quadrant). Finally, greater restrictions in terms of property rights (intellectual property, regulations, competition defence, etc.) run the curve associated to the competition regime towards the right (third quadrant). As a result of all these modifications, the diffusion-appropriation curve moves outside, denoting greater levels of appropriation for the same level of diffusion. At the same time, changes in the opposite direction in each one of the quadrants produce displacements of the relation towards the left, diminishing the appropriation with an equal level of diffusion.

For example, for the same level of development of cognitive capabilities, there can be a higher appropriation, if it is supported by specific instruments or institutions (technical restrictions or intellectual property rights). This can be thought of as displacements of the curve of competition regime towards the right (quadrant III) since it implies concrete forms of market that can vary in the long term or in deep transformations in the technological and productive paradigms. Market institutions define property rights and grant legitimacy to the application of the ties so that the appropriation of non-rival and non-excludible goods is admitted. Also, a profile of productive specialization closest to the new techno-productive paradigm implies that the relation of the first quadrant moves towards the right. Consequently, at a same level of diffusion, there is a smaller associated risk. Finally, changes in the local and national system of innovation are shown through a movement in the relation between the development of cognitive capabilities and risk. Thus, for example, systems of greater level of complexity that favor the development of cognitive capabilities in different organizational forms imply a displacement towards the right of this relation. In this sense, with the same level of development of cognitive capabilities, agents must deal with lower risks.

Although each of these changes responds to different causes, alterations cannot be conceived in isolation. Thereby, on average, as a result of the displacements proposed in the three quadrants, a diffusion-appropriation relation would normally move towards the right in developed countries. This allows these countries a larger degree of appropriation for equal levels of diffusion. Nevertheless, it is important to take into account the existence of intra-sectoral heterogeneity that goes beyond the level of development of the countries and between countries that arises as a consequence of differences in organizational categories (from isolated companies to knowledge networks). This last heterogeneity is
evinced in the presence of bureaucratic networks that coexist with knowledge islands and networks, as it happens in the case of chemicals or pharmaceutics, where technological regimes of the type Mark I and II coexist. This issue appears in different activities in countries of unequal development, where bureaucratic networks predominate.

These heterogeneities can be found in three layers. In the first place, they appear in varying profiles of productive specialization in countries with different levels of development. Secondly, they are reflected in different degrees of complexity inside sectors. Finally, they acquire greater absolute and relative importance in knowledge islands and networks of developed countries.

As a consequence of significant differences in the profiles of productive specialization between developed and developing countries, in the former there is a predominance of knowledge networks integrated with national systems of innovation, whereas in the latter this category is practically non-existent (Reinert, 1997). In contrast, in developing countries, bureaucratic networks predominate in dynamic industries within the framework of the specialization profile of the regions. In these countries, the knowledge islands represent a set of isolated companies dedicated to the production of knowledge intensive goods (i.e.: software, biotechnology). In general, these firms do not constitute a critical mass of agents capable of changing a country’s specialization profile. Another example where key organizational differences exist is the automotive sector, which includes knowledge networks in developed countries and forms akin to bureaucratic networks in developing countries. This difference can be explained by the weak technological and productive frameworks established by the subsidiaries of multinational companies installed in underdeveloped countries. These feeble frameworks end up generating bureaucratic networks that are significantly far from the knowledge intensive networks that exist in developed countries with a substantial production infrastructure and technological base.

4. Conclusions

This article has focused on specific questions associated to the debate on knowledge by presenting a conceptual exploration which hinges on the relation between knowledge diffusion and appropriation of quasi-rents in different organizational forms. This methodological contribution considers the interrelation between three central themes (technology, the nature of competition and knowledge management) structured as regimes.

The idea of knowledge regime allows integrating different issues discussed in the first section of this paper, where we emphasized the existing complementarities between the different types of knowledge, rather than the transformation processes. This presupposes the existence of different logics underlying tacit and codified knowledge. Also, we have analyzed the way in which the sources and modalities of learning are manifested, the capacity of absorption, the complementarities between tacit knowledge and codified knowledge and the appropriation of the economic benefits in the different organizational forms (isolated companies, bureaucratic networks, knowledge islands and knowledge networks). In this way, different knowledge regimes (weak, hierarchic, flexible internal and
flexible inside and outside) are associated to different points in the existing negative relation between the degree of development of cognitive capabilities and risk.

The idea of a competition regime has allowed us to see the problem of competition and of creation of quasi-rents in a systemic way. For this purpose, we have taken into account the firm’s size, the concentration and firm’s time in the market, the source and stability of the quasi-rents and the way of distributing quasi-rents in different organizational forms. The interaction of these factors will determine diverse competition regimes that in turn will be located along different points in the existing positive relation between the level of development of cognitive capabilities and knowledge appropriation.

Finally, we have analyzed the form in which the technological regime performs in terms of opportunity, cumulativeness, appropriability, knowledge base and main focus of technological activity in diverse organizational forms, which are reflected in different points of the existing positive relation between diffusion and risk, thus determining situations of the type Mark I and Mark II.

Altogether, these three regimes determine an inverse relationship between knowledge diffusion and appropriation of quasi-rents. From a dynamic perspective this relation can move before changes in the regimes. Thus, advances towards technological regimes Mark II, towards knowledge regimes flexible inside and, towards oligopoly and monopolistic competition regimes imply movements throughout the curve with an appropriation level and a minor diffusion level.

From all these elements, we have discussed the specificities that adopt the knowledge generation processes in different organizational forms, as well as in the relation between knowledge creation, generation of dynamic competitive advantages and market forms. Also, we have tried to contribute an analysis of the form under which these processes in countries of diverse levels of development manifest themselves, with differences in the profile of specialization, institutions, market forms and structural heterogeneity. Underlying the analysis we find that all these factors condition the importance of knowledge in the development of productive activities, as well as the importance of linkages in networks. Whereas knowledge networks predominate in developed economies, knowledge islands and bureaucratic networks appear with more frequency in developing countries. In spite of these differences, in both types of countries there are heterogeneities, although they are greater in developing ones. These heterogeneities are manifested in the possibility of finding bureaucratic networks and knowledge islands in developed countries and incipient knowledge networks in developing countries– yet these situations tend to be an exception not the rule.

Finally, developing countries face the challenge of moving in the curve diffusion-appropriation towards positions with greater levels of appropriation for equal degree of diffusion. Yet, for this to happen it will have to be the result of displacements towards technological regimes Mark II which are not independent of changes produced in the specialization profile. This implies moving towards markets in which the agents are price-formers rather than price-takers and where the development of cognitive capabilities becomes a key factor in competition. This movement will require industrial and
technological policies since a free market would consolidate the specialization pattern rather than modify it. The design of these policies requires, however, operating in a space in which public knowledge increasingly becomes a club good. In that sense, interventions should go beyond the idea of solving market failures. They should also aim at generating dynamic failures making it possible to follow a path of structural change (Castaldi et al, 2004). From the development of the cognitive capabilities of agents, what is needed is to generate a virtuous circle of variety, selection and regeneration of the variety, based on the development of processes of complementing codified and tacit knowledge.
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