UPGRADING IN GLOBAL VALUE CHAINS: 
LESSONS FROM LATIN AMERICAN CLUSTERS *

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ABSTRACT
The literature on industrial districts in advanced and less developed countries has shown that clustering helps local enterprises overcome growth constraints and compete in distant markets. Nevertheless, recent contributions have stressed that more attention needs to be paid to external linkages and to the role played by global buyers to foster upgrading at cluster level. In this study, we contribute to this debate focusing on the analysis of the relationships existing between clustering, global value chains, upgrading and sectoral patterns of innovation in Latin America. We find that sectoral specificities matter and influence the mode and the extent of upgrading in clusters integrated in global value chains.

Keywords: clusters, global value chain, upgrading, sectoral patterns of innovation

JEL codes: O1, O3, O54, R11

1. Introduction
There is now a rich empirical evidence showing that small firms located in clusters, both in developed and developing countries, are able to overcome some of the major constraints they usually face: lack of specialised skills, difficult access to technology, inputs, market, information, credit, external services.

Nevertheless, the literature on clusters, mainly focused on the local sources of competitiveness coming from intra-cluster vertical and horizontal relationships generating collective efficiency, has often neglected the increasing importance of external linkages. Due to recent changes in production systems, distribution channels and financial markets, and to the spread of information technologies, enterprises and clusters are increasingly integrated in value chains that often operate across many different countries. The literature on global value chains (Gereffi, 1999; Gereffi and Kaplinsky, 2001) calls attention to the opportunities for local producers to learn from the global leaders of the chains, that may be buyers or producers. The internal governance of the value chain importantly affects the scope of local firms’ upgrading (Pietrobelli and Rabellotti, 2003).

In fact, extensive evidence on Latin America reveals that both the local and the global dimensions matter at once, and firms often participate in clusters as well as in value chains. Both forms of organization offer opportunities to foster competitiveness via learning and upgrading, but also have remarkable drawbacks.

In addition, both strands of literature were conceived and developed to overcome the sectoral dimension in the analysis of industrial organisation and dynamism. On the one hand, studies on clusters, focusing on agglomerations of firms specialising in different stages of the filière, moved beyond the traditional units of analysis of industrial economics: the firm and the sector. On the other hand, in the value chain literature, the main differentiation is between buyer-driven versus producer-driven chains, and sectors usually fit in either form. Nevertheless, given our focus of analysis on how SMEs, located in clusters and involved in value chains, may undertake a process of upgrading in order to increase and improve their participation in the global economy, the nature of the industrial sector also plays a role and affects SMEs upgrading prospects.

In this paper, we argue that it is necessary to take into account all these dimensions at once: from the point of view of the enterprise, clustering and participating in value chains are not mutually exclusive alternatives, and the mode of organization of inter-firm linkages, of governance, and of innovation and upgrading differs in different groups of sectors.

The structure of the paper is the following: in the next section we briefly review the concepts of clustering and value chains, and focus on their overlaps and complementarities. Section 3 first discusses the notion of SMEs’ upgrading, and then introduces a categorization of groups of sectors, based on the famous Pavitt taxonomy, and applied to the actual industrial reality of Latin America. Section 4 reports the original empirical evidence on a large sample of Latin American clusters, and shows that the sectoral dimension matters to explain why clustering and participating in global value
chains offer different opportunities in different groups of sectors. Section 5 summarizes and concludes.

2. Clusters and Value Chains

During the last two decades, the successful performance of the industrial districts in the developed world, and particularly in Italy, has stimulated a new attention to the potential offered by this form of industrial organization for developing countries’ firms. The capability of clustered firms to be economically viable and strongly contribute to the growth process in industrial districts has attracted a great deal of interest in development studies. 1

In developing countries, the sectoral and geographical concentration of SMEs is rather common, and a wide range of cases is by now documented in the literature. 2 Obviously, the existence of a critical mass of specialized and agglomerated activities, in a number of cases with historically strong roots, does not necessarily imply that these clusters share all the stylized facts that identify the Marshallian type of district, as firstly defined by Becattini (1987). Nonetheless, clustering can be considered as a major facilitating factor for a number of subsequent developments (which may or may not occur): division of labor and specialization, the emergence of a wide network of suppliers; the appearance of agents who sell to distant national and international markets; the emergence of specialized producer services; the materialization of a pool of specialized and skilled workers; the formation of business associations.

To capture the positive impacts of these factors on the competitiveness of firms located in clusters, Schmitz (1995) introduced the concept of “collective efficiency” defined as the competitive advantage derived from local external economies and joint action. The concept of external economies 3 was first introduced by Alfred Marshall in his Principles of Economics (1920). According to Schmitz (1999a), incidental external economies are of importance in explaining the competitiveness of industrial clusters, but there is also a deliberate force at work, namely consciously pursued joint action. Such joint action can be within vertical or horizontal linkages. 4

The combination of incidental external economies and of the effects of active co-operation defines the degree of collective efficiency of a cluster, and dynamically, its potential for fostering SMEs’ upgrading. Thus, our focus is on the role of intra-cluster vertical and horizontal relationships generating collective efficiency.

However, recent changes in production systems, distribution channels and financial markets, accelerated by the globalization of product markets and the spread of information technologies, suggest that more attention needs to be paid to external linkages. 5 To this aim, the global value chain (GVC) approach helps to take into account activities taking place outside the cluster, and in particular to understand the strategic role of the relationships with key external actors.

From an analytical point of view, the value chain perspective is useful because (Kaplinksky, 2000; Wood, 2001) the focus moves from manufacturing only to the other activities involved in the supply of goods and services, including distribution and marketing. All these activities contribute to add to total value. Moreover, the ability to identify the activities providing higher returns along the value chain is key to understanding the global appropriation of the returns to production.

The focus of value chain research is on the nature of the relationships among the various actors involved in the chain, and on their implications for development (Humphrey and Schmitz, 2002b). To study these relationships, the concept of ‘governance’ is central to the analysis. At any point in the chain, some degree of governance or co-ordination is required. This co-ordination may occur through

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1 Among the studies on this issue see for instance Schmitz, 1995, Rabellotti, 1997 and the two special issues of World Development: Humphrey (1995) and Nadvi and Schmitz (1999).
2 For a review of the empirical cases available in the literature see on Africa McCormick (1999) and on Latin America Albaleado (2001).
3 External economies can be defined as positive or negative unpaid, out of the market rules, side-effects of the activity of one economic agent on other agents.
4 Nadvi (1999), proposes the following classification of joint actions: (i) Joint action within vertical linkages including backward ties with suppliers and subcontractors and forward ties with traders and buyers; (ii) Joint action within bilateral horizontal linkages between two or more local producers. This can include joint marketing of products, joint purchase of input, order sharing, common use of specialized equipment, joint product development and exchange of know-how and market information; (iii) Joint action within multilateral horizontal linkages among a large number of local producers.
5 Markusen (1996) broadening the definition of industrial district discusses four types of districts. In the “satellite platform” type, consisting of a congregation of branch facilities of externally based multi-plant firms, she acknowledges the importance of external linkages. Guerrieri et al., 2001, further develop this approach and apply it to clusters in Italy and Taiwan.
arm’s-length market relations or non-market relationships. In the latter case, following Humphrey and Schmitz (2000), we distinguish between three possible types of governance:

- **Network** implying co-operation between firms of more or less equal power which share their competencies within the chain;
- **Quasi-hierarchy** involving relationships between legally independent firms in which one is subordinated to the other, with a leader in the chain defining rules that the rest of the actors have to comply with;
- **Hierarchy** when a firm is owned by an external firm.

This literature also stresses the role played by the GVC leaders, and particularly by the buyers, in transferring knowledge along the chains. For small firms in LDCs, participation in value chains is a way to obtain information on the need (and the modes) of the necessary upgrading to gain access to global market. Yet, although this information has high value for local SMEs, the role played by the leaders of the GVCs in fostering and supporting the SMEs’ upgrading process is less clear. Gereffi (1999), mainly focusing on East Asia, assumes a rather optimistic view, emphasising the role of the leaders that almost automatically promote process, product and functional upgrading among small local producers. Pietrobelli and Rabellotti (2003) present a more differentiated picture for Latin America.

In line with the present approach, Humphrey and Schmitz (2000) discuss the prospects of upgrading with respect to the pattern of value chain governance. They conclude that insertion in a quasi-hierarchical chain offers very favourable conditions for process and product upgrading, but hinders functional upgrading; networks offer ideal upgrading conditions, but they are the least likely to occur for developing country producers.

Moreover, a more dynamic approach suggests that chain governance is not given forever and may change because (Humphrey and Schmitz, 2002b):

- Power is relational: existing producers, or their spin-offs, may acquire new capabilities and explore new markets, and this changes power relationships;
- Establishing and maintaining quasi-hierarchical governance is costly for the lead firm and leads to inflexibility because of transaction specific investments. Thus, quasi-hierarchy is chosen only to reduce the risk of potential losses arising from a failure to meet commitments and conform to the standards required;
- Firms and clusters often do not operate only in one chain but rather simultaneously in several types of chains. This implies that competences learned in one chain may be applied and adapted to supply other chains, introducing a strategic dimension in the interaction between the lead-firms and their local suppliers/subcontractors.

In sum, both modes of organization of production, i.e. the cluster and the value chain, offer interesting opportunities for the upgrading and modernization of local firms, and are not mutually exclusive alternatives. However, in order to assess their potential contribution to the innovation and upgrading of local SMEs, we need to understand their organization of inter-firm linkages and their internal governance. In addition, as we explain in the following section, the nature of the industrial sector also plays a role and affects SMEs upgrading prospects.

### 3. The Sectoral Dimension of Clusters’ Upgrading

#### 3.1. The Concept of Upgrading

Various recent studies explain the difference between the “high” and the “low road” to competitiveness with the capability of firms to upgrade (Kaplinsky and Readman, 2001; Humphrey and Schmitz, 2002a). All these authors, and policy-makers alike, share the same sense of urgency calling for sustained upgrading of enterprise clusters in laggard countries.

The concept of upgrading – making better products, making them more efficiently, or move into more skilled activities – has been often used by the literature on competitiveness (Porter, 1990, Kaplinsky, 2000). The macroeconomic dimension of competitiveness is often mixed with the microeconomic definition, embedded in the competitiveness literature. This generated an extensive debate among international trade economists rejecting the notion of ‘competitiveness’ as essentially wrong and
misleading, in comparison with the clear concept of “comparative advantage” (Krugman, 1996). Following the latter concept, all economies benefit from whatever international specialization, provided that it is consistent with their pattern of comparative advantage. However, insofar as we admit the possibility of inter-firm (intra-sector) differentials (for example related to market imperfections, information asymmetries, firm-specific learning and capabilities), that are ruled out by the (macro) theories of comparative advantage, then competitiveness becomes a meaningful, and indeed relevant concept (Lall, 2001). Further, the latter approach allows consideration of ‘dynamic’ comparative advantage, i.e. acquired through the purposeful efforts of enterprises, and in sectors different from those enjoying static comparative advantage (Pietrobelli, 1997). Therefore, the discussion of alternative "roads" to competitiveness refers to the macroeconomic implications of enterprise-level strategies. From the point of view of the individual enterprise, it could be statically optimal to become competitive by squeezing costs (including labor costs), but this would not be desirable i.e. high road, from the point of view of the country (or the region/cluster).

Following this approach, upgrading is strictly related to innovation. However, although upgrading involves process, product and organizational innovation, innovation in highly competitive and global markets, is a necessary but not sufficient condition to maintain or improve competitiveness.

Thus, we define upgrading as innovating to increase value added. Enterprises may achieve this in various ways, as for example by entering higher unit value market niches, by entering new sectors, or by undertaking new productive (or service) functions.

In addition, within this context innovation is clearly not defined only as a breakthrough into a product or a process that is new to the world. It is rather a story of marginal, evolutionary improvements of products and processes, that are new to the firm, and that allow it to keep up with an international (moving) standard. In turn, this crucially requires the continuous and consistent investment in technological capabilities (Lall, 1992, Pietrobelli, 1997). In other words, it may be conceived as a story of running to stand still, and innovating in a relative context: a firm or a cluster of firms upgrade when they innovate faster than their competitors. This involves a shifting to activities, products, sectors which sustain higher value added and enforce higher entry barriers.

The concept of upgrading may be effectively described for enterprises working within a value chain, where four types of upgrading are singled out (Humphrey and Schmitz, 2000):

a. Process upgrading: transforming inputs into outputs more efficiently by re-organizing the production system or introducing superior technology (e.g. footwear producers in the Sinos Valley: Schmitz, 1999a);

b. Product upgrading is moving into more sophisticated product lines in terms of increased unit values (e.g. the apparel commodity chain in Asia upgrading from discount chains to department stores: Gereffi, 1999);

c. Functional upgrading is acquiring new, superior functions in the chain, such as design or marketing or abandoning existing low-value added functions to focus on higher value added activities (e.g. Torreon’s blue jeans industry upgrading from maquila to “full-package” manufacturing: Bair and Gereffi, 2001);

Intersectoral upgrading is applying the competence acquired in a particular function to move into a new sector. For example, in Taiwan competence in producing TVs was used to make monitors and therefore move into the computer sector (Humphrey and Schmitz, 2002b, Guerrieri and Pietrobelli, 2003). In sum, upgrading within a value chain implies escalating on the value ladder, moving away from activities in which competition is of the “low road” type and entry barriers are low. However, upgrading also has a sectoral dimension, and may differ depending on the specific features of different groups of industries.

3.2. Pavitt taxonomy and sectoral specificities in upgrading and innovation

Indeed, belonging to a local cluster or participating in a global value chain may ease local learning and sustain upgrading. However, the role of each of these factors might change according to the sectoral specificities of a cluster and, more importantly, to the sector’s underlying technological features. Appropriability of knowledge, scale and scope of R&D and technological activities are, among others, the conditions that influence the way in which knowledge generation is carried out within firms and across firms.

In order to observe the variety of innovative processes across sectors, Nelson and Winter (1977, 1982) seminally introduced the notion of ‘technological regime’, which they define broadly as a technological condition that defines the boundaries and the direction of the innovative and problem-solving activities of technicians. This definition was further refined by Dosi (1982; 1988) who defined
the technological regime according to (1) the properties of the learning processes associated with firms’ problem solving activities; (2) the system of knowledge sources, internal and external to the firm, relevant for such problem-solving activities; (3) the nature of the scientific and technical base upon which firms draw in problem-solving.

More recently, other authors have attempted to apply the concept of technological regimes on the basis of the combination of (1) technological opportunity, (2) appropriability of knowledge, (3) cumulativeness of learning and (4) nature of the knowledge base (Malerba and Orsenigo, 1993, 1996; Breschi, Malerba and Orsenigo, 2000). Following this approach, two patterns of innovation have been singled out. The first one, defined as ‘Schumpeter-Mark I’ pattern, is characterised by high technological opportunity and low appropriability and cumulativeness of knowledge. Traditional sectors typically follow this pattern of innovation (Malerba, 2000). The second pattern (Schumpeter-Mark II) is characterised instead by low technological opportunity, high cumulative technology and high appropriability. In this case, the concentration of economic activities is high and the rate of entry/exit of firms is low; this pattern favours long lasting cumulative paths and large-sized firms. This is the typical pattern for chemical and electronic industries (Malerba, 2000).

Although this dichotomous view is important in deepening the understanding of technological change and performance across industries, it still does not cover the whole technological variety of firms (Marsili, Verspagen, 2002). Hence, we refer here to a more refined perspective, such as that proposed by Keith Pavitt (1984). In his extensive study of sectoral patterns of innovation, Pavitt developed a taxonomy aimed at explaining similarities and differences among sectors in the sources, nature and impact of innovation.

Such taxonomy identified four different categories of innovators: Supplier-Dominated, Scale Intensive, Specialised Suppliers and Science-based firms.

Supplier-Dominated firms are generally small, with weak in-house R&D activity and whose process of technical change is induced mostly by suppliers of inputs and capital goods. Technical choices are made on a cost-cutting perspective and technological accumulation is focused mainly on the improvements and modifications in production methods and associated inputs (Bell, Pavitt, 1993). This sectoral group is characterised by low appropriability, as technological externalities reduce the capacity of firms to protect from imitation, and propensity to patent innovations is low. Consequently, barriers to entry are low. Typical sectors belonging to this category are traditional manufacturing activities like textile, leather, printing and publishing, agriculture and construction.

Scale Intensive firms and specialised suppliers are both production intensive firms that exploit economies of scale to reduce production costs. In Scale Intensive firms, the process of technological accumulation is realised in the phases of design and operation of complex production systems. The complexity and scale of products typical of this group - which includes extraction and processing of bulk material, automobiles, rubber and plastics, food products and certain durable goods - requires that radical change is potentially costly and that products and process are developed incrementally and modularly (Ulrich, 1995). These firms produce in-house a relatively high proportion of their own process technology, and devote great part of their innovative resources to that. Scale intensive firms are characterised by medium appropriability which is pursued through both patents and industrial secrecy, while barriers to entry are relatively high due to complexity and high cumulativeness of knowledge (Malerba, 2000).

The learning and upgrading process of specialised suppliers is stimulated by scale intensive firms, that use their products, propose challenging projects and represent an important source of learning. In this case, knowledge appropriability is high, as key knowledge in this sectoral group is predominantly tacit and idiosyncratic.

Finally, Science-based firms are typically part of the chemical and electronic sectors, where innovation is carried out in R&D labs and it is heavily dependent on discoveries and knowledge.

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6 Technological opportunity reflects the likelihood of innovating for any given amount of money invested in research; appropriability of innovations refers to the possibilities of protecting innovations from imitation; cumulativeness of knowledge is related to the fact that today’s knowledge base constitutes the building blocks of tomorrow’s innovations and the properties of knowledge base is tied to the nature of knowledge and its degrees of specificity, tacitness, complexity and independence (see Breschi, Malerba and Orsenigo, 2000).
developed in universities. This sectoral group is characterised by high technological opportunity and high appropriability and cumulativeness. Barriers to entry are also high.

Since Pavitt’s contribution, a number of studies have adopted and refined the taxonomy to analyse the Latin American context (e.g. Guerrieri, 1994, ECLAC, 1996). In this paper, we adopt this taxonomy to our purposes and develop a classification of industries that fits Latin American industrial structure.

3.2. Pavitt taxonomy revisited: a sectoral classification for Latin America

Although the Pavitt taxonomy has been developed and holds reasonably well in developed countries, it cannot be transferred as such to Latin American countries without some necessary adaptations. A special caution needs to be paid, especially considering that in LA in-house R&D activities are very low in both domestic and foreign firms (Archibugi and Pietrobelli, 2003), domestic inter-sectoral linkages have been displaced by trade liberalisation (Cimoli and 2002) and university-industry linkages appear to be still relatively weak (Arocena and Sutz, 2001).

Furthermore, in the past 10 years, Latin America, has deepened its productive specialisation in resource-based industries and has weakened it’s position in more engineering intensive industries (Katz, 2001), reflecting its rich endowment of natural resources, relatively more than of human, technical resources (Wood and Berge, 1997). Hence, we choose to adapt the Pavitt taxonomy to the present conditions of LA, and retain its central notions by identifying four main sectoral groups on the basis of the way learning and upgrading occur, and on the related industrial organization that most frequently prevails. The categories are as follows:

1. **Traditional Manufacturing**, which refers mainly to labour-intensive and “traditional” technology industries such as textile, footwear, tile and furniture.

2. **Natural Resource-based industries (NR-based)**, which imply the direct exploitation of natural resources e.g. copper, marble, fruit, etc.

3. **Complex Product Systems’ industries (COPS)**, which include, among others, automobile, autoparts and aeronautic industries, ICT and consumer electronics;

4. **Specialised suppliers**, that in our LA cases, essentially includes software.

Each of these categories tends to have a predominant learning and innovating behaviour, in terms of: main sources of technical change, reliability and dependence on university basic research, modes of in-house innovation (e.g. ‘routinised’ versus large R&D labs), scale of R&D activity and appropriability (see Table 1 for details).

Traditional manufacturing and Resource-based industries are by far the most present in Latin America, and therefore especially relevant to our present aims of assessing SMEs’ potential for upgrading within clusters and value chains. Traditional manufacturing is defined as supplier-dominated, because major process innovations are introduced by producers of inputs (e.g. machinery, materials etc.). Indeed, firms have room to upgrade their products (and processes) by developing or imitating new products’ designs (‘style’), often interacting with large buyers that increasingly play a role in shaping the design of final products and hence the specificities of the process of production (times, quality standards and costs). Resource-based industries crucially rely on the advancement of basic and applied science, which, due to low appropriability conditions is most often led by public research institutes, possibly in connection with producers (farmers, breeders, etc.). In these sectors, applied research is mainly carried out by input suppliers (i.e. chemicals,

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7 “…..advances in electromagnetism, radio waves and solid state physics have enabled products and applications related to the availability of cheap decentralised and reliable electricity, communication and (now) information processing storage and retrieval” (Pavitt, 1984:362).

8 University-Industry linkages have been historically very poor in Latin America (Plonsky, 1993): during the Import Substitution period, there was little interest to cooperate because protected market conditions did not require firms to innovate and be competitive with imported products. At the same time, universities had little incentives to transfer technologies to business because research was not financed by privates but still by the Government. Since the 90s, the situation has shown signs of change, with some new policies specifically focusing on university-industry linkages.

9 The risk of ‘freezing’ a classification that may be outdated by changes occurred in technology over the years has been acknowledged by several authors (Freeman, 1994); to this aim, the taxonomy has been adapted to fit our empirical case studies.

that achieve economies of scale and appropriate the results of their research through patents.

Table 1. Sectoral Groups: A Pavitt Taxonomy for Latin America

<table>
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<tr>
<th>Groups</th>
<th>Industries</th>
<th>Learning Patterns</th>
<th>Description</th>
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<tbody>
<tr>
<td>1. Traditional Manufacturing</td>
<td>Textile and garments, Footwear,</td>
<td>Mainly Supplier dominated</td>
<td>• Most new techniques originate from machinery and chemical industries</td>
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<td>Furniture, Tile</td>
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<td>• Opportunity for technological accumulation are focused on improvements and</td>
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<td>modifications in production methods and associated inputs, and on product</td>
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<td>• Most of technology is transferred internationally, embodied in capital</td>
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<td>goods.</td>
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<td></td>
<td></td>
<td>• Low appropriability, low barriers to entry</td>
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<tr>
<td>2. Resource-based industries</td>
<td>Sugar, Tobacco, Wine, Fruit, Milk</td>
<td>Supplier dominated (Science-based)</td>
<td>• Importance of basic and applied research led by public research institutes</td>
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<td></td>
<td>Extraction industries</td>
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<td>• Most of Innovation is generated by suppliers (machinery, seeds, chemicals</td>
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<td></td>
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<td>• Increasing importance of international sanitary and quality standards, and</td>
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<td>of patents</td>
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<td>3. Complex Product Systems</td>
<td>Automobile and autoparts, Aircraft,</td>
<td>Scale intensive firms</td>
<td>• Technological accumulation is generated by the design, building and</td>
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<td>industries</td>
<td>Consumer electronics</td>
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<td>operation of complex production systems or products. Radical innovation</td>
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<td>is risky.</td>
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<td>• Process and Product technologies develop incrementally. For consumer</td>
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<td>electronics, technological accumulation emerges mainly from corporate R&amp;D</td>
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<td>labs and university skills.</td>
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<td></td>
<td>• Appropriability is medium, barriers to entry high</td>
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<td>4. Specialised Suppliers</td>
<td>Software</td>
<td>Specialized suppliers</td>
<td>• Often-small firms. Important user-producer interactions. Learning from</td>
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<td></td>
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<td>advanced users.</td>
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<td></td>
<td>• Low barriers to entry and low appropriability</td>
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<td></td>
<td>• High in-house R&amp;D for development of edge technologies</td>
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Complex Product Systems are defined as “high cost, engineering-intensive products, subsystems or constructed supplied by a unit of production” (Hobday, 1998)\(^{11}\) where the local network is normally anchored to one ‘assembler’, which operates as a leading firm characterised by high design and technological capabilities (e.g. Embraer in Brazil or foreign TNCs in the automotive industry such as Fiat, GM or Ford in Brazil and Mexico). To our aims, the relationships with these ‘anchors’ may be crucial to foster (hinder) SMEs upgrading through technology and skills transfers (or lack of it). Complex systems are typically led by scale-intensive firms (Bell, Pavitt, 1993), whose process of technical change is realised within an architectural set (Henderson, Clark, 1990) and is often incremental and modular.

Among the specialised suppliers we only consider software, that is typically client-driven. This is an especially promising sector for developing countries’ SMEs, due to the low transport and physical capital costs and high information intensity of the sector, that moderates the importance of proximity to final markets and extends the scope for a deeper international division of labour. Moreover, the disintegration of some productive cycles, such as for example of the telecommunications, opens up new market niches with low entry barriers (Torrisi, 2003). However, at the same time the proximity of the market and of clients may crucially improve the development of design capabilities and thereby foster product/process upgrading. Thus, powerful pressures for clustering and globalisation coexist in this sector.

The different learning patterns across the four groups of activities identified above affect the process of upgrading of clusters in value chains. More specifically, this paper aims at analysing with original empirical evidence whether - and how - the sectoral dimension influences the process of upgrading in clusters and value chains in Latin America.

\(^{11}\) In this study, the definition of COPs does not coincide entirely to that given by Hobday (1998). He distinguishes COPs from mass-market, commodity type industries. The former – which includes telecommunications exchanges, flight simulators, aircraft engines, cellular phone network equipments, etc.- would be characterised by high component customisation, by a hierarchical architecture and by small batch production. The latter - which includes cars, semiconductors and consumer electronics- is instead characterised by a higher degree of interface and components standardisation (modularity, Ulrich, 1995) which allow for mass production. In the present work, consistently with Bell and Pavitt (1993), the definition given to COPs will include both the above-mentioned industries, although the former is rarely encountered in Latin America.
4. Sectoral Patterns of Upgrading: Evidence from Latin America

4.1. Methodology

This study is based on the collection of original data from eleven new clusters in Latin America, and on an extensive review of cluster studies available in the literature. The empirical analysis was carried out from September 2002 to June 2003 with support from the Inter-American Development Bank to create an international team of twelve experts in Italy and in four LA countries. The desk and field studies were undertaken following the same methodology, that involved field interviews to local firms, institutions, and observers, interviews to foreign buyers and TNCs involved in the local cluster, and secondary sources such as publications and reports.\(^\text{12}\) A total of 40 case studies were selected for this analysis, fulfilling the following necessary conditions: (1) Agglomeration: all cases show some degree of geographical clustering of SMEs; (2) Upgrading: the clusters selected have experienced some degree of upgrading, of whatever nature (i.e. product, process, functional, inter-sectoral); (3) Value chains: all clusters are inserted in some form of value chain with other firms (and eventually institutions) and (4) Policy lessons: all cases offer relevant policy lessons for future experiences either in terms of successes or failures. The list of cases, whilst necessarily not complete, is the largest available – to our knowledge – on which comparative exercises have been carried out, and provides a good approximation to the reality of clusters and value chains in LA (see the Appendix).

For each of the clusters investigated, we have also made an attempt of classification adopting the following criteria: (i) a quantification of the different types of external economies and joint actions in an ordered scale, ranging from absent (0) to high (3), and the computing of an index of collective efficiency combining external economies and joint action; (ii) a quantification of the degree of product, process and functional upgrading. The number and mode of governance (market, network, quasi-hierarchy and hierarchy) of the value chains was also identified for each of the cluster analysed.

These classifications are obviously based on our interpretation of the case studies, with the collaboration of the team of experts. As with any study of this kind there may be potential problems on the accuracy of the results, that call for cautious interpretations. To overcome some of these problems, the information is complemented and cross-referenced in all possible ways, and tested with interviews to key informants and local experts. The next section presents a synthesis of the main results of this study. Fuller details and analyses of additional complementary issues are addressed in a longer study (Pietrobelli and Rabellotti, 2003).

4.2. Empirical Evidence

- **Collective efficiency and upgrading**

Collective efficiency reaches different levels in different clusters and groups of industries. On average, collective efficiency appears to reach higher levels in NR-based and software clusters. As expected, clusters in COPS record lower levels of collective efficiency, especially due to the very few joint actions undertaken. All clusters share the advantages of a local labour market, sometimes the by-product itself of geographical clustering. Inputs are also locally sourced, except for CoPS, where the logic of global sourcing prevails. In traditional manufacturing, clusters develop a medium degree of collective efficiency with the two footwear clusters of Sinos Valley and Leon clearly ahead of the others. In few clusters, among them Chipilo and Torrédon in Mexico (Zepeda, 2003, Bair and Gereffi, 2001), the degree of collective efficiency can be defined as low. In Chipilo, the lack of collective efficiency may be explained by a combination of factors: the very recent origin of the cluster and the main organisational pattern, dominated by vertical relationships between Segusino, the leading local Mexican firm, and its network of subcontractors. The predominance of these strong vertical relationships interferes with the development of external economies and, especially, of joint actions apart from cooperation between the leading firm and its subcontractors. Very similar results are also reported in the Torrédon blue jeans cluster, where the only significant external economy is the creation of a specialised local labour market while joint action at horizontal level is almost inexistent, due to a generalised distrust among firms and the absence of an institutional environment conducive to cluster growth (Bair and Gereffi, 2001).

\(^\text{12}\) For details, see Pietrobelli and Rabellotti, 2003.
Table 2: Collective Efficiency across sectoral groups

<table>
<thead>
<tr>
<th></th>
<th>EE</th>
<th>JA</th>
<th>CE Index*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional Manufacturing</td>
<td>7.6</td>
<td>5.23</td>
<td>6.31</td>
</tr>
<tr>
<td>NR-based</td>
<td>8.91</td>
<td>7.36</td>
<td>8.2</td>
</tr>
<tr>
<td>COPS</td>
<td>7.61</td>
<td>4.8</td>
<td>6.19</td>
</tr>
<tr>
<td>Specialised Suppliers</td>
<td>9.1</td>
<td>7.8</td>
<td>8.7</td>
</tr>
</tbody>
</table>

*Source: Author's database. * EE= external economies (average number and grade), JA = Joint actions (average number and grade), Collective Efficiency Index = 0.5*EE+0.5*JA

The number and variety of joint actions through collective institutions is surprisingly higher for specialised suppliers (software) clusters, perhaps as a result of their more recent history - that often involved local planning policies -, of their high human capital intensity, of the personal relationships linking small entrepreneurs, sometimes developed in Universities, and of the intense relationships with institutions of research and higher education. Similar high levels of Joint Action are recorded in NR-based clusters, especially collective institutions engaging in basic research and extension of innovation and technology to small farmers and producers (Gomes, 2003). The collaboration between private and public associations and institutions is especially noteworthy (Maggi, 2003, Vargas, 2001).

Upgrading has occurred in most clusters analysed, although with different features: process and product upgrading are more common while functional upgrading is more rarely achieved. Intersectoral upgrading only occurred in Chile, with salmon cluster firms venturing into biotechnology and genetics (Maggi, 2003, Pietrobelli and Rabellotti, 2003).

Table 3. Correlation Between Collective Efficiency and Upgrading*

<table>
<thead>
<tr>
<th></th>
<th>Collective Efficiency</th>
<th>Product Upgrading</th>
<th>Process Upgrading</th>
<th>Functional Upgrading</th>
<th>Intersectoral Upgrading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional Manufacturing</td>
<td>HIGH</td>
<td>2.5</td>
<td>2.5</td>
<td>1.25</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>MEDIUM</td>
<td>2</td>
<td>2.5</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>LOW</td>
<td>1.5</td>
<td>2.5</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>NR-based</td>
<td>HIGH</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>0.75</td>
</tr>
<tr>
<td></td>
<td>MEDIUM</td>
<td>2.5</td>
<td>2.33</td>
<td>0.33</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>LOW</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>COPs</td>
<td>HIGH</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>MEDIUM</td>
<td>2.33</td>
<td>2.66</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>LOW</td>
<td>2.66</td>
<td>2.66</td>
<td>0.83</td>
<td>-</td>
</tr>
<tr>
<td>Software (Spec.Suppl.s)</td>
<td>HIGH</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>MEDIUM</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>LOW</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

*Source: Authors' database. *The table presents the average level of each form of upgrading for each group of clusters classified on the basis of the degree of collective efficiency.

There is some evidence of a positive correlation between collective efficiency and local firms’ capabilities to upgrade (Table 3). Only in COPs clusters this evidence is less positive effect. In this group of industries, an interesting exception is represented by the metalworking cluster of Espírito Santo, Brazil, where the collaboration between the leader “anchor” firm with local SMEs, enhanced by a local institution acting as a “network-broker”, substantially helped (Cassiolato et al., 2003). Collective efficiency may have a positive influence on upgrading through several channels, including the local institutional network, the public support to local joint actions, research centers, Universities, international co-operation (e.g. salmon cluster in Chile, mangoes cluster in PJ, apple cluster in SC, Brazil).

- Passive external economies are more frequent than joint action in most clusters

Across all groups of sectors, passive external economies are more common than the various forms of joint action in all the groups considered (see Table 2). Joint action requires specific investments, and firms get involved in cooperation only if they have to face some external challenges as new competitors, an innovation to adopt or a new market to entry (Rabellotti, 1999).

This is also consistent with previous studies, as Nadvi and Schmitz, 1999.
Different types of chains often coexist in the same cluster and their strategic governance affects SMEs upgrading

On the basis of the literature on global value chains, one would expect the quasi-hierarchy as the dominating pattern of governance in the traditional manufacturing group, with buyers and manufacturers playing a leading role (Gereffi, 1999). However, according to our sample, the reality is characterized by a greater variety of forms of organization and governance of the value chains. There is in fact evidence that in some cases different value chains co-exist in the same cluster, with firms participating in local as well as in global value chains. The co-existence of different chains has been found especially in traditional manufacturing and natural-resource based industries. Instead, in the software clusters the relationships with clients are mainly of a market/network type, and rarely local enterprises are integrated in quasi-hierarchical global value chains.

An example of a cluster operating simultaneously in different types of chains is the footwear cluster of the Sinos Valley, where, besides the chain dominated by US and European buyers, there are other minor chains oriented to the Brazilian and the Latin American market. These different chains are characterized by various patterns of governance: the US value chain is a typical quasi-hierarchical chain, dominated by US buyers, while firms selling into the domestic market and exporting to Latin America operate under market conditions. In the quasi-hierarchical chain, US buyers impose their conditions concerning product design, marketing, branding on Brazilian producers. The buyers are the undisputed leaders in the chain, exerting control over intermediaries, local producers and often input suppliers as well. According to Bazan and Navas-Aleman (2001), this asymmetrical relationship with local producers can be explained by several factors, the most important being the marked concentration of exports by a small number of export agents in the US market. Moreover, the numerous sourcing options (e.g. China, Spain and Portugal) open to the buyers, in the unlikely scenario that local producers did not accept their terms, made the buyers stronger.

Similarly, the two Mexican footwear clusters of Guadalajara and León operate simultaneously in different chains: in quasi-hierarchical chains dominated by US buyers and in the domestic market, sometimes under market conditions and in a few cases also in network chains. While in the quasi-hierarchical chains, US buyers control design and product development, in network-governed value chains there is co-operation between firms of more or less equal power, which share their competencies within the chain. This is an increasingly common pattern in these clusters, where one of the effects of trade liberalization has been an increase in co-operation between domestic buyers and producers (Rabellotti, 1999).

In the Nicaraguan diary cluster studied (Artola and Parrilli, 2003), upgrading is occurring in different value chains: the cluster in fact participates in three different types of productive chains: (i) the chain led by the main buyer, Parmalat, (ii) the chains headed by the Salvadoran medium-sized processing plants and traders and (iii) the chain led by some local small cooperatives. A clear pattern of hierarchical governance is evident in the productive chain led by Parmalat and in the chain led by the Salvadoran agents, while a form of network-like governance prevails in the value chain led by local cooperatives. In such a context, upgrading dynamics has taken very different forms. The hierarchical value chain is fostering mainly upgrading of products and processes, and Parmalat is playing a role in this pattern, fostering product/process but hindering functional upgrading. However, the VC led by the semi-industrial cooperatives is also enhancing functional upgrading, together with improvements in products and processes.

In sum, an interesting and promising issue that has emerged from this study, is that value chains alternative to the quasi-hierarchical one dominated by buyers or TNCs, have sometimes facilitated a smoother and continuous process of learning which created the conditions for firms to functionally upgrade over time (Pietrobelli and Rabellotti, 2003). However, global buyers need not necessarily be the optimal solution for upgrading in value chains. National chains also offer promising and often more sustainable opportunities, and may represent an alternative avenue to the upgrading-with dependence participation in quasi-hierarchical value chains.

The sectoral dimension matters

The hypothesis that the sectoral dimension matters in the process of upgrading is supported by our empirical evidence: significant inter-cluster differences emerge when considering the specific features of learning, innovation, and industrial organization of the different sector groups. Clusters and value chains belonging to different industries tend to follow systematically different patterns of collective efficiency, modes of chain governance, performance and upgrading (Table 4).
<table>
<thead>
<tr>
<th>Table 4: Patterns of Learning and Upgrading Across Sectoral Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pattern of learning according to Pavitt taxonomy</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Supplier-driven</td>
</tr>
<tr>
<td><strong>Impact of collective efficiency on:</strong></td>
</tr>
<tr>
<td>Product upgrading</td>
</tr>
<tr>
<td>Process upgrading</td>
</tr>
<tr>
<td>Functional upgrading</td>
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<tr>
<td><strong>Impact of global buyers-leaders on:</strong></td>
</tr>
<tr>
<td>Product upgrading</td>
</tr>
<tr>
<td>Process upgrading</td>
</tr>
<tr>
<td>Functional upgrading</td>
</tr>
<tr>
<td><strong>Other critical sources of knowledge</strong></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

Source: Authors’ own database.

NOTES:
1. Process innovations in this sector are usually driven by technology suppliers, and in none of the sample clusters there is a local production of technology.
2. Often little collective efficiency (CE) is detected.
3. None refers to the case in which the global buyer is not present.
4. Global leaders set the target and provide market outlets, but do not normally engage in supporting initiatives.
5. Neutral, only indirect impact through the incentive (spur) to enter global value chains and fulfill the standards required. Not attained through the direct support of buyers.

In **Traditional manufacturing** clusters upgrading may occur by incremental developments and imitating new products’ designs, sometimes helped by large buyers, who have to rely on the specialized competencies of their local suppliers. Chain leaders have a strong interest to foster local SMEs upgrading as most knowledge is tacit, and constant monitoring and interaction is needed to avoid costly delays or failures to comply of the local providers.

Collective efficiency is positively related with local firms’ capabilities to upgrade products (Table 4). Instead, the link with process upgrading does not appear to be significant, perhaps as process innovations are usually driven by technology suppliers, and in none of the clusters analysed there is a local production of technology. However, integration into value chains is a two-edged sword, and offers conflicting opportunities. On the one hand it facilitates inclusion and rapid enhancement of product and process capabilities. In traditional industries buyers usually provide support, because these products are not customised, and information on products and processes cannot be easily codified in technical norms, and the quality of products depends on the specialised skills of local producers. Relying on the competencies of their local suppliers, obliges global buyers to assist them in improving products and processes, and meet the requirements of international markets.

On the other hand, however, SMEs become tied into relationships that prevent functional upgrading and leave them dependent on a small number of powerful customers (e.g. Sinos Valley footwear cluster, Brazil, Bazan and Navas-Aleman, 2001). The access to alternative value chains, with a less hierarchical governance structure and targeting a different market, may offer powerful opportunities to upgrade functionally and enter higher value-added segments of the chain. This has occurred in the dairy cluster in Nicaragua, with local producers’ cooperatives entering chains alternative to the one led by Parmalat (Artola and Parrilli, 2003), and in Sinos Valley, where value chains selling to the Brazilian market allowed functional upgrading, in addition to product and process upgrading.
A leader-firm (and an innovative entrepreneur) may spur the creation of a cluster of successful firms, following his example and exploiting the accumulated learning, such as the footwear cluster in Puebla, Mexico, and several cases in Southern Italy (Cersosimo and Viesti, 2003). Favorable macroeconomic conditions are essential, especially for these sectors, where new entrants constantly coming from developing countries crowd out higher-wage and lower-productivity producers. Unfavourable macro conditions may rapidly revert success into failure (e.g. Zepeda, 2003, on Chipilo, Mexico).

In NR-based clusters, process and product upgrading are tied to the advancement of science and technology. New methods, inputs and machineries are in fact introduced by the interactive relations between suppliers and research labs (i.e. universities), which carry out the majority of the research activity. In particular, given the high uncertainty and low appropriability conditions of knowledge in this sector, public research plays an important role in the process of upgrading (Pray, Umali-Deininger, 1998).

In fact, successful clusters of upgrading SMEs in these sectors have often been supported by public-private joint actions, chiefly oriented to research and technology extension services: as an example, in the mango-grape cluster of Petrolina Juazeiro in Brazil, the local San Francisco River Valley Development Agency (CODEVASF) promoted a sequence of crops that facilitated the learning process of small growers. Similarly, in the wine recluster of Serra Gaucha (Vargas, 2001), the National Centre for Research on Grape and Wine (CNPUV) of EMBRAPA and the JK Agro technical Federal School, both sited in the city of Bento Gonçalves, constitute the main research and human resources formation centres of this cluster.

In Southern Chile, in the early eighties the salmon cluster development was fostered by Chile Foundation, that ventured into salmon farming, unknown in the region until then, proving that this activity could be profitable. This example, set by a public actor, was then followed by several private firms and TNCs (Pietrobelli, 1998). Later, joint actions led by the private sector and supported by public policies (e.g. a trade market, joint promotion abroad) paved the way to the further strengthening and evolution of the cluster. Over the late nineties R&D funds were then allocated through competitive tenders (Maggi, 2003).

In clusters operating within buyer-driven chains, global buyers facilitate the link with the international market by signalling the need (and the modes) of the necessary upgrading. They relay information on the standards that need to be met, but they do not normally foster and support the SMEs' upgrading process. Sometimes in a way they set the target and the prize, and then let local suppliers compete to fill the orders. Knowledge and technology is usually well-codified, and its diffusion helped by local institutions, universities and technical extension services, and constant supervision, monitoring and interaction is not needed as it is with traditional manufacturing. Consequently, collective efficiency has a positive influence on upgrading, through several channels including the local institutional network, the public support to local joint actions, research centers, Universities, international co-operation (e.g. salmon cluster in Chile (Maggi, 2003), mangoes cluster in Petrolina Juazeiro, apple cluster in Santa Catarina, Brazil (Gomes, 2003)). However, upgrading may not be enhanced by collective efficiency when the cluster is dominated by few large enterprises, which have large financial strength and resources to support their own upgrading without cooperative actions (e.g. melon cluster in Rio Grande do Norte, Brazil (Gomes, 2003)).

In Complex Product Systems (COPS), technological accumulation and upgrading are generated by the design and development of parts and components of a complex product, and global value chains are dominated by large assemblers and by their first-tier suppliers. Local suppliers (which are second or third-tier) are required to attain high quality standards and certifications to be part of the subcontracting network, but the lead firms have little understanding and sensitivity of the upgrading concerns of local firms. This is explained by their little interest in it, as a second or third tier supplier may be easily replaced, and this is usually responsibility of the first tier supplier anyway.

Thus participating in a value chain offers no direct advantages to upgrade in these industries. Rather, it is the interest to operate as suppliers that induces firms to try to keep up with technological advancements. According to our evidence, this effect is limited to few cases, while the majority of

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14 Most of the local small growers had never previously worked with irrigated agriculture. Thus, they first produced a combination of annual crops, including beans, corns, and melons, followed by widespread adoption of industrial tomato, and subsequently higher-value fruit crops, including mangoes and grapes. The transition from phase to phase involved a combination of conventional and more innovative support policies to help growers in each, consecutively more difficult, phase (Gomes, 2003:8).
local suppliers have been displaced by global outsourcing strategies of multinational assemblers. In such a context, no room is left for functional upgrading of local suppliers.

In this sector, moreover, there is also little collective efficiency and upgrading is left to individual efforts in competitive markets. Few alternative avenues are left for local SMEs. A viable strategy is to find a profitable niche by servicing large leading firms in the chain (e.g. the metalworking cluster in Espírito Santo, Brazil (Cassiolato et al., 2003)).

The analysis of the notable experience of local industrial policy carried out by the Regional Chamber of ABC, São Paulo, presented by Leite (2002) further confirms: “…the difficulties of developing a local policy network in a sector with strong global linkages as in the automotive sector. Firms in the automotive sector demonstrated little interest in participating in the Chamber’s activities. The sector’s global linkages and the hierarchical structure of the chain, appear to establish strong relationships between the firms involved, leading them to show less of a propensity to participate in other forums aimed at raising competitiveness. This type of behaviour was to be found not just amongst the assemblers but also amongst the automotive components firms …. Other firms within the plastics sector (particularly small firms committed to producing various products aimed at a varied client group and not directly inserted into any one specific chain) showed a greater propensity to strategies within the Chamber and aimed at increasing competitiveness by improving collective efficiency” (Leite, 2002: 35).

In sum, the impact of global buyers on clusters’ upgrading ranges from positive to neutral moving from traditional manufacturing, to NR-based industries and COPs (Table 4). More specifically, buyers spur directly or sometimes only indirectly and passively a high degree of product and process upgrading, and important differences emerge across the sectoral groups in this regard (Table 4).

Thus, in traditional manufacturing buyers do normally intervene directly in their suppliers’ production process, often reshaping them heavily in order to attain higher international quality standards of products. In traditional industries, global buyers look constantly for lower-cost production sites, and when they integrate new producers into a global value chain, they need to transfer substantial tacit knowledge and assist them in meeting requirements that frequently do not apply to the domestic market. Thus, buyers exert close monitoring and control on their suppliers to ensure that products meet international standards (Humphrey and Schmitz, 2000).

In NR-based industries instead, global buyers play a crucial role in connecting the local cluster with a challenging market, but they rarely support upgrading directly. In many cases, this role has been played by institutional support, in the form of technology extension services provided by universities, research centres or producers’ associations and cooperatives.

Finally, in COPs, the complexity and technological sophistication of the products and processes often require that suppliers have sufficient technological capabilities already before they are subcontracted. In many cases (e.g. automotive industry in Mexico, Argentina and Brazil) leading producers (assemblers) do not engage in co-design with local – typically 2nd and 3rd tier suppliers - nor do they directly transfer knowledge to them. Yet, suppliers are required to attain high quality standards and obtain several certifications to enter a subcontracting agreement. What follows is that the chain leader (the ‘buyer’) sets the incentive and imposes the urgency to upgrade, but the support to the process itself is in most cases left to market-based initiatives, such as consulting firms and local network-brokers.

In all cases, however, functional upgrading is not enhanced by the presence of foreign buyers, that in often openly discourage their suppliers from functional upgrading in order to prevent competitive backlashes.

In Specialised Suppliers, our empirical analysis focus only on Software clusters in Brazil and Mexico. Software firms are usually client-driven as they develop or adapt software packages to the specific requirements of their local clients. Barriers to entry are low, proximity to demand is crucial, and this encourages start-ups near major clients. Software houses perform incremental product and process improvements. Functional upgrading is more likely to occur than in other sectors because it is favoured by the ease of software firms to engage in design and commercialisation of their activities.

The relationships with clients is usually of a market/network type, and the leader-firms facilitate access to markets, and sustain the formation of a skilled labour force. However, they do not provide direct knowledge transfer to locally-owned firms, that often perform low value added activities.
Collective efficiency plays a clear role through various means. The relationships with higher education institutions, resulting in a good endowment of cheap and qualified technical workforce and engineers, are essential. Spin-offs seem to be a way of diffusing capabilities locally. In some cases, the subcontracting firms are founded by previous employees of the leading firm, and this in turn fosters smooth collaborative relations with the leaders.

5. Conclusions. Clusters, Value Chains and Sector-specific Learning and Upgrading Patterns

Clustering and participating in a (global) value chain are increasingly considered by development scholars and policy-makers as possible alternative strategies to enhance enterprise performance in international markets. In this paper we show, and support with substantial empirical evidence, that from the point of view of the enterprise, clustering and participating in value chains are not mutually exclusive alternatives. What really matters is the mode of organization of inter-firm linkages, and the governance of value chain. These differ, and have different implications for learning and upgrading, in different groups of sectors.

The paper utilizes new evidence originally gathered with extensive field-works on a sample of clusters and value chains in Latin America, and shows how collective efficiency differs by sectors. The differences grow even deeper when differentiating between external economies and consciously pursued joint actions.

A central conclusion of this paper is that collective efficiency makes a difference and affects enterprise upgrading, but the impact is different, and follows different routes, in different groups of industries.

However, this is not the only thing that matters, as participation in a global value chain, and the mode of governance of the value chain all affect the scope and extent of local firms' upgrading. More specifically, in quasi-hierarchical value chains product and process upgrading are often enhanced, but functional upgrading is almost always inhibited.

In order to test the hypothesis that the upgrading prospects offered by clusters and value chains differ in different sectors, we use a revised version of the Pavitt taxonomy. Although this taxonomy was originally built on the basis of the empirical evidence on an industrial country, it identified some patterns of innovation that may help the interpretation of the results of our empirical analysis. Indeed, what in advanced countries is called a pattern of innovation, in Latin American contexts should be better viewed as a pattern of learning, provided that firms tend to adapt and incrementally improve, rather than create knowledge and technology. Consistently, a process of technological capability development is needed to create the knowledge base upon which further improvements may be based (Bell and Pavitt, 1993, Lall, 1992). Thus, the degree of cumulativeness of knowledge, together with the degree of appropriability and complexity of the knowledge base may therefore influence the capacity of firms to upgrade in presence of global buyers.

In Traditional Manufacturing, low levels of technological complexity and appropriability favour processes of local learning, which rely on the accumulation of tacit knowledge and its diffusion among clustered firms. Thus, global buyers may speed up processes of product or process upgrading, imposing new routines and pressuring local firms with timeliness and quality standards. At the same time, though, empirical evidence has shown that by controlling the process, they also manage to inhibit functional upgrading, thus reducing the scope of learning for local firms. Our interpretation of the evidence collected, suggests that this learning process could be pursued independently by local firms, probably in a smoother and longer period of time. In this event, collective efficiency and cooperative actions may foster this upgrading process.

In NR-based industries, the appropriability of knowledge is low and applied research is not at reach of farmers. In this case, universities and large firms are important for the R&D and technological activities that they carry out. However, contrary to what occurs in advanced countries, in Latin America the pattern of learning identified for this Pavitt sectoral group, is still in a preliminary phase. University-Industry linkages are in fact still limited (Arocena and Sutz, 2001) and local innovative capabilities have weakened in the 1990s (Katz, 2001; Cimoli and Katz, 2002; CEPAL, 2002). Indeed, on the basis of our empirical evidence, a local effort of technology transfer and extension ought to be pursued by public research institutes, and the synergies between them, input suppliers and local farmers are particularly important in the process of upgrading and should be encouraged.
In the case of COPS, sectors are characterised by a highly complex knowledge base which incorporates a variety of distinct knowledge and skills ranging from electronics, engineering, informatics, and that needs a preliminary and cumulative process of technological capability building. Furthermore, limited appropriability of knowledge and high entry barriers render product, process and functional upgrading very difficult for local firms. It is unlikely for them to be contracted and to upgrade, unless they already have accumulated technological capabilities over the years.

Moreover, we observe that in the majority of the studies analysed, one or few large - typically foreign owned- scale-intensive firms carry out the design and manufacturing of ‘complex systems’ products. Hence, local firms that gravitate around these ‘anchor firms’ (or buyers) appear to have more properly the characteristics of specialised suppliers, whose connection to the user (i.e. buyer) is critical. However, the buyer only provides the stimulus to learn rather than the means of learning. The opportunities for interactive learning for most locally-owned firms appear to be very limited. In this sense – contrary to what expected on the basis of the Pavitt taxonomy - suppliers do not directly learn from their users but through other, often market-based, sources of learning. This is due mainly to the backward technological capabilities of local Latin American suppliers, and this creates a gap that buyers do not fill and where policies may usefully operate.

This story differs from the case of the software-specialised suppliers, where instead the Pavitt taxonomy seems to explain the learning pattern of firms. User-producer interactions are important and appropriability of knowledge is high, due to the specificities of the products developed, most often customised to the user’s requirements.

In sum, the Pavitt taxonomy applied to clusters in Latin America fits better the learning patterns of those industries where the complexity of knowledge and cumulativeness is low and where the innovative activity is not concentrated in very few firms, such as in traditional manufacturing and software. In contrast, in NR-based and COPS clusters, the gap in capabilities, both at the firm and at the institutional level, prevents local firms from pursuing effectively the patterns of learning and upgrading that the Pavitt taxonomy would suggest.

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## APPENDIX  List of case studies of clusters in Latin America

<table>
<thead>
<tr>
<th>Sectoral group</th>
<th>Sector</th>
<th>Region/Country</th>
<th>Collective Efficiency</th>
<th>Main VC</th>
<th>Product Upgr</th>
<th>Process Upgr</th>
<th>Functional Upgr</th>
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* Original field studies were carried out in these clusters by the authors and their research associates.