www.elsevier.com/locate/worlddev

World Development Vol. 33, No. 4, pp. 549 573, 2005

Printed in Great Britain
0305 750X/$ see front matter

doi:10.1016/j.worlddev.2005.01.002

Upgrading in Global Value Chains: Lessons from Latin American Clusters

ELISA GIULIANI
University of Sussex, UK

CARLO PIETROBELLI
University of Rome III, Italy

and

ROBERTA RABELLOTTI *
University of Piemonte Orientale, Italy

Summary. It has been shown that clustering helps local enterprises in industrial districts over come growth constraints and compete in distant markets in advanced and less developed countries. 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 levels. In this study, we contribute to this debate focusing on the analysis of the relationships existing between cluster ing, 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 inte grated in global value chains.

Key words Latin America, small enterprise, industrial policy, clusters, global value chain, in novation

* This paper draws on the empirical findings of a project on "Clusters, Value Chains, and Competitiveness," carried out for AGORA'2000, Italy, on behalf of the Micro and SME Division, Department of Sustainable Development (SDS/MSM) of the Inter American Devel opment Bank (IDB), and directed by Pietrobelli and Rabellotti. The paper reflects the opinions of the au thors who bear full responsibility for errors and omis sions. The authors wish to thank Manuel Albaladejo, Pablo Angelelli, Alessandro Bolondi, Claudio Cortellese, Juan José Llisterri, Carlos Guaipatin, Chris Freeman, Sanjaya Lall, Carlo Manfredi, Jorg Meyer Stamer, Rajah Rasiah, Fréderic Richard, Andrés Rodríguez Clare, Giovanni Stumpo, and four anonymous referees, who provided comments and support at various stages of the study. We are also grateful to Alessia Amighini, Ner Artola, Jose Cassiolato, Domenico Cersosimo, Raquel Gomes, Helena Lastres, Claudio Maggi, Davide Parrilli, Clemente Ruiz Duran, Gianfranco Viesti, Arl indo Villaschi, and Eduardo Zepeda, who were part of the international team of research. Drafts of the paper were presented at Conferences at the Universities of Modena, Novara, and Bocconi in Italy, the Univer sidade Federal de Espirito Santo, in Victoria, Brazil, and the Universidad Nacional de General Sarmiento in Buenos Aires; at the IDB in Washington, DC, and Buenos Aires; at IBERPYME in Guadalajara; at an ECLAC UAM workshop in the DF, Mexico; and at DTI in Pretoria, South Africa. Financing from the IDB and the Italian Ministry of Economy is gratefully ack nowledged. Andrew Martin Garvey patiently revised our paper. Final revision accepted: September 30, 2004.

1. INTRODUCTION

The aim of this paper is to explore how small- and medium-sized Latin American 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, which 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*." In this paper, upgrading refers to the capacity of a firm to innovate to increase the value added of its products and processes (Humphrey & Schmitz, 2002a; Kaplinsky & 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*. There is now a wealth of empirical evidence (Humphrey, 1995; Nadvi & 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, and external services.

Nevertheless, the literature on clusters, mainly focused on the *local* sources of competitiveness coming from intracluster 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 & 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 has an important effect on the scope of local firms' upgrading (Humphrey & Schmitz, 2000).

Indeed, extensive evidence on Latin America reveals that both the local and the global dimensions matter, and firms often participate in clusters as well as in value chains (Pietrobelli & Rabellotti, 2004). Both forms of organization offer opportunities to foster competitiveness via learning and upgrading. However, they also have remarkable drawbacks, as, for instance, 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.

Moreover, 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 *filiére*, moved beyond the traditional units of analysis of industrial economics: the firm and the sector. On the other hand, according to the value chain literature, firms from different sectors may all participate in the same value chain (Gereffi, 1994). Nevertheless, 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, especially as the industrial sector plays a role and affects the upgrading prospects of SMEs.

The contribution this paper makes is by taking into account all of these dimensions together. 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 Section 2, 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 present economic 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 for 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 industrial districts in the developed world, particularly in Italy, has stimulated new attention to the potential offered by this form of industrial organization for firms of developing countries. 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 has since been reported. [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 which identify the Marshall type of district, as firstly defined by Becattini (1987). [3] Nonetheless, clustering may 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, and 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* [4] was first introduced by 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: *consciously pursued joint action* (JA). Such joint action can be within vertical or horizontal linkages. [5]

The combination of both incidental external economies and the effects of active cooperation 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 intracluster 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. [6] Gereffi's *global value chain approach* (Gereffi, 1999) helps us 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, 2001; 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 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.

Value chain research focuses on the nature of the relationships among the various actors involved in the chain, and on their implications for development (Humphrey & 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 coordination is required in order to take decisions not only on "what" should be, or "how" something should be, produced but sometimes also "when," "how much," and even "at what price." Coordination may occur through arm's-length market relations or nonmarket relationships. In the latter case, following Humphrey and Schmitz (2000), we distinguish three possible types of governance: (a) *network* implying cooperation 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 the rules to which the rest of the actors have to comply; and (c) *hierarchy* when a firm is owned by an external firm.

Also stressed is the role played by GVC leaders, particularly by the buyers, in transferring knowledge along the chains. For small firms in less developed countries (LDCs), participation in value chains is a way to obtain information on the need and mode to gain access to global markets. Yet, although this information

has high value for local SMEs, the role played by the leaders of 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 (2004) 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 & Schmitz, 2002b): (a) power relationships may evolve when existing producers, or their spinoffs, 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 simultaneously in several types of chains, and they may apply competencies learned in one chain to supply other chains.

In sum, both modes of organizing production, that is, 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 local SMEs' innovation and upgrading, we need to understand their organization of interfirm linkages and their internal governance. Furthermore, as we explain in the following section, the nature of their dominant specialization also plays a role and affects SMEs' upgrading prospects.

3. THE SECTORAL DIMENSION OF SMEs' UPGRADING

(a) *The concept of upgrading*

The concept of *upgrading making better products, making them more efficiently, or moving into more skilled activities* has often been used in studies on competitiveness (Kaplinsky, 2001; Porter, 1990), and is relevant here.

Following this approach, upgrading is decisively related to innovation. Here we define *upgrading as innovating to increase value added*. [7] Enterprises achieve this in various ways, such as, for example, by entering higher unit value market niches or new sectors, or by undertaking new productive (or service) functions. The concept of upgrading may be effectively described for enterprises working within a value chain, where four types of upgrading are singled out (Humphrey & Schmitz, 2000):

Process upgrading is transforming inputs into outputs more efficiently by reorganizing 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).

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 & Gereffi, 2001).

Intersectoral upgrading is applying the competence acquired in a particular function to move into a new sector. For instance, in Taiwan, competence in producing TVs was used to make monitors and then to move into the computer sector (Guerrieri & Pietrobelli, 2004; Humphrey & Schmitz, 2002b). 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.

Our focus on upgrading requires moving a step forward and away from Ricardo's static concept of "Comparative Advantage" (CA). While CA registers *ex-post* gaps in relative productivity which determine international trade flows, success in firm-level upgrading enables the dynamic acquisition of competitiveness in new market niches, sectors or phases of the productive chain (Lall, 2001; Pietrobelli, 1997). In sum, the logic goes from innovation, to upgrading, to the acquisition of firm-level *competitiveness* (i.e., *competitive advantage*). [8]

In this paper, we argue that the concept of *competitive advantage* increasingly matters. In the theory of *comparative* advantage, what matters is *relative* productivity, determining different patterns of interindustry specialization. Within such a theoretical approach, with perfectly competitive markets, firms need to target only production efficiency. In fact, this is not enough, and *competitive advantage* is the relevant concept to analyze SMEs' performance because of (i) the existence of forms of imperfect competition in domestic and international markets and (ii) the presence of different degrees of (dynamic) externalities in different subsectors and stages of the value chain.

More specifically, in nonperfectly competitive market rents and niches of "extra-normal" profits often emerge, and this explains the efforts to enter selectively specific segments rather than simply focusing on efficiency improvements, regardless of the prevailing productive specialization (as advocated by the theory of CA). Moreover, different stages in the value chain offer different scope for dynamic externalities. Thus, for example, in traditional manufacturing, the stages of design, product innovation, marketing, and distribution may all foster competitiveness increases in related activities and sectors. The advantage of functional upgrading is in reducing the *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 competitiveness.

For all these reasons, the concept of production efficiency is encompassed within the broader concept of competitiveness, and the efforts to upgrade functionally and intersectorally (and the policies to support these processes) are justified to reap larger rents and externalities emerging in specific stages of the value chain, market niches, or sectors.

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 intraindustry case studies.

In order to take into account such a 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 easily 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 an organization to be active in the earlier stages of its development, and a close and continuous interaction between the user and the producer or transfer of such knowledge. Interfirm relationships are especially needed in this context. Tacit knowledge is an essential dimension to define a useful grouping of economic activities.

(b) *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. [9] 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 textiles and the most traditional manufacturing), while in other sectors, technology users, organizations such as universities or the firms themselves (as, for example, with software or agroindustrial 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 & Orsenigo, 1993) [10] may

affect the strategic relevance of collective efficiency for the processes of upgrading in clusters. 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, and technology and quality diffusion centers), in other words, upgrading *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 such as transnational corporations (TNCs), or research laboratories located in developed countries become more critical for upgrading.

Furthermore, the differences across sectoral groups raise questions on the role of global buyers in fostering (or hindering) the upgrading in 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 are likely to be included in GVCs even if they have very low technological capabilities. Therefore, tight supervision and direct support become necessary conditions for global buyers who rely on the competencies of their local suppliers and want to reduce the risk of noncompliance (Humphrey & 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 subcontracted, 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. [11] 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 & Pietrobelli, 2003), domestic intersectoral linkages have been displaced by trade liberalization (Cimoli & Katz, 2002), and university industry linkages appear to be still relatively weak (Arocena & Sutz, 2001). [12] Furthermore, in the past 10 years, Latin America has deepened its productive specialization in resource-based sectors and has weakened its position in more engineering intensive industries (Katz, 2001), reflecting its rich endowment of natural resources, relatively more than human and technical resources (Wood & 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. [13] The categories are as follows:

1. *Traditional manufacturing*, mainly labor-intensive and "traditional" technology industries such as textiles, footwear, tiles, and furniture;
2. *Natural resource-based sectors (NR-based)*, implying the direct exploitation of natural resources, for example, copper, marble, fruit, etc.;
3. *Complex products industries (COPs)*, including, among others, automobiles, autocomponents and aircraft 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., "routinized" versus large R&D laboratories), tacitness or codified nature of knowledge, scale and relevance of R&D activity, and appropriability of innovation (Table 1).

Traditional manufacturing and *resource-based* sectors 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).

Natural resource-based sectors 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.). [14] In these

Table 1. *Patterns of learning and innovation in different sectoral groups in LA*

Groups	Industries	Learning patterns	Description
1. Traditional manufacturing	Textiles and apparel, footwear, furniture, tiles	Mainly supplier driven	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 technology is transferred internationally, embodied in capital goods Low appropriability, low entry barriers
2. Natural resource based	Sugar, tobacco, wine, fruit, milk, mining industry	Supplier driven, science based	Importance of basic and applied research led by public research institutes due to low appropriability of knowledge Innovation is also spurred by suppliers (machinery, seeds, chemicals, etc.) Increasing importance of international sanitary and quality standards, and of patents Low appropriability of knowledge, but high for input suppliers
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 accumu lation emerges mainly from corporate R&D laboratories and university skills Appropriability is medium, high entry barriers
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 from Pavitt (1984), Bell and Pavitt (1993), and Malerba (2000).

sectors, applied research is mainly carried out by input suppliers (i.e., chemicals, machinery, etc.) which 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), [15] 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) firms' upgrading through technology and skill transfers (or the lack of them). Scale-intensive firms typically lead complex product sectors (Bell & Pavitt, 1993), where the process of technical change is realized within an architectural set (Henderson & Clark, 1990), and it is often incremental and modular.

Among the *Specialized 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 the high information intensity of the sector, which 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 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 globalization coexist in this sector.

The different learning patterns across these four groups of activities are expected to affect the process of upgrading of clusters in value chains. This paper also 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 12 clusters in Latin America that have not hitherto been investigated, and on an extensive review of cluster studies available. The empirical analysis was carried out from September 2002 to June 2003 with the support of the InterAmerican Development Bank. An international team of 12 experts in Italy and in four LA countries collected and reviewed the empirical data.

Desk and field studies were undertaken following the same methodology, which involved field interviews with local firms, institutions, and observers, interviews with foreign buyers and TNCs involved in the local cluster, and secondary sources such as publications and reports. [16] Case studies were selected which fulfilled the following conditions: (1) *agglomeration*: all cases show some degree of geographical SME clustering; [17] (2) *upgrading*: the clusters selected have experienced some degree of upgrading, of whatever nature (i.e., product, process, functional, intersectoral); and (3) *policy lessons*: all cases offer relevant policy lessons for future experiences either in terms of successes or failures.

A total of 40 case studies were selected for this analysis. [18] The list of cases, albeit incomplete, is to our knowledge the largest available 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 to be analyzed: the degree of collective efficiency and levels of upgrading. Cluster studies have also been categorized according to the governance pattern of the value chain to which they are connected.

To quantify the degree of *collective efficiency*, a 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*; backward and forward vertical linkages, horizontal bilateral and multilateral linkages for *joint action*. [19] The same was done 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 were determined during either the original field studies, or, in the cases reviewed from the context and from the specific wording of papers. Finally, we identified the number and *mode of governance* (market, network, quasi-hierarchy, and hierarchy) of the value chains into which the clusters feed.

Whenever the evidence was derived from other published sources, 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 crossreferencing information in all possible ways, and testing it with interviews with key informants and local experts. Nevertheless, as with any study of this kind, there may be potential problems on the accuracy of the results, which will therefore 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 nor do they take into account 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 the hypotheses presented above with rich, 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, where summarized descriptions of the case studies undertaken in the project are included (Pietrobelli & Rabellotti, 2004).

5. SECTORAL PATTERNS OF UPGRADING: EMPIRICAL EVIDENCE

(a) *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, being a byproduct 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 very few clusters, among them Chipilo and Torreón in Mexico (Bair & Gereffi, 2001; Zepeda, 2003), the degree of collective efficiency can be defined as low.

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 buildup 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 the horizontal level is almost inexistent, due to a generalized distrust among firms and the absence of an institutional environment conducive to cluster growth (Bair & Gereffi, 2001).

The level of CE appears especially weak also in COPs clusters, such as the electronics and automotive industries. 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 such 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. Intense *joint action* is explained by diffused specific policies at the local level, high human capital intensity, strong personal relationships linking small entrepreneurs, sometimes developed in Universities, and deep 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).

Table 2. *Collective efficiency across sectoral groups index of collective efficiency: average*

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

Source: Authors' database.
EE = external economies (average).
JA = joint actions (average).
Collective Efficiency Index = 0.5 * EE + 0.5 * JA.

(b) *Governance and sectors*

In light of other works on global value chains, one would expect the quasi-hierarchy to be 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 coexist in the same cluster, with firms participating in local as well as in global value chains. The coexistence of different chains has especially been found in traditional manufacturing and natural resource-based sectors. Instead, in COPs, there is a prevalence of quasi-hierarchy in GVCs led by TNCs and their first-tier suppliers whereas in the software clusters, the relationships with clients are mainly of a market/network type (Table 3).

An interesting example of a cluster operating simultaneously in different types of chains is the Sinos Valley footwear cluster where, besides the chain dominated by US and European buyers, there are other minor chains oriented to the Brazilian and the Latin American markets (Bazan & Navas-Aleman, 2004). 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, and 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 (2004), 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 also in a few cases in network chains. While in the quasi-hierarchical chains, US buyers control design and product development, in network-governed value chains there is cooperation among 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 cooperation between domestic buyers and producers (Rabellotti, 1999).

In the Nicaraguan dairy case (Artola & 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.

(c) *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 relationship is not significant in COPs. As far as governance is concerned, 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. [20] In the paragraphs that follow, we provide a detailed analysis of the findings for each group of sectors.

Table 3. *Value chains: the pattern of GOVERNANCE*

	Market	Network	Quasi hierarchy	Hierarchy
Traditional manufacturing clusters				
Textiles:				
Medellin (Col.)	0	0	1	0
Itaji, Santa Catarina (Br.)	3	0	0	0
Apparel:				
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				
Aircraft: 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 equip.: 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
Specialized suppliers (software)				
Software:				
Joinville (Br.)	1	1	0	0
D.F. (Mex.)	1	1	0	0
Guadalajara (Mex.)	1	1	0	0
Aguascaliente (Mex.)	1	0	0	0
Monterrey (Mex.)	1	1	3	0

Source: Authors' database.
0 = absent; 1 = domestic chain; 2 = global chain; 3 = domestic and global chain.

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[a]	Positive
Process upgrading	Neutral[b]	Positive	Neutral[b]	Positive
Functional upgrading	Neutral	Positive	Neutral[b]	Positive
The impact of global buyers/leaders operations on				
Product upgrading	Positive	Positive[c] (but passive)	Neutral[d] Indirectly Positive	None[e]
Process upgrading	Positive	Positive[c] (but passive)	Neutral[d] Indirectly Positive	None[e]
Functional upgrading	Often negative	Neutral/negative	Neutral/negative	None[e]
Other critical sources of knowledge	Suppliers, local institutions, National buyers alternative to the global leaders	Suppliers, university and research laboratories, technology extension services, producers' associations and cooperatives	Consultants, local agencies (network brokers)	Users, universities and higher education institutions

Source: Authors' database.
[a] Often little collective efficiency (CE) is detected.
[b] Process innovations in this sector are usually driven by technology suppliers, and in none of the sample clusters is there local production of technology.
[c] Global leaders set the target and provide market outlets, but do not normally engage in supporting initiatives.
[d] 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.
[e] None refers to the case in which the global buyer is not present.

(i) *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 the 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).

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 relationship can be explained by several factors: (a) circulation of information, knowledge, and labor force which facilitates the upgrading process of clustered firms; (b) product upgrading is also facilitated by vertical joint action with local suppliers and with buyers; and (c) multilateral horizontal cooperation plays an important role in product upgrading through various actions such as participation in international trade fairs, collection of information about international fashion trends, easier connections 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) showed 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 for the product upgrading at the 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.

In contrast, on the basis of the available empirical evidence, it would seem that there is a clear link between collective efficiency and process upgrading. This can be explained by a combination of factors. In traditional industries, technology suppliers drive process innovations and in none of the clusters analyzed is there a local production of technology. Therefore, in most Latin American clusters, the virtuous and close relationship between technology producers and technology users that it is so

Table 5. *Upgrading in traditional manufacturing clusters*[a]

	CE degree	Product upgrading	Process upgrading	Functional upgrading	Intersectoral upgrading	Sum of upgrading
Textile:						
Medellin (Col.)	Medium	2	2	1	1	6
Itaji, Santa Catarina (Br.)	Medium	3	3	1	0	7
Apparel:						
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	4.73

Source: Authors' database.

[a] 3 = high; 2 = medium; 1 = low; 0 = absent.

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 (2000) 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 can be related to the characteristics of products, which are not standardized. In these industries, on products and processes information 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 VCs.

This upgrading effect is well documented in the Sinos Valley, where according to Bazan and Navas-Aleman (2004), 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, since the 1994 devaluation of the Peso, 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 Coahuila Mexico (Bair & Gereffi, 2001). In all these cases, integration in global value chains has supported rapid enhancement of product and process capabilities.

Moving on to *functional upgrading*, it has been documented (Bazan & Navas-Aleman, 2004; Humphrey & Schmitz, 2002b; Rabellotti, 2004) that although inclusion into GVCs facilitates product and process upgrading, 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 sales with them:

> Activities that are highly valuable are design, market ing, 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, Bra zilians 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, 2004).

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 & Schmitz, 2000). In the Sinos Valley, functional upgrading in design, branding, and marketing has been achieved by those firms selling to buyers in the domestic and regional markets in Latin America. Bazan and Navas-Aleman (2004) 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, Cário, & Nicolau, 2000).

Finally, in Table 5, we may observe a positive (albeit weak) relationship between functional upgrading and collective efficiency. Complementing this information with the available qualitative evidence, we can conclude that this is due to: (a) the circulation of information and skilled manpower (external economies); and (b) 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 (joint actions).

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 need to take advantage of the ongoing collective initiatives in a cluster to improve their access to information, know-how, and knowledge about markets. In other words, the degree of collective efficiency positively affects the SMEs' chances to functionally upgrade.

(ii) *Upgrading in natural resource-based clusters*

In *NR-based clusters*, process and product upgrading are strongly tied to the advancement of science and technology in related 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 laboratories, 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).

Indeed, SMEs have successfully upgraded in clusters characterized by public private initiatives aimed at supplying research and technology extension services, such 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. [21] 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 located in the city of Bento Gonçalves, constitute the main research and human resources formation centers of the cluster.

In Southern Chile, in the early 1980s, the salmon cluster development was fostered by the Chile Foundation, which ventured into salmon farming, which had, until then, been unknown in the region, proving that this activity could be profitable. Several private firms and TNCs then followed this example, initially set up by a public actor (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. In the late 1990s, R&D funds were then allocated through competitive tenders (Maggi, 2003).

Hence, the presence of mainly public private horizontal joint action positively affects product and process upgrading, achieved through several channels including the local institutional network, the public support to local joint actions, research centers, Universities, and international cooperation. Useful examples of cases in this respect are the salmon cluster in Chile (Maggi, 2003), the Petrolina Juazeiro mango cluster, and the apple cluster in Santa Catarina, in Brazil (Gomes, 2003). These results suggest a positive relation between CE and product and process upgrading, although functional upgrading is very rare (Table 6).

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

Table 6. *Upgrading in NR based clusters*[a]

	Location	Degree of CE	Product upgrading	Process upgrading	Functional upgrading	Intersectoral 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
Milkdairy	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	0.6	6.09

Source: Authors' database.

[a] 3 = high; 2 = medium; 1 = low; 0 = absent.

often codified by standards (e.g., HACCP), imposing them on to producers bears few transaction 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 (Gomes, 2003):

> . . .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.

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.

In the Nicaragua milk and dairy cluster, upgrading dynamics has taken very different forms. The hierarchical value chain led by a TNC has fostered upgrading of products and processes, but hindered functional upgrading (Artola & Parrilli, 2003). However, the VC led by the semiindustrial 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 & Rabellotti, 2004). However, global buyers are not necessarily the optimal solution for upgrading; national chains also offer alternative, promising, and often more sustainable opportunities.

(iii) *Upgrading complex products*

In *Complex Products* (COPs), process (and to a lower extent product) upgrading is remarkable, but functional upgrading was only achieved in a few cases (Table 7).

One case of functional upgrading is that of the Delphi automotive cluster in Juarez, Mexico, that has experienced functional upgrading at a local level, due to the development of the design and engineering center of Delphi (Carrillo & Lara, 2004). Local second and third tier suppliers have started producing higher value added products and services, mainly in electronics and informatics (Dutrenit, Vera-Cruz, & Gil, 2002). A similar example is the SJC cluster in Sao Paulo, Brazil (Bernardes & Pinho, 2002).

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

Table 7. *Upgrading in COP clusters*[a]

Main product	Location	CE degree	Product upgrading	Process upgrading	Functional upgrading	Intersectoral upgrading	Sum of upgrading
Aircraft	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 equip.	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	
Average			2.44	2.7	0.94	0.0	6.06

Source: Authors' database.
[a] 3 = high; 2 = medium; 1 = low; 0 = absent.

is no new design development locally by the local subsidiaries. What is done locally is rather to adapt such a design to local conditions (''*tropicalizaçao*'') (Lemos, Diniz, Crocco, & Camargo, 2000; Santos, Crocco, & Lemos, 2002). In the case of the TV industry in Baja California (Mexico), upgrading regards predominantly foreign first tier suppliers (Gerber & 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 & Lindegaard, 2002).

Similarly, in the GM and Volkswagen automotive cluster 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, Milesi, & Yoguel, 2002; Dutrenit *et al*., 2002).

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

This further suggests 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*, which implies that firms make an effort to upgrade through market mechanisms, such as a self-standing basis, contracting consultants, or recurring to other sources of knowledge available in the market, to improve their capabilities. Most of the upgrading effort is *not* led by or done jointly with the buyer, who merely represents an external stimuli and spectator to the process.

An interesting result of this study is also 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 who provide the suppliers with detailed designs. The lack of local coordination 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)

(iv) *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) presented five different types of products with 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 since been 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 & 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 developing standardized systems, which are implemented and sold to a large number of customers. A case in point is a small enterprise located in Aguascalientes that has developed a software for ophthalmologists, translating other existing packages into Spanish and adapting them 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 flow of skilled people inside the clusters very important determinants of their product upgrading. Moreover, the various collective initiatives, undertaken in most of these clusters, also contribute to enhancing firms' knowledge, access to information, and skills.

Process upgrading, in the Mexican clusters, 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 probably play a crucial supporting role. Besides, the linkages between software firms and local universities also importantly enhance 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 catalog in Aguascalientes, with some joint marketing initiatives by the local business association.

6. 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 policymakers as possible strategies to enhance enterprise competitiveness in international markets. In this paper, we show and support with novel empirical evidence on Latin America, that what really matters is the mode of organization of interfirm linkages and the governance of value chains. These differ and have different implications for process, product, and functional upgrading, in different groups of sectors. Thus, the degree of cumulativeness of knowledge, together with the degree of appropriability, codification, and complexity of the knowledge base influence the capacity and way firms upgrade.

A central and novel 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 sectors. However, this is not the only thing that matters, as the mode of governance of the value chain in which firms participate affects the scope and extent of local firms' upgrading as well as how upgrading is pursued. More specifically, in quasi-hierarchical value chains, the pressure to comply with the standards imposed by the chains' leaders often enhances product and process upgrading, but functional upgrading is almost always inhibited. But if this is a common result throughout all sectors, the way of pursuing product and process upgrading changes. In traditional industries, buyers directly facilitate the process, in NR-based clusters, a crucial role is played by collective initiatives, while in COPS, firms find the resources needed to upgrade in the market.

In sum, firm-level strategies to pursue upgrading substantially differ by groups of sectors: clustering and collective efficiency play a key role in some sectors but not in others, where the global logic of foreign buyers prevails and firms need to learn how to cope with more competent (and often larger) players. Future empirical research will need to build rigorous quantitative methods to address some of the issues raised in this paper and, most importantly, the implications for policy design and implementation.

NOTES

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 on Africa, see McCormick (1999) and on Latin America Albaladejo (2001).

3. An important difference is also related to the fact that in developing countries (specifically in Latin Amer ica), industrial clusters often include a heterogeneous set of firms, which differ widely in terms of size. Unlike the typical Marshallian industrial district, in the developing world, clusters are populated by SMEs as well as large firms (Rabellotti & Schmitz, 1999).

4. External economies can be defined as positive or negative unpaid, outside of the market rules, as side effects of the activity of one economic agent on other agents.

5. Nadvi and Schmitz (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.

6. Markusen (1996) broadening the definition of an industrial district discusses four types of districts. In the "satellite platform" type, consisting of a congregation of branch facilities of externally based multiplant firms, she acknowledges the importance of external linkages. Guerrieri, Iammarino, and Pietrobelli (2001) and Guerrieri and Pietrobelli (2004) further develop this approach and apply it to clusters in Italy and Taiwan.

7. 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.

8. The macroeconomic dimension of competitiveness is often mixed with the microeconomic definition, embed ded 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 *any* international specialization, provided that it is consistent with their pattern of comparative advantage. However, insofar as we admit the possibility of interfirm (intrasector) 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, competi tiveness becomes a meaningful, and indeed relevant concept (Lall, 2001). Further, the latter approach allows consideration of "dynamic" comparative advantage, that is, acquired through the purposeful efforts of enterprises, and in sectors different from those enjoying static comparative advantage (Pietrobelli, 1997). There fore, the present discussion of alternative "roads" to competitiveness refers to the macroeconomic implica tions 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 national point of view of the country (or the region/cluster).

9. 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 broadly define as a technological condition that defines the boundaries and the direction of the innovative and problem solving activities of technicians (also see Dosi, 1982, 1988). More recently, other authors have attempted to differentiate technolog ical regimes on the basis of the combination of concepts such as *technological opportunity*, *appropriability of knowledge*, *cumulativeness of learning*, and *nature of the knowledge base* (Breschi, Malerba, & Orsenigo, 2000; Malerba & Orsenigo, 1993).

10. The properties of the knowledge base are tied to the nature of knowledge and its degree of specificity, tacitness, complexity, and independence (Breschi *et al.*, 2000).

11. Starting from seminal contribution of Pavitt (1984), different attempts have been made to identify and understand patterns of innovation (Marsili & Versp agen, 2001), and a number of different studies have

adopted and refined the taxonomy to analyze the Latin American context (e.g., ECLAC, 1996; Ferraz, Kupfer, & Haguenaer, 1996; Guerrieri, 1994).

12. University Industry linkages have been historically very poor in Latin America (Plonski, 1993). During the Import Substitution period, there was little interest to cooperate because protected market conditions did not encourage firms to innovate. At the same time, univer sities had little incentives to transfer technologies to business because research was mainly financed by the Government. Since the 1990s, the situation has shown signs of change, with some new policies specifically focusing on *university industry* linkages.

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

14. On this see Pray and Umali Deininger (1998) and Echevarria *et al*. (1996).

15. In this study, the definition of COPs does not coincide entirely with 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, mobile phone network equipment, etc. would be characterized by high com ponent 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 component standardization (modularity) (Ulrich, 1995) which allow for mass production. In the present work, consistent 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.

16. For details, see Pietrobelli and Rabellotti (2004).

17. As the definition of SMEs varies greatly across the different countries of the region and firm size also depends on the sector, we use the concept in a rather loose way to refer to the majority of domestic firms.

18. For a list of all case studies, see Appendix A.

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

20. Specialized suppliers are not mentioned since none of the cases analyzed forms part of a quasi hierarchical value chain.

21. Most of the local small growers had never previ ously worked with irrigated agriculture. Thus, they first produced a combination of annual crops, including beans, corns, and melons, followed by widespread adoption of industrial tomatoes, and subsequently higher value fruit crops, including mangoes and grapes. The transition from phase to phase involved a combi nation of conventional and more innovative support policies to help growers in each, consecutively more difficult, phase (Gomes, 2003).

REFERENCES

Albaladejo, M. (2001). The determinants of competi tiveness in SME clusters: Evidence and policies for Latin America. In H. Katrack & R. Strange (Eds.), *Small scale enterprises in developing and transitional economies*. London: MacMillan.

Albornoz, F., Milesi, D., & Yoguel, G. (2002). New Economy in Old Sectors: some issues coming from two production networks in Argentine. Paper Pre sented at the *DRUID summer conference 2002*. <http://www.druid.dk>.

Alonso, J., Carrillo, J., & Contreras, O. (2000). Tray ectorias tecnologicas en empresas maquiladoras asi aticas y americanas en Mexico. *Serie Desarrollo Productivo*, 72, CEPAL, Naciones Unidas: Santiago.

Archibugi, D., & Pietrobelli, C. (2003). The globaliza tion of technology and its implications for develop ing countries. Windows of opportunity or further burden? *Technological Forecasting and Social Change, 70*, 861 883.

Arocena, R., & Sutz, J. (2001). Changing knowledge production and Latin American universities. *Re search Policy, 30*(8), 1221 1234.

Artola, N., & Parrilli, D. (2003). In C. Pietrobelli, & R.Rabellotti (Eds.), El despegue del cluster de productos lácteos de Boaco y Chontales, Nicaragua.

Bair, J., & Gereffi, G. (2001). Local clusters in global chains: The causes and consequences of export dynamism in Torreon's blue jeans industry. *World Development, 29*(11), 1885 1903.

Bazan, L., & Navas Aleman, L. (2004). The Under ground Revolution in the Sinos Valley: A compar ison of Upgrading in global and national value chain, in Schmitz (2004).

Becattini, G. (1987). *Mercato e forze locali: Il distretto industriale*. Bologna: Il Mulino.

Bell, M., & Pavitt, K. (1993). Technological accumula tion and industrial growth: contrast between devel oped and developing countries. *Industrial and Corporate Change, 2*(2), 157 211.

Bercovich, N., & Swanke, C. (2003). Cooperacao e competitividade na industria de software de Blume nau. WP. 138, *Serie Desarrollo Productivo*, CEPAL/ United Nations: Santiago de Chile.

Bernardes, R., & Pinho, M. (2002). Aglomeração e aprendizado na rede de fornecedores locais da Embraer. Mimeo. <http://www.ie.ufrj.br/redesist>.

Bortagaray, I., & Tiffin, S. (2000). Innovation clusters in Latin America. Paper presented at *4th international conference on technology policy and innovation*, Curitiba, Brazil, August 28 31.

Breschi, S., Malerba, F., & Orsenigo, L. (2000). Tech nological regimes and the schumpeterian patterns of innovation. *The Economic Journal, 110*, 388 410.

Buitelaar, R. M., Padilla, R., & Urrutia, R. (1999). Industria Maquiladora y Cambio Tecnico. *Revista de la Cepal, 67*, Abril, CEPAL. Naciones Unidas: Santiago.

Calandro, M. L., & Campos, H. S. (2002). O setor de autopeças de Caixas do Sul e Regiao: diagnostico para a implementaçao de politica de apoio ao desenvolvimento de SLPs. In C. C. Chiappino (Ed.), *Programa de Apoio aos Sistemas Locais de Produ çao: a constru çao de uma politica publica do RS*. Porto Alegre: Fundaçao de Economia e Estat istica.

Campos, R. R., Nicolau, J. A., & Ferraz Cario, S. A. (1998). Sistemas locais de inovacao: um estudo preliminar de casos selecionados ni estado de Santa Catarina. NT 10. <http://www.ie.ufrj.br/redesist>.

Campos, R. R., Cário, S., & Nicolau, J. (2000). Arranjo productivo textil vestuario do Vale de Itajai, SC. NT 20. <http://www.ie.ufrj.br/redesist>.

Carrillo, J., & Hualde, A. (2000). Existe un cluster en la maquiladora electrónica en Tijuana. In J. Carrillo (Ed.), *Aglomeraciones Locales o Clusters Globales? Evolución Empresarial e Institucional en el Norte de México* (pp. 99 139). Fudación Ebert and El Colegio de la Frontera Norte, Tijuana: Universidad Autónoma de Ciudad Juárez.

Carrillo, J., & Lara, A. (2004). Maquiladoras de cuarta generación y coordinación centralizada. *Estudios Sociológicos, XXII*(66).

Carrillo, J., Mortimore, M., & Estrada, J. A. (1998). El impacto de las empresas transnacionales en la reesreucturacion industrial de Mexico. El caso de las Industrias de Partes para Vehiculos y Televisores. *Serie Desarrollo Productivo*, n. 50, CEPAL.

Cassiolato, J., Villaschi, A., & Lastres, H. (2003). In C. Pietrobelli, & R. Rabellotti (Eds.), Local productive and innovative systems in Brazil: A policy perspec tive from a study of the metal mechanics system in Espírito Santo.

Cimoli, M., & Katz, J., (2002). Structural reforms, technological gaps and economic development. A Latin American perspective. *Serie Desarrollo Pro ductivo*, 129, CEPAL, Santiago de Chile.

Crocco, M., & Horacio, F. (2001). Industrializaçao descentralizada: Sistemas Industriais Locais. O Arranjo Produtivo Moveleiro de Ubá. NT 38. <http://www.ie.ufrj.br/redesist>.

De Souza, M. C., & Garcia, R. (1998). O arranjo produtivo de industrias de alta tecnologia da regiao de Campinas Estado de Sao Paulo Brazil. NT 27/ 99. <http://www.ie.ufrj.br/redesist>.

Dosi, G. (1982). Technological paradigms and techno logical trajectories. *Research Policy, 11*, 147 162.

Dosi, G. (1988). Sources, procedures. and microeco nomic effects of innovation. *Journal of Economic Literature, XXVI*, 1120 1171.

Dussel, E. (1999). La subcontratación como proceso de aprendizaje: el caso de la electronica en Jalisco (México) en la década de los noventa. Red de reestructuración y competitividad, ECLAC, United Nations: Santiago, Chile.

Dutrenit, G., Vera Cruz, A. O., & Gil, J. L. (2002). Desafios y oportunidades de las Pymes para su integracion a la red de proveedores: el caso de la maquila automotriz en cdad Juarez. <http:// www.ie.ufrj.br/redesist>.

Echevarria, R. G., Trigo, E. J., & Byerlee, D. (1996). Institutional change and effective financing of agri coltural research in Latin America. *World Bank Papers*, N. 330, Washington, DC.

ECLAC (1996). Panorama de la insercion internacional de America Latina y el Caribe, Edicion 1996 (lc/g. 1941). CEPAL, Naciones Unidas: Santiago.

Ferraz, J., Kupfer, D., & Haguenaer, L. (1996). El Desafío Competitivo para la Industria Brasileña. *Revista de la CEPAL, 58* (LC/G.1916 P).

Freeman, C. (1994). The economics of technical change. *Cambridge Journal of Economics, 18*, 463 514.

Garcia, R., & Roselino, J. E. (2002). Critical Evaluation of the results of the 'Informatics Law' and its reflexes on the electronic complex. Paper presented at the *6th EUNIP Conference*, Turku, Finland, 5 7 December.

Gerber, J., & Carrillo, J. (2002). Are Baja California's Maquiladora Plants Competitive? Paper Presented at *San Diego Dialogue Fronterizo*, The Future of Manufacturing un Baja California: The Electronics and Auto Part Sectors, July 18.

Gereffi, G. (1994). The organization of buyer driven global commodity chains: How, US retailers shape overseas production networks. In G. Gereffi & M. Korzeniewicz (Eds.), *Commodity chains and global capitalism*. London: Praeger.

Gereffi, G. (1999). International trade and industrial upgrading in the apparel commodity chain. *Journal of International Economics, 48*, 37 70.

Gereffi, G., & Kaplinsky, R. (2001). The value of value chains. Special issue of *IDS Bulletin*, Vol. 32.

Giuliani, E. (2002). Beyond static comparative advan tage in wine production: The case of the Colchagua Valley, Chile. Mimeo.

Giuliani, E. (2003). Knowledge in the air and its uneven distribution. A story of a Chilean Wine Cluster.

Paper Presented at the *Druid Winter Conference*, Denmark.
Gomes, R. (2003). In C. Pietrobelli, & R. Rabellotti (Eds.), Upgrading without exclusion: Lessons from SMEs in fresh fruit clusters in Brazil.
Guerrieri, P. (1994). International competitiveness, trade integration and technological interdependence. In Bradford, Jr. & I. Colin (Eds.), *The new paradigm of systemic competitiveness: Toward more integrated policies in Latin America*. Paris: OECD.
Guerrieri, P., & Pietrobelli, C. (2004). Industrial dis tricts' evolution and technological regimes: Italy and Taiwan. *Technovation, 24*(11), 899 914.
Guerrieri, P., Iammarino, S., & Pietrobelli, C. (2001). *The global challenge to industrial districts: SMEs in Italy and Taiwan*, Cheltenham, UK and Lyme, US: Edward ELGAR (paperback in 2003).
Henderson, R. M., & Clark, K. B. (1990). Architectural innovation: The reconfiguration of existing product technologies and the failure of established firms. *Administrative Science Quarterly, 35*, 9 30.
Hobday, M. (1998). Product complexity, innovation and industrial organization. *Research Policy, 26*, 689 710.
Humphrey, J. (Ed.) (1995). Industrial organization and manufacturing competitiveness in developing coun tries. Special Issue of *World Development*, *23*(1), 1 7.
Humphrey, J., & Schmitz, H. (2000) Governance and upgrading: Linking industrial cluster and global value chain research. IDS Working Paper, No. 120, Institute of Development Studies, University of Sussex, Brighton.
Humphrey, J., & Schmitz, H. (2002a). How does insertion in global value chains affect upgrading industrial clusters? *Regional Studies, 36*(9), 1017 1027.
Humphrey, J., & Schmitz, H. (2002b). Developing country firms in the world economy: Governance and upgrading in global value chains. INEF Report, No. 61, University of Duisburg, Duisburg.
Kaplinsky, R. (2001). Learning networks in the South African auto components industry. *Innovation News*.
Kaplinsky, R., & Readman, J. (2001). How can SME producers serve global markets and sustain income growth? Mimeo, University of Brighton and Univer sity of Sussex, Brighton. <http://www.ids.ac.uk/ids/global/valchn.html>.
Katz, J. (2001). Structural reforms and technological behaviour. The sources and nature of technological change in Latin America in the 1990s. *Research Policy, 30*, 1 19.
Krugman, P. (1996). Making sense of the competitive debate. *Oxford Review of Economic Policy, 12*(3), 17 25.
Lall, S. (2001). Competitiveness indices and developing countries: An economic evaluation of the global competitiveness report. *World Development, 29*(9), 1501 1525.
Leite, M. de Paula (2002). The struggle to develop regional industrial policy: The role of the plastics and auto sectors in the Regional Chamber of ABC, São Paulo. IDS Working Paper No. 154, Institute of Developing Studies, Brighton, UK. <http://www.ids.ac.uk>.
Lemos, M. B., Diniz, C., B. Teixeira dos Santos, F., Crocco, M.A., Camargo, O., (2000). O Arranjo Produtivo da Rede Fiat de Fornecedores, NT 17, <http://www.ie.ufrj.br/redesist>.
Lemos, C., & Palhano, A. (2000). Arranjo Produtivo Coureiro Calçadista de Campina Grande/PB. NT 22. <http://www.ie.ufrj.br/redesist>.
Maggi, C. (2003). In C. Pietrobelli, & R. Rabellotti (Eds.), El cluster del cultivo y procesamiento del salmón en la región sur austral de Chile.
Malerba, F. (Ed.). (2000). *Economia dell'Innovazione*. Roma: Carocci Editore.
Malerba, F., & Orsenigo, L. (1993). Technological regimes and firm behaviour. *Industrial and Corporate Change, 2*(1), 74 89.
Markusen, A. (1996). Sticky places in slippery space: A typology of Industrial Districts. *Economic Geogra phy, 72*, 293 313.
Marques, R. A. (forthcoming). Evolution of the civil aircraft manufacturing system of innovation: A case study in Brazil. In S. Mani, & Henny Romijn (Eds.), *Innovation, learning, and technological dynamism of developing countries* (pp. 77 106). Tokyo: United Nations University Press.
Marshall, A. (1920). *Principles of economics* (8th ed.). London: MacMillan (1st ed. 1890).
Marsili, O., & Verspagen, B. (2001). Technological regimes and innovation: Looking for regularities in Dutch manufacturing. No. 150, *DRUID's Nelson and Winter Conference*.
McCormick, D. (1999). African enterprise clusters and industrialization: Theory and reality. *World Devel opment, 27*(9), 1531 1551.
Meyer Stamer, J. (1998a). Avoiding collective efficiency. Growth and crises in the furniture cluster in Sao Bento do Sul (Santa Catarina, Brazil). <http://www.meyer stamer.de/1998/sbs.moveis.htm>.
Meyer Stamer, J. (1998b). Towards knowledge driven development? Upgrading to face the challenges of an open economy: Experience from industrial clusters in Santa Catarina, Brazil. Paper presented for the *conference on globalisation and industrial competitive ness in Brazil*, Oxford, June 11.
Meyer Stamer, J., Maggi, C., & Siebel, S. (2001). Improving upon nature: Creating comparative advantage in tile clusters in Italy, Spain and Brazil. INEF Report, No. 54, University of Duisburg, Duisburg.
Millan, F. (2002). El conglomerado del azũcar del valle del Cauca: cien años de construccion social. In CEPAL, Aglomeraciones agroindustriales en Amé rica latina, CEPAL, Naciones Unidas: Santiago.
Nadvi, K. & Schmitz, H. (Eds.) (1999). Industrial clusters in developing countries. Special issue of *World Development 27*(9).
Nelson, R., & Winter, S. (1977). In search of a useful theory of innovation. *Research Policy, 6*, 36 76.
Nelson, R., & Winter, S. (1982). *An evolutionary theory of economic change*. Harvard University Press.
Pavitt, K. (1984). Sectoral patterns of technical change: Towards a taxonomy and a theory. *Research Policy, 13*, 343 373.

Pietrobelli, C. (1997). On the theory of technological capabilities and developing countries' dynamic com parative advantage in manufactures. *Rivista Intern azionale di Scienze Economiche e Commerciali, XLIV*(2), June.

Pietrobelli, C. (1998). *Industry, competitiveness and technological capabilities in Chile. A new tiger from Latin America?* London and New York: MacMillan and St. Martin's.

Pietrobelli, C., & Olarte, B. T. (2002). Enterprise clusters and Industrial Districts in Colombia's Fashion Sector. *European Planning Studies, 10*(5), 541 562.

Pietrobelli, C., & Rabellotti, R. (2004). Upgrading in clusters and value chains in Latin America: The role of policies. In *Sustainable Development Department Best Practices Series*. Washington, DC: Inter Amer ican Development Bank.

Plonski, A. G. (Ed.) (1993). Cooperacion Empresa Universidad en Iberoamerica, Programa CYTED, São Paulo.

Polanyi, M. (1967). *The tacit dimension*. Garden City, NY: Doubleday Anchor.

Porter, M. (1990). *The competitive advantage of nations*. London and Basingstoke: MacMillan.

Pray, C. E, & Umali Deininger, D. (1998). The private sector in agricultural research systems: Will it fill the gap? *World Development, 26*(6), 1127 1148.

Quadros, R. (2002). Global quality standards, chain governance and the technological upgrading of Brazilian auto components producers. IDS Working Paper, No. 156.

Rabellotti, R. (1997). *External economies and coopera tion in industrial districts: A comparison of Italy and Mexico*. London and Basingstoke: MacMillan.

Rabellotti, R. (1999). Recovery of a Mexican cluster: Devaluation bonanza or collective efficiency? *World Development, 27*(9), 1571 1585.

Rabellotti, R. (2004). In H. Schmitz (Ed.), The effect of globalisation on industrial districts in Italy: The case of Brenta.

Rabellotti, R., & Schmitz, H. (1999). The internal heterogeneity in industrial districts in Italy, Brazil and Mexico. *Regional Studies, 33*(2), 97 108.

Ruiz Duran, C. (2003). In C. Pietrobelli, & R. Rabellotti (Eds.), Cadenas de Valor y Clusters del Software en México.

Santos, F., Crocco, M., & Lemos, M. B. (2002). As MPME em Espacos Industriasi perifericos: os casos de Nova Serrana e da Rede de Fornecedores Fiat. <http://www.ie.ufrj.br/redesist>.

Schmitz, H. (1995). Collective efficiency: Growth path for small scale industry. *Journal of Development Studies, 31*(4), 529 566.

Schmitz, H. (1999a). Increasing returns and collective efficiency. *Cambridge Journal of Economics, 23*(4), 465 483.

Schmitz, H. (1999b). Global competition and local co operation: Success and failure in the Sinos Valley, Brazil. *World Development, 27*(9), 1627 1650.

Schmitz, H. (Ed.) (2004). *Local enterprises in the global economy: Issues of governance and upgrading*. Ed ward Elgar.

Torres Zorrilla, J. (2000). Una estrategia de desarrollo basada en recursus naturales: analisis cluster del completo de cobre de la Southern Peru, Serie Desarrollo Productivo, n. 70, CEPAL/United Na tions: Santiago de Chile.

Torres Zorrilla, J. (2001). El completo de cobre de la Southern Peru. In R. Buitelaar (Ed.), *Aglomeraciones minerai y desarrollo local en America Latina*. CE PAL Alfaomega.

Torrisi, S. (2003). Imprenditorialitá, nuovi modelli di business e distretti tecnologici: un confronto tra India ed Irlanda. In F. Cesaroni & A. Piccaluga (Eds.), *Distretti industriali e distretti tecnologici*. Milano: Franco Angeli.

Ulrich, K. (1995). The role of product architecture in the manufacturing firm. *Research Policy, 24*, 419 440.

Vargas, M. A. (2000). Arranjo productivo coureiro calcadista do Vale dos Sinos. NT 21, IE/UFRJ. <http://www.ie.ufrj.br/redesist>.

Vargas, M. A. (2001a). Local systems of innovation in developing countries: A study of technological learning in local productive arrangements in Brazil. Paper presented at the *DRUID Winter Conference*, Aalborg, January 16 18.

Vargas, M. A. (2001b). Forms of governance, learning mechanisms and upgrading strategies in the Tobacco Cluster in Rio Pardo Valley Brazil. IDS Working Paper, 125, Institute of Development Studies, Uni versity of Sussex, Brighton.

Vargas, M. A., & Alevi, R. M. (2000). Competitividade, capacitaçao tecnologica e inovaçao no arranjo moveleiro da Serra Gaucha. NT 39. <http://www.ie. ufrj.br/redesist>.

Vargas, L., & Lindegaard, K. (2002). New economies and innovation for developing countries. The case of intel in Costa Rica. Paper presented at the *DRUID summer conference on industrial dynamics of the new and old economy, who embraces whom*? Copenhagen, June 6 8.

Villaschi, F. V., & Bueno, F. O. (2000). Elementos dinamicos do arranjo productivo Madeira/Moveis no Nordeste de Capaixaba, Redesist. NT 24. <http:// www.ie.ufrj.br/redesist>.

Villaschi, A. F., & de Souza Sabadini, M. (2000). Arranjo Produtivo Ornamentais (marmore, granito) no Estado do Espirito Santo. NT 15, IE/UFRJ. <http://www.ie.ufrj.br/redesist>.

Visser, E. J. (1999). A comparison of clustered and dispersed firms in the small scale clothing industry of Lima. *World Development, 27*(9), 1553 1570.

Von Hippel, E. (1987). Cooperation between rivals: Informal know how trading. *Research Policy, 16*, 291 302.

Wood, A. (2001). Value chains: an economist's perspec tive. *IDS Bulletin*, special issue: The Value of Value Chains, *32*(3), 41 45.

Wood, A., & Berge, K. (1997). Exporting manufactures: Human resources, natural resources and trade policy. *Journal of Development Studies, 34*(1), 35 59.

Zepeda, E. (2003). In C. Pietrobelli, & R. Rabellotti (Eds.) Segusino: Auge y Caida de la Exportacion de Muebles.

APPENDIX A. LIST OF CASE STUDIES

Case study	Country	Source
Traditional manufacturing clusters		
Footwear, Sinos Valley	Brazil	Bazan and Navas-Aleman (2004), Vargas (2000), Schmitz (1999b, 1995)
Footwear, Guadalajara	Mexico	Rabellotti (1997, 1999)
Footwear, Leon	Mexico	Rabellotti (1997, 1999)
Footwear, Campina Grande	Brazil	Lemos and Palhano (2000)
Textiles, Coahuila	Mexico	Bair and Gereffi (2001)
Textiles, Medellin	Colombia	Pietrobelli and Olarte (2002)
Apparel, Bucaramanga	Colombia	Pietrobelli and Olarte (2002)
Textiles, Itaji	Brazil	Campos *et al.* (2000)
Apparel, Gamarra	Peru	Visser (1999)
Furniture, Serra Gaucha	Brazil	Vargas and Alevi (2000), Meyer-Stamer (1998a),
Furniture, Espirito Santo	Brazil	Villaschi and Bueno (2000)
Furniture, Ubà	Brazil	Crocco and Horacio (2001),
Furniture, Segusino-Chipilo	Mexico	Original field study (Zepeda, 2003)
Tiles, Santa Catarina	Brazil	Meyer-Stamer, Maggi, and Siebel (2001), Meyer-Stamer (1998a, 1998b), Campos, Nicolau, and Ferraz Cario (1998)
Natural resource-based clusters		
Tobacco, Rio Pardo	Brazil	Vargas (2001a, 2001b)
Wine, Colchagua	Chile	Giuliani (2002, 2003)
Wine, Serra Gaucha	Brazil	Vargas (2001a)
Sugar, Valle del Cauca	Colombia	Millan (2002)
Marble, Espirito Santo	Brazil	Villaschi and de Souza Sabadini (2000)
Copper, Cuajone-Toquepala	Peru	Torres-Zorrilla (2000, 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		
Aircraft, SJC, Sao Paolo	Brazil	Bernardes and Pinho (2002), Marques (forthcoming, Chapt. 4)
Automotive, Nova Serrana	Brazil	Lemos *et al.* (2000), Santos *et al.* (2002)
Metalworking, Espirito Santo	Brazil	Original field study Cassiolato, Villaschi, and Lastres (2003)
Automotive, Caixa do Sul, RGS	Brazil	Calandro and Campos (2002)
Automotive, Juarez	Mexico	Dutrenit *et al.* (2002), Carrillo and Lara (2004)
Audio-visual equip., Baja California	Mexico	Gerber and Carrillo (2002), Alonso, Carrillo, and Contreras (2000), Buitelaar, Padilla, and Urrutia (1999), Carrillo, Mortimore, and Estrada (1998), Carrillo and Hualde (2000)

APPENDIX A—*continued*

Case study	Country	Source
High Tech., Campina-Sao Paolo	Brazil	Garcia and Roselino (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)
Specialized 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)