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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.

1. INTRODUCTION

The scope of this paper is to explore how Latin American small and medium-sized enterprises (SMEs) may participate in global markets in a way that provides for sustainable growth. This may be defined as the "high road" to competitiveness, contrasting with the "low road", typical of firms from developing countries, that often compete by squeezing wages and profit margins rather than by improving productivity, wages and profits. The key difference between the high and the low road to competitiveness is often explained by the different capabilities of firms to "*upgrade*" (Humphrey and Schmitz, 2002a, Kaplinsky and Readman, 2001, Porter, 1990). Capitalizing on one of the most productive areas of the recent literature on SMEs, we restrict our field of research to *small enterprises located in clusters*. As a matter of facts, there is now a rich empirical evidence (Humphrey, 1995; Nadvi and Schmitz, 1999; Rabellotti, 1997) showing that small firms in clusters, both in developed and developing countries, are able to overcome some of the major constraints they usually face: lack of specialized 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" (Schmitz, 1995), 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 (GVCs) (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 (Humphrey and Schmitz, 2000).

As a matter of 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 (Pietrobelli and Rabellotti, 2003). Both forms of organization offer opportunities to foster competitiveness via learning and upgrading. However, they have also remarkable drawbacks, as for example upgrading may be limited in some forms of value chains, and clusters with little developed external economies and joint actions may have no influence on competitiveness.

In addition, both strands of literature were conceived and developed to overcome the sectoral dimension in the analysis of industrial organization and dynamism. On the one hand, studies on clusters, focusing on agglomerations of firms specializing 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 (Gereffi, 1994), 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 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.

The contribution of this paper to the literature is to take into account all these dimensions at once. Thus, within this general theoretical background, this study aims to investigate the hypothesis that *enterprise upgrading is simultaneously affected by firm-specific efforts and actions, and by the environment in which firms operate*. The latter is crucially shaped by three characteristics: (i) the collective efficiency of the cluster in which SMEs operate; (ii) the pattern of governance of the value chain in which SMEs participate, and (iii) the peculiar features that characterize learning and innovation patterns in specific 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 notions underlying the 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 of upgrading 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 grow 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 and specialization of labor; 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*" (CE) 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 (EE) are of importance in explaining the competitiveness of industrial clusters, but there is also a deliberate force at work, namely *consciously pursued joint action* (JA). Such joint action can be within vertical or horizontal linkages.[4]

The combination of both 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. Both dimensions are crucial: only incidental, passive external economies may not suffice without joint actions, and the latter hardly develop in the absence of external economies. 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 approach* (Gereffi, 1999) 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 (Kaplinsky, 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 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: a) *network* implying co-operation between firms of more or less equal power which share their competencies within the chain; b) *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 and c) *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 modes to gain access to global markets. 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, emphasizing 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 favorable 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. In addition, a more dynamic approach suggests that chain governance is not given forever and may change because (Humphrey and Schmitz, 2002b): a) power relationships may evolve when existing producers, or their spin-offs, acquire new capabilities; b) establishing and maintaining quasi-hierarchical governance is costly for the lead firm and leads to inflexibility because of transaction specific investments and c) firms and clusters often do not operate only in one chain but rather simultaneously in several types of chains, therefore they may apply competencies learned in one chain to supply other chains.

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 of their dominant specialization also plays a role and affects SMEs upgrading prospects.

3. THE SECTORAL DIMENSION OF SME'S UPGRADING

3.1. The concept of upgrading

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), and is relevant to our present aims.[6]

Following this approach, upgrading is decisively related to innovation. Here 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. 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):

(i) *Process upgrading* is 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, 1999b);*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);

(iii) *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);

(iv) *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, 2004).

In sum, upgrading within a value chain implies going up on the value ladder, moving away from activities in which competition is of the "low road" type and entry barriers are low.

But why does the concept of *competitive advantage* increasingly matter? In the theory of *comparative* advantage what matters is *relative* productivity, determining different patterns of inter-industry specialization. However, *competitive advantage* is the relevant concept to analyze SMEs performance, as it is not only production efficiency that matters, but also other dimensions. This is due to several considerations, among which is the existence of forms of imperfect competition in domestic and international markets, where rents and niches of "extra-normal" profits often emerge. A complementary consideration is that different sub-sectors and stages in the value chain are likely to have different degrees of (dynamic) externalities. For example, in traditional manufacturing this applies to design, product innovation, marketing and distribution, that may all foster success in related activities. For all

these reasons, the effort to upgrade functionally (and the policies to support this process) may often be justified in order to reap larger rents and externalities emerging in specific stages of the value chain.

Dynamic considerations also essentially require the concept of competitive advantage. While comparative advantage registers *ex-post* gaps in relative productivity that determine international trade flows, success in firm-level upgrading enables the dynamic acquisition of competitiveness in new market niches and sectors.

Moreover, functional upgrading is also likely to reduce *fragility* and *vulnerability* of an enterprise's productive specialization. Competition from new entrants - i.e. firms from developing countries with lower production costs, crowding out incumbents - is stronger in the manufacturing phases of the value chain than in other more knowledge and organization-intensive phases (e.g. product design and innovation, chain management, distribution and retail, etc.). Therefore, functional upgrading may bring about more enduring and solid performance.

An additional element that crucially affects the upgrading prospects of firms and clusters is the *sectoral dimension*. Insofar as we have defined upgrading as innovating to increase value added, then all the factors influencing innovation acquire a new relevance. This dimension is often overlooked in studies on clusters, perhaps due to the fact that most of these studies are not comparative but rather detailed intra-industry case-studies.

In order to take into account such sectoral dimension, and the effect this may have on the firms pattern of innovation and learning, we need to introduce the concept of "*tacit knowledge*". This notion was first introduced by Polanyi (1967), and then discussed in the context of evolutionary economics by Nelson and Winter (1982). It refers to the evidence that some aspects of technological knowledge are well articulated, written down in manuals and papers, and taught. Others are largely tacit, mainly learned through practice and practical examples. In essence, this is knowledge which can be freely used by its owners, but that cannot be expressed and communicated to anyone else.

The tacit component of technological knowledge makes its transfer and application costly and difficult. As a result, the mastery of a technology may require that an organization be active in the earlier stages of its development, and a close and continuous interaction between the user and the producer – or transferor - of such knowledge. Inter-firm relationships are especially needed in this context. Tacit knowledge is an essential dimension to define a useful grouping of economic activities, as we do in the next section.

3.2. Sectoral specificities in upgrading and innovation: a classification for Latin American countries

The impact of collective efficiency and patterns of governance on the capacity of SMEs to upgrade may differ across sectors. This claim is based upon the consideration that sectoral groups differ in terms of technological complexity and in the modes and sources of innovation and upgrading[7]. As shown by innovation studies, in some sectors vertical relations with suppliers of inputs may be particularly important sources of product and process upgrading (as in the case of textile and most traditional manufacturing), while in other sectors, technology users, organizations such as universities or the firms themselves (as for example in the case of software or agro-industrial products) may provide major stimuli for technical change (Pavitt, 1984; von Hippel, 1987).

Consistently with this approach, the properties of firm knowledge bases across different sectors (Malerba and Orsenigo, 1993)[8] may affect the strategic relevance of collective efficiency for the processes of upgrading at the cluster level. Thus, for example, in traditional manufacturing sectors, technology has important tacit and idiosyncratic elements and therefore upgrading strongly depends on the intensity of technological externalities and cooperation among local actors (e.g. firms, research centers, technology and quality diffusion centers), in other words depends on the degree of collective efficiency. While in other groups (e.g. complex products or large natural resource-based firms) technology is more codified and the access to external sources of knowledge as TNCs, research laboratories located in developed countries becomes more critical to upgrade than collective efficiency.

Furthermore, the differences across sectoral groups raise questions on the role of global buyers in fostering (or hindering) the upgrading of different clusters; thus, for example global buyers may be more involved and interested in their providers' upgrading if the technology required is mainly tacit and requires intense interaction. Moreover, in traditional manufacturing industries, characterized by a low degree of technological complexity, firms might be included in GVCs even if they have very low technological capabilities. Therefore, tight supervision and direct support becomes a necessary condition for global buyers who rely on the competencies of their local suppliers and want to reduce the risk of non compliance (Humphrey and Schmitz , 2002b) The situation is at the opposite extreme in the case of complex products, where technology is often thoroughly codified and the technological complexity requires that firms have already internal technological capabilities to be sub-contracted, otherwise large buyers would not contract them at all.

In order to take into account the above mentioned hypotheses, we develop a sectoral classification, adapting existing taxonomies to the Latin American case[9]. On the basis of Pavitt's seminal work (1984), we consider that in Latin America in-house R&D activities are

very low both in domestic and foreign firms (Archibugi and Pietrobelli, 2003), domestic inter-sectoral linkages have been displaced by trade liberalization (Cimoli and Katz, 2002) and university-industry linkages appear to be still relatively weak (Arocena and Sutz, 2001).[10] Furthermore, in the past 10 years, Latin America has deepened its productive specialization in resource-based industries and has weakened its position in more engineering intensive industries (Katz, 2001), reflecting its rich endowment of natural resources, relatively more than of human and technical resources (Wood and Berge, 1997). Hence, we retain Pavitt's key notions and identify four main sectoral groups for Latin America on the basis of the way learning and upgrading occur, and on the related industrial organization that most frequently prevails. [11] The categories are as follows:

1. *Traditional Manufacturing*, mainly labor-intensive and "traditional" technology industries such as textile, footwear, tile and furniture;
2. *Natural Resource-based industries (NR-based)*, implying the direct exploitation of natural resources e.g. copper, marble, fruit, etc.;
3. *Complex Products' industries (COPs)*, including, among others, automobile, autoparts and aeronautic industries, ICT and consumer electronics;
4. *Specialized suppliers***,** in our LA cases, essentially software.

Each of these categories tends to have a predominant learning and innovating behavior, in terms of main sources of technical change, dependence on basic or applied research, modes of in-house innovation (e.g. 'routinised' versus large R&D labs), tacitness or codified nature of knowledge, scale and relevance of R&D activity and appropriability of innovation (Table 1).

Table 1 Patterns of Learning and Innovation in Different Sectoral Groups in LA

Groups	Industries	Learning Patterns	Description
1. Traditional Manufacturing	Textile and garments, Footwear, Furniture, Tile	Mainly Supplier dominated	• Most new techniques originate from machinery and chemical industries; • Opportunity for technological accumulation are focused on improvements and modifications in production methods and associated inputs, and on product design; • Most of technology is transferred internationally, embodied in capital goods; • Low appropriability, low barriers to entry.
2. Resource-based	Sugar, Tobacco, Wine, Fruit, Milk, Mining industry	Supplier dominated	• Importance of basic and applied research led by public research institutes due to low appropriability of knowledge; • Innovation is spurred also by suppliers (machinery, seeds, chemicals etc.); • Increasing importance of international sanitary and quality standards, and of patents; • Low appropriability of knowledge.
3. Complex Products	Automobile and auto components, Aircraft, Consumer electronics	Scale intensive firms	• Technological accumulation is generated by the design, building and operation of complex production systems or products; • In-house R&D is critical for innovation; • Process and Product technologies develop incrementally; • In consumer electronics, technological accumulation emerges mainly from corporate R&D labs and university skills; • Appropriability is medium, high barriers to entry.
4. Specialized Suppliers	Software	Specialized suppliers	• Important user-producer interactions. Learning from advanced users; • Low barriers to entry and low appropriability; • High in-house R&D for development of edge technologies.

Source: Adapted on the basis of Pavitt, 1984, Bell and Pavitt, 1993, Malerba, 2000.

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, 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 undertaken by public research institutes, possibly in connection with producers (farmers, breeders, etc.).[12] In these sectors, applied research is mainly carried out by input suppliers (i.e. chemicals, machinery etc.) that achieve economies of scale and appropriate the results of their research through patents.

Complex Products are defined as "high cost, engineering-intensive products, subsystems or constructs supplied by a unit of production" (Hobday, 1998)[13], where the local network is normally anchored to one 'assembler', which operates as a leading firm characterized by high design and technological capabilities. To our aims, the relationships of local suppliers with these 'anchors' may be crucial to foster (or hinder) SMEs upgrading through technology and skills transfers (or the lack of them). Complex products are typically led by scale-intensive firms (Bell and Pavitt, 1993), whose process of technical change is realized within an architectural set (Henderson and Clark, 1990) and it is often incremental and modular.

Among the S*pecialized Suppliers* we only consider *software*, which 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 labor. 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 are expected to affect the process of upgrading of clusters in value chains. This paper aims at analyzing with original empirical evidence whether - and how - the sectoral dimension influences this process in Latin America.

4. METHODOLOGY: COLLECTION AND ANALYSIS OF DATA

This study is based on the collection of original data from twelve 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 the support of the Inter-American Development Bank. An international team of twelve experts in Italy and in four LA countries has participated to the collection and review of the empirical data.

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.[14] According to the purposes of this present study, case studies have been selected that fulfilled the following 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.

According to this, a total of 40 case studies were selected for this analysis[15]. 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. Thus, although it cannot claim to correspond to the universe of clusters in the region, it represents a database that allows reasonable generalizations.

The analysis consists of a systematic attempt to *quantify* on Likert scales, for each of the clusters investigated, the dimensions that are object of analysis: degree of collective efficiency and levels of upgrading. Cluster studies have also been categorized according to the type of value chain they are connected to.

To quantify the degree of *collective efficiency*, careful evaluation of CE main components – external economies and joint action - has been carried out. Hence, a value ranging from absent (0) to high (3) was attributed to the following components: specialized labor market, local availability of inputs, easy access to information and market access for *external economies* and backward vertical linkages, forward vertical linkages, horizontal bilateral linkages and horizontal multilateral linkages for *joint action.*[16] The same we did with reference to product, process, functional and intersectoral *upgrading*: a value ranging from absent (0) to high (3) was attributed to each of these types of upgrading. The values have been determined during either the original field-studies, or, in the cases reviewed from existing literature, from the context and from specific wording of papers. Finally, we identified the number and *mode of governance* (market, network, quasi-hierarchy and hierarchy) of the value chains in which the clusters feed into.

Whenever the evidence was derived from the literature, we carefully analyzed the wording of each paper with the collaboration of the team of experts, and tried to minimize the occurrence of bias and misinterpretations complementing and cross-referencing information in all possible ways, also testing it with interviews to key informants and local experts.

Nevertheless, as with any study of this kind there may be potential problems on the accuracy of the results, that call for cautious interpretations.

The empirical analysis is inevitably affected by some limitations, due to the lack of reliable data: even when updated firm-level statistics are available, which seldom happens in developing countries, they are usually available at the national or local level, but they are never gathered at the cluster level or to take account of the relationships within the same value chain. Therefore, the empirical analysis has to rely on the available quantitative evidence complemented by careful qualitative assessments. Given its qualitative content, the aim of this study is not to identify causal relationships but rather to explore a rich and newly gathered empirical evidence on Latin American clustered SMEs.

The next section presents a synthesis of the main results. Fuller details and analyses of additional complementary issues are addressed in a longer study (Pietrobelli and Rabellotti, 2003).

5. SECTORAL PATTERNS OF UPGRADING: EMPIRICAL EVIDENCE

5. 1. Collective efficiency and sectors

The empirical evidence suggests that the degree of collective efficiency attained in the clusters analyzed vary across the four sectoral groups (Table 2). More specifically, it reaches higher levels in NR-based and software clusters. Instead, 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 labor 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 show 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 Torreón in Mexico (Zepeda, 2003, Bair and Gereffi, 2001), the degree of collective efficiency can be defined as low.

Table 2: Collective Efficiency across sectoral groups

Index of collective efficiency: average

	EE	JA	CE Index
Traditional	7.6	5.23	6.31
Manufacturing			
NR-based	8.91	7.36	8.2
COPs	7.61	4.8	6.19
Specialized Suppliers	9.1	7.8	8.7

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

In Chipilo, for example, the lack of collective efficiency may be explained by a combination of factors: the very recent origin of the cluster and the organizational pattern prevailing, dominated by vertical relationships between Segusino, the leading local Mexican firm, and its network of subcontractors (Zepeda, 2003). The predominance of these strong vertical relationships interferes with the development of external economies and, especially, of horizontal joint actions. Moreover, the lack of a strong industrial tradition before the inception of the cluster, that was generated by the explicit, intentional action of the leading firm, further hindered the build-up of joint actions and collective efficiency. Very similar results are also reported in the Torreón blue jeans cluster, where the only significant external economy is the creation of a specialized local labor market while joint action at horizontal level is almost inexistent, due to a generalized distrust among firms and the absence of an institutional environment conducive to cluster growth (Bair and Gereffi, 2001).

The level of CE appears especially weak also in COPs clusters, such as electronics and automotive. This probably reflects their intrinsic logic of operation and history, as in most cases they were created following the initiative of a large TNC (a leader, or an assembler), searching for local providers, often indirectly through the working of the first-tier suppliers, following the leader. In these circumstances, joint cooperative actions often prove especially difficult.

The number and variety of *joint actions* through collective institutions is surprisingly higher for specialized 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 among collective institutions engaging in basic research and extension of innovation and technology and small farmers (Gomes, 2003). In this group of sectors, the collaboration between private and public associations and organizations is especially noteworthy (Maggi, 2003, Vargas, 2001a, 2001b).

5.2. Governance and sectors

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 COPs there is a prevalence of quasi-hierarchy in GVCs led by TNCs and their first-tier suppliers while in the software clusters the relationships with clients are mainly of a market/network type (Table 3).

Table 3: Value chains: the pattern of GOVERNANCE

	Market	Network	Quasi-hierarchy	Hierarchy
Traditional Manufacturing Clusters:				
Textile:Medellin (Col.)	0	0	1	0
Itaji, Santa Catarina (Br.)	3	0	0	0
Garment: Bucaramanga (Col.)	2	0	0	0
Gamarra (Peru)	1	0	0	0
Torreon (Mex.)	0	0	2	0
Shoes: Sinos Valley (Br.)	3	0	2	0
Leon (Mex.)	1	1	2	0
Guadalajara (Mex.)	1	1	2	0
Campina Grande (Br.)	N/A.	N/A.	N/A.	N/A.
Furniture: Serra Gaucha (Br.)	1	0	0	0
Uba, Minas Gerais (Br.)	1	0	0	0
Espirito Santo (Br.)	1	1	0	0
Sao Bento do Sul (Br.)	0	1	2	1
Segusino/Chipilo (Mex.)	3	0	1	0
Tiles: Santa Catarina (Br.)	2	0	0	0
NR-based Clusters:				
Tobacco: Rio Pardo, RGS (Br)	0	0	2	0
Wine: Colchagua (Ch)	3	0	2	0
Serra Gaucha, RGS (Br)	3	0	0	0
Sugar: Valle del Cauca (Co)	3	0	0	0
Marble: ES (Br)	1	0	2	0
Copper: Cuajone-Toquepala (Pe)	2	0	2	0
Salmon: Region Austral (Ch)	0	2	2	0
Milk-dairy: Boaco,Chontales (Nic)	1	1	2	2
Mangoes and grapes : Petrolina-Juazeiro (Br)	1	0	3	0
Melons: Rio Grande Norte (Br)	1	0	3	0
Apples: Santa Catarina (Br)	1	0	3	0
COPs:				
Aeronautics: SJC aeronautics, S.Paolo, (Br)	0	0	2	0
Automotive: Nova Serrana (Br)	0	0	2	0
Caixa do Sul, RGS, (Br)	0	2	2	0
Juarez, (Delphi) (Mex)	2	0	2	0
Metalworking: Espírito Santo (Br)	0	0	1	0
Electronics: Jalisco (Mex)	0	0	2	0
Audio-visual eq.: Baja California, (Mex)	0	0	0	2
Intel ICT: San Jose, Costa Rica	2	0	0	0
H-T: Campinas, Sao Paulo (Br)	2	2	2	0

Legenda: O=absent; 1=domestic chain; 2=global chain; 3=domestic and global chains

Source: Author's database

An interesting 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 (Bazan and Navas-Aleman, 2003). 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 (2003), 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 case (Artola and Parrilli, 2003), firms in the cluster participate in three different types of productive chains: (i) the chain led by a TNC (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 the TNC 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.

5.3. Collective Efficiency, Global Buyers and Upgrading across sectoral groups

The empirical evidence presented so far suggests that different sectoral groups tend to show different CE and governance settings. In this paragraph, we explore whether it is possible to associate the level of CE and the particular form of chain governance with upgrading across different sectoral groups. In this respect, our analysis shows that upgrading is achieved in different sectors in considerably different ways.

As shown in Table 4, CE does not seem to be equally related to upgrading in all sectors. In fact, while it is positively associated with upgrading in Traditional Manufacturing, Natural Resource-Based and Software clusters, the relation is not significant in COPs. As concerns governance, the impact of global leader firms on cluster upgrading is very mixed. It tends to be positive for product and process upgrading in Traditional Manufacturing and Natural-Resource based clusters, while it has only a moderate impact on the same type of upgrading in COPs. Most interestingly, global buyers show a weak or, in some cases, negative relationship

with functional upgrading in all three sectoral groups mentioned above[17]. In the paragraphs that follow, we provide a detailed analysis of the findings for each group of sectors.

Table 4: Patterns of Learning and Upgrading Across Sectoral Groups

	Traditional manufacturing	Natural-Resource based	COPs	Software
Pattern of learning according to Pavitt taxonomy	**Supplier-driven**	**Supplier-driven, science based**	**Scale-intensive-Specialized suppliers**	**Specialized-suppliers**
Relation between collective efficiency and:				
Product upgrading	Positive	Positive	Neutral 2	Positive
Process upgrading	Neutral 1	Positive	Neutral 2	Positive
Functional upgrading	Neutral	Positive	Neutral 2	Positive
The impact of global buyers/leaders operations on:				
Product upgrading	Positive	Positive 4 (but passive)	Neutral 5 Indirectly Positive	None 3
Process upgrading	Positive	Positive 4 (but passive)	Neutral 5 Indirectly Positive	None 3
Functional upgrading	Often negative	Neutral / negative	Neutral / negative	None 3
Other critical sources of knowledge	Suppliers, local institutions, National buyers alternative to the global leaders	Suppliers, university and research labs, technology extension services, producers' associations and cooperatives	Consultants, local agencies (network-brokers)	Users, Universities and higher education institutions

Source: Authors' own database
NOTES:
(a) 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.
(b) Often little collective efficiency (CE) is detected.
(c) None refers to the case in which the global buyer is not present.
(d) Global leaders set the target and provide market outlets, but do not normally engage in supporting initiatives.
(e) 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.

5.3.1. Upgrading in Traditional Manufacturing

In the clusters belonging to the traditional manufacturing group, process and product upgrading are often present, although with a wide dispersion across cases; functional

upgrading is only incipient in a few cases, and intersectoral upgrading appears to have almost never occurred in the clusters analyzed (Table 5).

Table 5: Upgrading in Traditional Manufacturing Clusters*

	CE Degree	Product Upgrading	Process Upgrading	Functional Upgrading	Intersect. Upgrading	Sum of Upgrading
Textile: Medellin (Col.)	Medium	2	2	1	1	6
Itaji, Santa Catarina (Br.)	Medium	3	3	1	0	7
Garment: Bucaramanga (Col.)	Medium	1.5	1.5	N/A.	0	3
Gamarra (Peru)	Medium	1	1	0	0	2
Torreon (Mex.)	Low	1	3	1	0	5
Shoes: Sinos Valley (Br.)	High	3	3	1.5	0	7.5
Leon (Mex.)	High	2	2	1	0	5
Guadalajara (Mex.)	Medium	2	2	1	0	5
Campina Grande (Br.)	Medium	1.5	1.5	0	0	3
Furniture: Serra Gaucha (Br.)	Medium	2.5	2.5	0	0	5
Uba, Minas Gerais (Br.)	Low	1	1.5	0	0	2.5
Espirito Santo (Br.)	Medium	1.5	1.5	1	0	4
Sao Bento do Sul (Br.)	Medium	1	2	1	0	4
Chipilo (Mex.)	Low	2	2	1	0	5
Tiles: Santa Catarina (Br.)	Medium	3	3	1	0	7
Total		28	31.5	10.5	1	
Average		**1.86**	**2.1**	**0.7**	**0.06**	**4.44**

*3=High; 2=Medium; 1=Low; 0=absent

Source: Authors' own database

An important result is that there appears to be a *positive relationship between product upgrading and the degree of collective efficiency* in this group of industries (Table 5). This positive relation can be explained by several factors: a) circulation of information, knowledge and labor force might facilitate the upgrading process of clustered firms; b) product upgrading is also facilitated by vertical joint action with local suppliers and with buyers is crucial to improve products as components and inputs contribute to their quality and c) multilateral horizontal co-operation play an important role in product upgrading through various actions

as participation in international trade fairs, collection of information about international fashion trends, easier connection with international buyers.

The two Mexican and the Sinos Valley footwear clusters are good examples of the positive interaction between collective efficiency and product upgrading. Rabellotti (1999) shows how the efforts to improve the quality and fashion content of components undertaken by some manufacturers together with their suppliers have percolated all over the Guadalajara cluster. Moreover, she stresses the importance of a program undertaken in León, aimed at promoting the standardization of components, in product upgrading at cluster level. In the Sinos Valley, Schmitz (1995) underlines the importance of various cluster programs aimed at supporting the participation of local producers in international trade fairs and at bringing international buyers in the cluster, at an early stage of development.

On the contrary, on the basis of the available empirical evidence, it does not appear that there is a clear link between collective efficiency and process upgrading. This can be explained by a combination of factors: in traditional industries process innovations are driven by technology suppliers and in none of the clusters analyzed there is a local production of technology. Therefore, in most of Latin American clusters the virtuous and close relationship between technology producers and technology users that it is so important to explain process upgrading in Italian industrial districts is missing.

Furthermore in some of the cases analyzed, *process and product upgrading have been facilitated by international large buyers*. This result confirms Gereffi's view that producers entering a quasi-hierarchical chain have good prospects for upgrading their processes and products (1999). Along the same lines Humphrey and Schmitz (2003) agree that "local producers learn a great deal from global buyers about how to improve their production processes, attain consistency and high quality, and increase their speed of response to customer orders".

The fact that buyers often provide support for upgrading might be due to the characteristics of products, which are not standardized: in these industries information on products and processes cannot be easily codified in technical norms and the quality of products depends on the specialized skills of local producers (or alternatively, even though the processes could be codified, local firms lack the capability to decode and use such codes to transform them into idiosyncratic routines). Relying on the competencies of their local suppliers, global buyers are obliged to assist them in improving products and processes, their support being particularly crucial in the first stages of new producers' integration into global VC.

This upgrading effect is well documented in the Sinos Valley, where according to Bazan and Navas-Aleman (2003) a rapid process and product upgrading has been facilitated by the inclusion in the US VC. A similar effect was also detected in León, Mexico, where after the

1994 Peso devaluation US buyers have also begun to play a very significant role in upgrading. Again, US buyers have contributed in an important way to process and product upgrading in the blue-jeans cluster of Torreón, in Jalisco - Mexico (Bair and Gereffi, 2001). In all these cases, integration in global value chains has supported inclusion rapid enhancement of product and process capabilities.

Moving on to *functional upgrading*, it has been documented in the literature (Bazan and Navas-Aleman, 2003; Humphrey and Schmitz, 2002b, Rabellotti, 2001) that although inclusion into GVCs facilitates product and process upgrading, on the other hand, firms become tied into relationships that often prevent functional upgrading and leave them dependent on a small number of powerful customers. In the Sinos Valley, local suppliers were discouraged from functional upgrading by their main US buyers, who did not want to share their core competencies in design, marketing and sale with them:

> "Activities that are highly valuable are design, marketing, branding, and chain coordination, exactly the ones performed by most foreign buyers. […] since the acquisition of capabilities to engage in the higher value added activities requires great investments, Brazilians have been feeding into the footwear value chain mostly as producers and their buyers have been more than happy to keep the status quo for as long as is possible." (Bazan, Navas-Aleman, 2003).

If functional upgrading is prevented by buyers' power in quasi-hierarchical chains, it can take place more easily in market-based value chains. In these chains producers experience neither support for, nor blockages to upgrading (Humphrey and Schmitz, 2003). In the Sinos Valley, functional upgrading in design, branding, marketing has been achieved by those firms selling to buyers in the domestic and regional markets in Latin America. Bazan and Navas-Aleman (2003) explain that in those markets buyers are smaller and buy ready-designed shoes, often sold with the producers' brand. A similar process of functional upgrading can also be detected among the Mexican footwear producers selling in the domestic market and in some cases also in the rest of Latin America (Rabellotti, 1999). In the textile sector, the Brazilian cluster of the Valle de Itaji in the state of Santa Catarina has experienced a similar process of functional upgrading (Campos et al., 2000).

Finally, in Table 5 we may observe a positive (albeit weak) relation between functional upgrading and collective efficiency. Complementing this information with the available qualitative evidence we can conclude that there are several factors confirming the positive role of collective efficiency to support the process of functional upgrading: a) among external economies, the circulation of information and skilled labor force and b) among joint actions, various initiatives such as participation in international trade fairs, collection of information about fashion trends, training programs for designers, and collective promotion of local brands.

To conclude, in order to functionally upgrade firms need to invest in design, branding and marketing, and given that the funds involved are often large, SMEs may take advantage of the collective initiatives undergoing in a cluster to improve access to information, know-how and knowledge about markets. In other words, the degree of collective efficiency may positively affect the SMEs' chances to functionally upgrade.

5.3.2. Upgrading in Natural –resource-based industries

In *NR-based clusters,* process and product upgrading are strongly tied to the advancement of science and technology in connected industries: i.e. plants and seeds, machinery and tools, chemicals and pharmaceuticals. New methods, inputs and machinery are in fact introduced by the interactive relations between suppliers and research labs, 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 centers and universities play an important role in the process of upgrading (Pray, Umali-Deininger, 1998).

In fact, SMEs have successfully upgraded in clusters characterized by public-private initiatives aimed at supply of research and technology extension services, as in the mango and grape cluster of Petrolina Juazeiro in Brazil, where the local San Francisco River Valley Development Agency (CODEVASF) promoted a sequence of crops that facilitated the learning process of small growers.[18] Similarly, in the wine cluster of Serra Gaucha (Vargas, 2001a), the National Center 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 centers of the 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).

Hence, the presence of mainly public-private horizontal joint action is positively related with product and process upgrading, achieved through several channels including the local institutional network, the public support to local joint actions, research centers, Universities, international co-operation. Informing cases in this respect are the salmon cluster in Chile (Maggi, 2003), the mangoes' cluster in Petrolina Juazeiro and the apple cluster in Santa Catarina, in Brazil (Gomes, 2003). These results suggest that there is a positive relation between CE and product and process upgrading, but functional upgrading is very rare (Table 6).

Table 6: Upgrading in NR-based Clusters *

	Location	Degree of CE	Product Upgrading	Process Upgrading	Functional Upgrading	Intersect. Upgrading	Sum of Upgrading
Tobacco	Rio Pardo, RGS (Br)	Medium	3	3	0	0	**6**
Wine	Colchagua (Ch)	Medium	3	3	0	0	**6**
Wine	Serra Gaucha, RGS (Br)	Medium	3	3	0	0	**6**
Sugar	Valle del Cauca (Co)	High	3	3	2	1	**9**
Marble	ES (Br)	Medium	2	2	0	0	**4**
Copper	Cuajone-Toquepala (Pe)	Low	2	2	0	1	**5**
Salmon	Region Austral (Ch)	High	3	3	2	2	**10**
Milk–dairy	Boaco,Chontales (Nic)	Medium	2	2	2	0	**6**
Mangoes, grapes	Petrolina-Juazeiro (Br)	High	3	3	0	0	**6**
Melons	Rio Grande Norte (Br)	Medium	2	1	0	0	**3**
Apples	Santa Catarina (Br)	High	3	3	0	0	**6**
Total			29	28	6	4	
Average			**2,64**	**2,55**	**0,55**	**0,36**	**6,09**

*3=High; 2=Medium; 1=Low; 0=absent

Source: Authors' own database

In Natural Resource-Based clusters operating within buyer-driven chains, foreign buyers facilitate the link with the international market by signaling the need and the modes of the necessary upgrading. Nevertheless, given that the requirements of the international market are often codified by standards (e.g. HACCP), imposing them on to producers bears little transactions costs: buyers relay information on the standards that need to be met, but do not normally support the SMEs' upgrading process, and select SMEs complying with these standards. An example is that of the fresh fruit cluster in Petrolina-Juazeiro reported below:

> "….the greater power of importers and buyers in these chains has meant mounting pressures for growers to make the necessary changes in their products and production processes to meet the demands of these buyers. That is, growers are under greater pressures to upgrade because they now have fewer buyers and these buyers are more demanding than ever" (Gomes, 2002: 15). And: "…the intermediaries in these chains relay market information on to their suppliers, but are less likely to engage in the actual process of upgrading". Finally, "…in

many cases participation in value-chains means growers face greater demands that are passed down to them from their importers, but these demands are not accompanied by lessons on how to upgrade" (Gomes, 2003: 17).

In the Nicaragua's milk and dairy cluster upgrading dynamics has taken very different forms. The hierarchical value chain lead by a TNC has fostered upgrading of products and processes, but hindered functional upgrading (Artola and Parrilli, 2003). However, the VC led by the semi-industrial cooperatives has also enhanced functional upgrading, together with improvements in products and processes. The 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 creating the conditions for firms to functionally upgrade over time (Pietrobelli and Rabellotti, 2003). However, global buyers are not necessarily the optimal solution for upgrading, and national chains also offer alternative, promising and often more sustainable opportunities.

5.3.3. Upgrading Complex Products

In Complex Products (COPs), The pattern of upgrading is especially interesting. Process (and to a lower extent product) upgrading are remarkable, but functional upgrading was only achieved in a few cases (Table 7).

Table 7: Upgrading in COPs Clusters: *

Main product	Location	CE Degree	Product Upgrading	Process Upgrading	Functional Upgrading	Intersect. Upgrad.	Sum of Upgrad.
Aeronautics	SJC, Sao Paolo, (Br)	MEDIUM	2	2	2	0	6
Automotive	Nova Serrana (Br)	MEDIUM	3	3	1	0	7
Automotive	Caixa do Sul, RGS, (Br)	MEDIUM	1,5	2,5	0	0	4
Automotive	Juarez, (Delphi) (Mex)	MEDIUM	3	3	2	0	8
Metalworking	Espírito Santo (Br)	MEDIUM	2	3	0	0	5
Electronics	Jalisco (Mex)	LOW	2,5	2,5	0	0	5
Audio-visual eq	Baja California, (Mex)	LOW	2,5	2,5	1,5	0	6,5
Intel ICT	San Jose, Costa Rica	LOW	3	3	1	0	7
high tech	Campinas, S.Paulo (Br)	MEDIUM	2,5	2,5	1	0	6
	Total		22	24	8,5	0	54,5
	Average		**2,44**	**2,67**	**0,94**	**0,0**	**6,06**

*3=High; 2=Medium; 1=Low; 0=absent

Source: Authors' own database

One case of functional upgrading, is that of the Delphi automotive cluster in Juarez, Mexico, that has experienced functional upgrading at local level, due to the development of the design and engineering center of Delphi. Local 2nd and 3rd tier suppliers have started producing higher value added products and services, mainly in electronics and informatics (Dutrénit et al., 2002). A similar example is the SJC cluster in Sao Paulo, Brazil (Bernardes and Pinho, 2002, Carrillo and Hualde, 1996).

In all other cases, instead, the predominant pattern seems to be only product and process upgrading, with a very limited support role of the leader firms. In Nova Serrana (Brazil) there is no new design development locally by the local subsidiaries. What is done locally is rather the adaptation of such design to local conditions (‘*tropicalizaçao’*) (Lemos et al., 2000, Santos et al., 2002). In the case of the TV industry in Baja California (Mexico), upgrading regards predominantly foreign 1st tier suppliers (Gerber and Carrillo, 2002). In Costa Rica (Intel), there has been a very limited upgrading of locally-owned firms into more value added activities: “With the reorganization of the plant after 1999, the process attracts some other suppliers and promotes local interaction with the software industry…. major services are in low-tech low-value added activities, except for some recent software contracts” (Vargas and Lindegaard, 2002:9-10).

Similarly, in the automotive cluster of GM and Volkswagen in Sao Paulo (Brazil), Quadros (2002) reports that local suppliers improved the qualitative standards of production and achieved certification (ISO 9000) but leading firms in the Brazilian automotive chain have dispensed little effort to assist suppliers in the adoption of quality standards. Instead, firms received technical support mainly from consultancies and accredited certification institutions. Similar evidence is also observed in other cases (e.g. Albornoz et al. 2002; Dutrenit et al., 2002).

Some evidence also points out that interactions between leader firms and local suppliers have been developed fostering product and process upgrading (e.g. Santos et al., 2002; Bernardes and Pinho, 2002). Nevertheless, according to our evidence, this effect is limited to few cases, since market liberalization has produced a displacement of most local 1st tier suppliers in favor of global outsourcing strategies by multinational assemblers.

This suggests further that 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. In other words, most evidence suggests that *upgrading is left to the market*, that is to the private individual initiatives of small firms.

An interesting result of this study is that *collective efficiency* does not appear to be related to upgrading in any way in most of these COPs clusters. In his study of industrial policies in the plastics and auto sectors in the Regional Chamber of ABC, Sao Paulo, Quadros (2002)

concludes that technical collaboration from customers to achieve certification is limited and rarely systematic, and that assistance has rather come from private consultants. Certification has not improved collaboration within the value chain, as the design of light components is entirely carried out by customers that provide the suppliers with detailed designs. The lack of local co-ordination is portrayed as:

> "… 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 behavior 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)

5.3.4. Upgrading in software clusters

In the case of *Specialized Suppliers*, our empirical analysis focuses on *software* clusters in Brazil and Mexico. In all the software clusters studied, product and process upgrading is generally high. Regarding *product upgrading*, Ruiz-Duran (2003) presents five different types of products characterized by increasing value added: data processing, outsourcing (offshore and near shore), '*ad hoc*' software development, development of software packages, development of registered packages. Some of the oldest enterprises in the Mexican clusters analyzed began their activity supplying data processing services and most of them have now upgraded to '*ad hoc*' software packages, and often adapt existing packages to the specific needs of their customers. In these cases, most of the product upgrading consists of incremental improvements, which are favored by the existence of network relationships with users.

Another form of product upgrading, also increasingly common in Blumenau (Brazil), is the supply of full systems instead of specific systems for book-keeping, human resource management, etc. With SMEs beginning to adopt ERP solutions, the market for full and integrated systems has expanded, opening the opportunity to be competitive in these systems to small software firms (Bercovich and Swanke, 2003). Finally, in all the clusters analyzed there are a few firms which have been able to evolve from producing '*ad hoc*' solutions to develop standardized systems, implemented and sold to a large number of customers. A case in point is a small enterprise located in Aguascalientes that has developed software for

ophthalmologists, translating into Spanish and adapting other existing packages to Mexican doctors' necessities. The software is now exported to other Latin American countries.

According to the empirical evidence available, in all these clusters the degree of collective efficiency is positively related with product upgrading. Most of the entrepreneurs interviewed in Mexico and Brazil consider the exchange of information and the circulation of skilled people inside the clusters very important determinants of their product upgrading strategies. Besides, the various collective initiatives, undertaken in most of these clusters, also contribute to enhancing firms' knowledge, access to information and skilled resources.

With regard to *process upgrading*, in the Mexican clusters it is very strongly related with the process of obtaining the Capability Maturity Model (CMM) certification. This is aimed at improving the process of software development. This certification is a very time consuming and expensive process for SMEs and the various existing collective initiatives would likely play a crucial supporting role. Besides, the linkages between software enterprises and local universities are also very important in supporting process upgrading.

Finally, *functional upgrading* appears to be more common in this sector than in others. In all these clusters, there are examples of firms making efforts to improve their marketing activity within collective initiatives. Examples are the joint participation to trade fairs in Blumenau and the creation of a cluster catalogue in Aguascalientes, with some joint marketing initiatives by the local business association.

5. CONCLUDING REMARKS: CLUSTERS, VALUE CHAINS AND SECTOR-SPECIFIC 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 novel 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 chains. These differ, and have different implications for process, product and functional upgrading, in different groups of sectors according to the main features of their technological patterns. Thus, the degree of cumulativeness of knowledge, together with the degree of appropriability and complexity of the knowledge base may influence the capacity of firms to upgrade.

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 sum, upgrading – and not only production efficiency - is a relevant concept that differs by groups of sectors. As a consequence, the opportunities offered by clustering and participating in value chains are different depending on the specific features of each sector. Hopefully, further empirical research following this integrated approach will be undertaken, improving the quality of the information available to future analyses and policy design and implementation.

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Appendix
List of case studies

Case Study	Country	Source
Traditional Manufacturing clusters:		
Footwear, Sinos Valley	Brazil	Bazan and Navas-Aleman (2003), Vargas (2000), Schmitz (1999b and 1995)
Footwear, Guadalajara	Mexico	Rabellotti (1997 and 1999)
Footwear, Leon	Mexico	Rabellotti (1997 and 1999)
Footwear, Campina Grande	Brazil	Lemos and Palhano (2000)
Textile, Jalisco	Mexico	Bair and Gereffi (2001)
Textile, Medellin	Colombia	Pietrobelli and Olarte (2002)
Garment, Bucaramanga	Colombia	Pietrobelli and Olarte (2002)
Textile, Itaji	Brazil	Campos et al., 2000,
Garment, Gamarra	Peru	Visser, 1999
Forniture, Serra Gaucha	Brazil	Vargas and Alevi (2000), Meyer-Stamer (1998a),
Forniture, Espirito Santo	Brazil	Villaschi and Bueno (2000)
Forniture, Ubà	Brazil	Crocco and Horacio (2001),
Forniture, Segusino-Chipilo	**Mexico**	**Original field study (Zepeda, 2003)**
Tile, Santa Catarina	Brazil	Meyer-Stamer, Maggi, Siebel (2001), Meyer-Stamer (1998a, 1998b), Campos et al. (1998)
Natural Resource-based clusters:		
Tobacco, Rio Pardo	Brazil	Vargas (2001a and 2001b)
Wine, Colchagua	Chile	Giuliani (2002 and 2003)
Wine, Serra Gaucha	Brazil	Vargas (2001a)
Sugar, Valle del Cauca	Colombia	Millan (2002)
Marble, Espirito Santo	Brazil	Villaschi and Sabadini (2000)
Copper, Cuajone-Toquepala	Peru	Torres-Zorrilla (2000 and 2001)
Salmon, Region Austral	**Chile**	**Original field study (Maggi, 2003)**
Milk, Boaco,Chontales	**Nicaragua**	**Original field study (Artola and Parrilli, 2003)**
Mangoes & grapes, Petrolina -Juazeiro	**Brazil**	**Original field study (Gomes, 2003)**
Melons, Rio Grande do Norte	**Brazil**	**Original field study (Gomes ,2003)**
Apples, Santa Catarina	**Brazil**	**Original field study (Gomes, 2003)**
Complex Products' industries		
Aeronautics, SJC, Sao Paolo	Brazil	Bernardes and Pinho (2002), Marques (200_)
Automotive, Nova Serrana	Brazil	Lemos et al., (2000), Santos, Crocco and Lemos (2002)
Metalworking, Espirito Santo	**Brazil**	**Original field study Cassiolato, Villaschi, Lastres (2003)** and Villaschi, Limas dos Santos, (2000)
Automotive, Caixa do Sul, RGS	Brazil	Calandro and Campos (2002)
Automotive, Juarez	Mexico	Dudrenit, Vera-Cruz and Gil (2002), Carrillo and Hualde (1996)
Audio-visual equip., Baja California	Mexico	Gerber and Carrillo (2002), Alonso, Carrello,Contreras (2000), Buitelaar, Padilla , Urrutia (1999), Carrello, Mortimore, Estrada (1998)

High tech, Campina-Sao Paolo	Brazil	Garcia and Rosolino (2002); De Souza and Garcia (1998)
Intel ICT, San Jose	Costa Rica	Vargas and Lindegaard (2002); Bortagaray and Tiffin (2000)
Electronics, Jalisco	Mexico	Dussel (1999)
Specialised suppliers (Software)		
Software, Joinville	Brazil	Bercovich and Swanke (2003)
Software, D.F.	**Mexico**	**Original field study (Ruiz-Duran 2003)**
Software, Guadalajara	**Mexico**	**Original field study (Ruiz-Duran 2003)**
Software, Aguascaliente	**Mexico**	**Original field study (Ruiz-Duran 2003)**
Software, Monterrey	**Mexico**	**Original field study (Ruiz-Duran 2003)**

Note: Clusters in bold characters were analyzed for this specific study.

[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 Albaladejo (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, and Guerrieri and Pietrobelli, 2004, further develop this approach and apply it to clusters in Italy and Taiwan.

[6] 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 present 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).

[7] 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 (on this see also Dosi 1982; 1988). More recently, other authors have attempted to differentiate technological regimes on the basis of the combination of concepts like *technological opportunity*,

appropriability of knowledge, *cumulativeness of learning* and *nature of the knowledge base* (Malerba and Orsenigo, 1993, 1996; Breschi, Malerba and Orsenigo, 2000).

[8] The properties of knowledge base are tied to the nature of knowledge and its degrees of specificity, tacitness, complexity and independence (see Breschi, Malerba and Orsenigo, 2000).

[9] Starting from seminal contribution of Kieth Pavitt (1984), different attempts have been done to identify and understand patterns of innovation (Marsili, Verspagen, 2001) and a number of different studies have adopted and refined the taxonomy to analyze the Latin American context (e.g. Guerrieri, 1994, ECLAC, 1996, Ferraz et al., 1996).

[10] 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.

[11] 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.

[12] On this, see Pray, Umali-Deininger, (1998), Echevarria, Trigo, and Byerlee (1996).

[13] In this study, the definition of COPs does not coincide entirely to that given by Hobday for *Complex Products Systems* (1998). He distinguishes COPs from mass-market, commodity type industries. The former – which includes telecommunications exchanges, flight simulators, aircraft engines, cellular phone network equipment, etc.- would be characterized by high component customization, by a hierarchical architecture and by small batch production. The latter - which includes cars, semiconductors and consumer electronics- is instead characterized by a higher degree of interface and components standardization (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.

[14] For details, see Pietrobelli and Rabellotti, 2003.

[15] For a list of all case studies see the Appendix.

[16] The indexes of external economies and joint action are computed by summing up the figures obtained in each component. Then, the index of collective efficiency is the simple average of the two.

[17] Specialized suppliers are not mentioned since none of the cases analyzed form part of a quasi-hierarchical value chain.

[18] 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).