

# Designing Policies for Local Production Systems: A Methodology Based on Evidence from Brazil

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## Abstract

Using a previously developed methodology for identifying, classifying and characterizing local production systems (LPS) in Brazil, and evidence produced by a number of case studies, the paper suggests that policies aimed at LPS (or industrial clusters) should be tailored according to a typology of clusters. This typology must take into account the cluster importance for local or regional development, its share in the respective industry, and its characteristics in terms of production structure, trading schemes, institutional infrastructure, governance structures, and social contexts. The paper starts by reviewing, from the point of view of policy-making, the theories that support industrial cluster analyses, namely those that explain clusters as: outcomes of plain agglomeration economies and increasing returns; the result of spatial dynamic processes; knowledge systems emerging from the geography of innovation and agglomeration; governance structures, and as evolving complex systems. Next, the results from an application of the methodology to Brazilian data and information and from a number of case studies are summarized. Finally, the paper suggests policy guidelines with some measures of general application, aimed at problems observed in all LPS, and some specific measures differentiated according to a typology of local production systems that resulted from the application of the methodology.

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## Resumo

Utilizando uma metodologia anteriormente desenvolvida para identificar, classificar e caracterizar Sistemas Locais de Produção (SLP) no Brasil, e um conjunto de evidências produzidas por diversos estudos de caso, o trabalho tem por objetivo sugerir que políticas para SLP devem ser formuladas de acordo com uma tipologia de sistemas locais. Esta tipologia deve levar em conta a importância do SLP para o desenvolvimento local ou regional, sua participação na respectiva indústria, e suas características em termos de estrutura industrial, esquemas de comercialização, infra-estrutura institucional, estrutura de governança e contexto social. O trabalho parte de uma revisão, do ponto de vista das políticas, das teorias que sustentam a análise de sistemas locais de produção, notadamente aquelas que explicam tais sistemas como: decorrentes de simples economias

de aglomeração e de retornos crescentes; resultados de processos espaciais dinâmicos; sistemas de conhecimento que emergem da geografia da inovação e da aglomeração de agentes; estruturas de governança, e sistemas complexos evolucionários. Em seguida, o artigo resume os resultados da aplicação da referida metodologia a dados e informações para o Brasil, bem como dos estudos de casos realizados. Finalmente, o trabalho sugere diretrizes de políticas com medidas de aplicação geral, dirigidas a problemas verificados em todos os SLP estudados, e medidas específicas diferenciadas de acordo com a tipologia de SLP que resultou da aplicação da metodologia.

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*JEL Classification:* L52, O18, R11, R58

## 1. Introduction

There is an enormous and varied literature dealing with industrial clusters under different approaches and emphasizing either theories to explain clustering or other analytical aspects like model building, structural characteristics, and the dynamics and evolution of clusters. Relatively less attention, however, is given to policy issues, especially when less-developed countries are concerned.

This paper focuses policy-making for industrial clusters (or local production systems – LPS), with a particular attention to less-developed countries, on the basis of evidence produced by

- (i) the application of a quantitative methodology to Brazilian statistical data;
- (ii) a number of case studies and
- (iii) a survey of the institutions that support firms in clusters.

Our aim is to develop a typology of clusters or LPS for policy purposes, claiming that differences in the cluster relevance for regional development and its share of the industry, production structure, industrial organization, technical and innovative capabilities, trading and governance structures, institutional infrastructure and social and cultural contexts, all justify different policy approaches and specific measures, according to different types of clusters.

The paper is organized as follows. First, a brief review of the literature is presented with the purpose of pinpointing policy issues. By no means it should be considered a comprehensive review. Second, the results of the application of the methodology are summarized, showing the major problems that affect LPS and could be the object of policy-measures. Finally, the paper suggests policy guidelines with some measures of general application, aimed at problems evidenced in case studies, and some specific measures differentiated according to the typology of local systems that resulted from the quantitative and other indicators.

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## 2. Policy Issues: A Selective Review of the Literature

A great number of contributions under different and complementary approaches have substantially improved the knowledge about the relationships between geography and industry. Most of the effort has been spent on explaining and characterizing industrial clusters by way of purely theoretical work, empirical studies, and case studies. Policy implications have not been systematically discussed. Some authors are reticent, while others are more inclined to suggest policy guidelines. This is also the case in studies related to less-developed countries. This section summarizes those contributions in a very schematic way, trying to point out policy issues. We understand that such schematic summary may be tricky, but space is a relevant dimension, especially in an academic paper. We understand also that there are lacunae in our focus on policy issues, but could not lose perspective.

We classified nine groups of authors, corresponding to different and complementary approaches. We were tempted to label each group or approach according to schools of thought or institutional origin, but preferred to use catchwords that highlight the approach itself. The next paragraphs sum up each group without going into greater detail about the individual contributions. It is important to note that the classification is not intended to be hierarchical, nor chronological. It could be read as successive layers in the process of collective learning that built the present knowledge about industrial clustering.

### 2.1. *Marshallian external economies*

Alfred Marshall's seminal analysis of English industrial districts inspired a great deal of literature devoted to explain agglomerations of small firms in geographically bounded areas. Local external economies derived from knowledge spillovers, specialized labor skills, and interdependencies or linkages are at the root of the explanation.

Several Italian authors, among them G. Becattini, S. Brusco and G. Garofoli, have pioneered modern studies of industrial districts in Italy since the late 1970s following Marshall's ideas. However, Marshallian external economies alone did not explain the origin and development of Italian industrial districts. In fact, as pointed out by those authors, Industrial districts had special characteristics such as: a territorial concentration of a large number of small firms specialized in one specific industry, with an extensive division of labor among them, embedded in a local community with strong socio-cultural ties that facilitated cooperation based on trust and local governance by private-firms organizations and public bodies. These special characteristics made them unique as forms of spatial organization of industrial production. Later on, evolution in the 1990s changed substantially the structural characteristics of Italian industrial districts, turning them into more hierarchically organized production systems and lessening the

importance of regional social, political and cultural ties.<sup>1</sup> For these reasons policy recommendations based on case studies of Italian industrial districts are usually very cautious.

## 2.2. *Increasing returns and positive feedbacks*

In late 1980s W. Brian Arthur, recovering old contributions neglected in mainstream economics, brought into the field the dynamic analysis of self-reinforcing mechanisms in spatial economics, as well as in international trade theory and in industrial organization, with possibilities of multiple equilibria, inefficient solutions, lock-in and path-dependence (Arthur 1988). An industry location pattern may result from the location decision of the first firm that enters the industry, and the sequence of location decisions by subsequent entrant firms. The first firm decision is based “purely on geographical preferences”, influenced by local external economies or some “historical accident”. Subsequent entrants’ location decisions are “based on preference modified by the benefits of locating near the first firm(s)”, and thus “industrial concentration becomes self-reinforcing.” One region may dominate the industry if there is no limit to positive feedbacks, and this may not be an efficient solution. But usually one region cannot offer increasing returns indefinitely because of, for instance, agglomeration diseconomies. So, other regions share the industry (Arthur (1988, 1990)).

This approach is particularly relevant for knowledge-based industries, although self-reinforcing mechanisms influence location patterns of any industry. Arthur’s (1990) policy suggestions are directed to high-tech production. In his words, policies should “encourage industries to be aggressive in seeking out product and process improvements. They would strengthen the national research base on which high-tech advantages are built. They would encourage firms in a single industry to pool their resources in joint ventures that share upfront costs, marketing networks, technical knowledge and compatibility conventions. And they might even extend to strategic alliances among companies in several countries to enter a complex industry that none could tackle alone. Increasing returns theory also recommends paying close attention to timing when fostering research initiatives in new industries. There is little sense in entering a market that is already close to being locked in or where there are otherwise little chance of success”.

## 2.3. *Centripetal versus centrifugal forces*

In the 1990s Krugman (1991, 1999) modeled the so-called ‘new economic geography’ as a new wave in the “increasing returns-imperfect competition revolution” of economic theory. Later on Fujita et al. (1999) extended the model to

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<sup>1</sup> Excellent analyses of recent trends in Italian industrial districts can be found in Lazerson and Lorenzoni (1999) and Lombardi (2003).

cover spatial issues related to urban, regional and international economics. Starting with the three sources of Marshallian external economies – linkages, labor skills and spillovers – as centripetal forces favoring spatial concentration, and immobile factors, land rents and congestion as three opposing centrifugal forces, and adding some stylized facts from empirical regularities observed in urban, regional and industrial location theories, the authors try to model the evolution of the spatial structure of the economy as determined by the confront of centripetal versus centrifugal forces. However, recognizing that the trinity of Marshallian external economies “has proved to be notoriously hard to model in any formal way” (Fujita et al. (1999), pp. 18–19), the authors modeled just one pair of centripetal and centrifugal forces, namely linkages, “when producers are subject both to transport costs and to increasing returns”, and immobile factors. This limitation may explain why Krugman (1999), pp. 105–6 and Fujita et al. (1999), pp.348–9 are so reticent about policy implications.

Commenting on Krugman (1999) paper, David (1999) criticized the excessive reductionism of the “new economic geographers”. Considering the “complicating realities” of the real world, David (1999), p.111, states that: “economic life is not formed by ordering pairs from Krugman’s locational forces – one item from the list of centripetals and the other from the list of centrifugals. A multiplicity of dynamic processes usually are under way concurrently and, that being the reality, one must venture beyond minimal heuristic models in order to identify which combinations are operative where, and how they interact”. Other criticisms by David state that: supply-side externalities should not be neglected, transport cost changes are not geographically neutral, powerful positive feedback mechanisms attribute advantages of initial agglomeration and strong historicity to the spatial evolution of the economy, technological and organizational innovations are not geographically neutral, and so on.

However, more important for the purposes of this paper are David’s comments on policy. First of all, David (1999), pp. 115–6 raises several policy questions not discussed by Krugman. Second, he states that Krugman’s “commendable caution” on policy issues may be justifiable by the author’s notion of the limitations of his model, in light of previous delusions with the policy prescriptions of new trade theories. Third, and most important, David calls attention to the historical fact that regional development strategies are made throughout the world. The real policy concern is the occurrence of “locational tournaments” that cause “regional failures” in the sense of outcomes that are socially inefficient because they dissipate “at least part of the potential agglomeration economies and, in addition, possibly leaving taxpayers of numerous communities burdened with debt charges incurred for the provision of infrastructure capacity that remained underutilized”.

#### 2.4. *The “diamond” of competitive advantage of firms in local clusters*

On the basis of his ‘competitive advantage of nations’ approach, Porter (1990, 1998a) developed the analytical argument that the competitiveness of firms in local clusters is determined by four sets of favorable conditions prevailing in the local business environment:

- (i) factors of production (supply, cost, quality and specialization of inputs: natural resources, skills, knowledge, capital, physical and science and technology infrastructures, information and management infrastructures);
- (ii) demand (sophisticated customers, with needs of specialized goods or services that could be also internationally supplied);
- (iii) presence of suppliers and related industries and business services, and
- (iv) a context of rivalry and competition strategies of local firms.

In such an environment, multiple local actors “make up a complex web of relations that tie firms, customers, research institutions, schools and local authorities to each other. The interaction between economic, socio-cultural, political and institutional actors in a given location triggers learning and enhances the ability of actors to modify their behavior and find new solutions in response to competitive changes” (Porter and Sölvell (1998), p.443).

Although possibly too much idealized, this is a fair characterization of localized externalities and interactions in well-developed local clusters. When it comes to policy implications, however, Porter’s approach is limited to general recommendations such as: to ensure the supply of high quality inputs (educated citizens, physical infrastructure, information), to eliminate barriers to competition (protection of intellectual property rights, anti-trust laws), to stimulate the creation of norms and standards for product certification, to promote related businesses meetings and encourage the attraction of suppliers and service firms. Generally speaking, “the aim of cluster policy is to reinforce the development of all clusters”, and “market forces – not government decisions – should determine the outcomes” (Porter (1998b), p.89).

#### 2.5. *Geography and industry are dynamically interrelated*

Authors in the economic geography tradition have brought “plain old geography”<sup>2</sup> back to the core of the debate on industrial clusters. Many authors have contributed in this field,<sup>3</sup> but for the sake of objectivity we will focus the specific contribution by Scott (1998), adding comments on contributions by other authors whenever appropriate. Our interest in this specific contribution is based on two important points: first, the paper demonstrates quite clearly that industrial performance and location patterns in modern capitalism are intrinsically

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<sup>2</sup> Expression adapted from David’s (1999), p.109 ironic reference to the “plain old geographers” when commenting on Krugman’s (1999) “new economic geography” paper.

<sup>3</sup> For a critical review, see Scott (2004).

related to geography, despite globalization, and second, it strongly suggests that non-market coordination and public action are necessary to adjust the “social bases of production” of localized industrial complexes (regional industrial clusters).

To demonstrate that industrial performance is grounded in geography, Scott (1998), p.386, starts by arguing that: “(...) we can only start fully to decipher the locational logic of industrial landscape when we approach it in terms of its origins as a pure social construct, and more specifically as a question about external economies and locational agglomeration”. Then the argument proceeds by showing that, besides those static spatial issues, constrained by counter-forces (agglomeration diseconomies) that limit locational convergence, complex dynamic and historical determinants also influence industrial location. Localized increasing returns effects, dynamic learning effects, and cumulative causation characterize the evolution of regional clusters as a path-dependent process in which history, historical “accidents”, lock-in and branching points caused by radical shifts in markets and technologies play an important role. Next, the paper characterizes three historical instances of regional development associated with different forms of industrial organization and capitalist accumulation processes:

- (i) the workshop and factory system, which gave rise to the classical Marshallian industrial districts;
- (ii) Fordist mass-production, leading to large lead-plants in growth-pole industries and to the formation of core-regions and peripheral regions, and
- (iii) the flexible industrialization process, allowing the appearance of new industrial spaces, the resurgence of industrial districts<sup>4</sup> and agglomerations, and the formation of worldwide webs of interdependence that articulate global business strategies with local resources and interests, specially in industries with modular production organization.<sup>5</sup>

The conclusion is that “Regions are once again emerging as important foci of production and as repositories of specialized know-how and technological capability, even as the globalization of economic relationships proceeds apace” (Scott (1998), p.394).

The paper ends with a detailed and comprehensive set of policy considerations. Although recognizing that market mechanisms are efficient in activating agglomeration economies, Scott (1998), pp.394–9, considers that they can be enhanced by non-market coordination and collective action. In general, regional

<sup>4</sup> Markusen (1995) has made an important contribution to the understanding of this resurgence of industrial districts. She analyses the “new industrial districts” (NID) as “stick places in slippery spaces” and classifies them in four types:

- (i) the Marshallian NID, with special reference to the present Italian ID;
- (ii) the hub-and-spoke NID;
- (iii) the satellite industrial platform NID, and
- (iv) the state-centered NID.

<sup>5</sup> Some relevant contributions to the analysis of this new model of industrial organization are those by Sturgeon (2002), who discusses the emergence of modular production networks in the American electronics industry; Gereffi (1994), with a characterization of global production networks as buyer-driven and producer-driven chains, and Humphrey and Schmitz (2000), with a discussion of upgrading strategies when local producers operate in global value chains.

policies should aim at building institutional infrastructures “that lie outside of the sphere of market relations”, and at providing urban equipment, planning the use of industrial land, and mitigating pollution problems. Collective action, in turn, could bring “significant augmentation of market capability” in localized industrial complexes. They should be organized to adjust “the social bases of production in at least three main fronts”, namely

- (i) the supply of critical inputs and services such as technological research, labor-training activities, information, marketing;
- (ii) cooperation among local firms to increase efficiency in transactional interactions and to facilitate learning processes and pooling of technologies and labor skills. Cooperation schemes can be organized as consortia of local firms or public-private partnerships under some structure of local governance, and
- (iii) organization of forums for strategic choice and action to secure regional trademarks, create producer’s associations to manage short-term adverse conditions, and organize regional economic councils to discuss long-term trends and strategies.

All the participants should be local “agents of collective order” such as government bodies, firms’ and worker’s associations, and private-public consortia and partnerships. Thus all major local actors would be committed and social cohesion in the regional industrial cluster would be reinforced. This approach, according to Scott (1998), p. 397 is cost-effective because it does not involve large financial commitments, and it does not preclude market mechanisms from eliminating firms that fail.

## 2.6. *Collective efficiency*

The collective efficiency approach<sup>6</sup> also emphasizes collective actions. The argument is summarized by Schmitz (1999), pp.1504–5, by explaining that: “(...) Marshallian external economies are not sufficient to explain cluster development. In addition to incidental external economies, there is often a deliberate force at work, namely the conscious pursuit of joint action”, and so they “brought together the incidental and deliberate effects into the concept of *collective efficiency defined as the competitive advantage derived from external economies and joint action.*” After the application of this approach to case studies in many countries, the authors concluded that collective efficiency can only emerge when local producers are connected to external markets through trade networks, and when inter-firm relations are subject to sanctions and sustained by trust (Schmitz (1999), pp.1506–7). This led Schmitz and other authors in this approach to develop new

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<sup>6</sup> This approach was developed by Schmitz (1995, 1997). Later on Schmitz (1999) reviewed the concept of collective efficiency in light of a large number of applications to several case studies, published in the excellent Special Issue on Industrial Clusters in Developing Countries that they edited for *World Development*, 27(9), September 1999.

research lines to investigate the performance of industrial clusters connected to global commodity or value added chains, and to discuss the role of trust in exporting clusters.<sup>7</sup>

In their discussion of policy issues, (Schmitz (1999), pp. 1509-10) recover a previous contribution by Humphrey and Schmitz (1996) that suggests a “Triple-C Approach” to policy interventions. According to those authors, interventions must be customer-oriented, collective, and cumulative. This policy approach oriented the case studies included in the *World Development* special issue on industrial clusters. The results allowed Schmitz and Nadvi (1999) to qualify the application and to identify deficiencies of the approach.

They suggest that those policy principles should be applied “differently to different categories of clusters”, following Altenburg and Meyer-Stamer (1999) classification of three types of clusters: survival clusters of micro- and small-scale enterprises, more advanced clusters of differentiated mass producers, and clusters of transnational corporations and their suppliers.<sup>8</sup> Survival clusters should be supported for employment reasons or for their seedbed role for industrial growth and entrepreneurship. Policies should stimulate local cooperation and network formation. More advanced clusters need policy attention for upgrading in technical learning and innovation. The first step is to “build awareness of the necessity to upgrade”, and then to help firms to meet international best practices through strategic interventions and the promotion of joint actions in technological development and environment upgrading (Schmitz (1999), pp. 1509–10).<sup>9</sup> The authors advise, however, that although they emphasize joint action (or private self-help), policy interventions are not superfluous in mature clusters. They can be aimed at reducing export barriers, imposing temporary import barriers, assisting firms to acquire technical know-how and to implement quality programs, and at mediating conflicting interests among local firms and institutions.

The numerous case studies also highlighted two important deficiencies of the collective efficiency approach. First, it is not adequate for capturing cluster external linkages. This finding opened an important agenda for future research work. But the authors took a radical view on this point, stating that “clusters only experience industrial growth where effective trade networks connect them to sizable distant markets and where trust sustain interfirm relations” (Schmitz (1999), p.1507). In fact this raises governance problems, which is the second deficiency pointed out by the authors in the collective efficiency approach. They acknowledge that the potential for conflict is higher in mature clusters, where collective organizations

<sup>7</sup> The role of trust in exporting clusters is discussed in Schmitz (1999). Contributions to the study of cluster performance in global chains are summarized in the next topic of this paper.

<sup>8</sup> We do not intend to polemize about typologies, but Altenburg and Meyer-Stamer (1999) classification seems to be of little help for policy purposes. We would rather see a classification based on cluster growth potential, capabilities for innovation, insertion in the regional economy, share of the industry employment or value added, production structure, industrial organization, market channels, and social embeddedness.

<sup>9</sup> Not surprisingly there is no mention of policy objectives for the third type of clusters. Usually clusters commanded by transnational corporations leave little room for policy-making.

are more common and, we would add, where hybrid structures are present, with some firms engaged in external networks and others operate in their own, external or domestic, market channels. This gave another important clue for future research – governance structures –, which has been explored by a number of authors.

## 2.7. *Governance structures, agglomerations and global chains*

Many authors have made important contributions to the study of forms of governance in territorial agglomerations of firms or local production systems.<sup>10</sup> It is impossible to review those contributions in detail in this paper. Instead, we will highlight policy issues that stem from some of the papers.

From a policy-maker point of view, the most important analytical contributions in this literature are:

- (i) the taxonomic classification of production structures in territorial agglomerations and their relationships with governance structures;
- (ii) the characterization of global commodity chains or production networks and their connection with successful exporting clusters under chain or network governance;
- (iii) the emphasis on local governance, even if as a complementary action by local actors. Policy issues stemming from those analytical constructions can be summarized as follows.

Storper and Harrison (1991) paper offers a comprehensive classification of production systems that are differentiated according to the division of labor, the size of firms and their inter-relationships and territorial agglomeration, and then connects this classification of production structures to different forms of governance. The result is the well-known set of four types of governance structures, namely all-ring, no core; core-ring with coordinating firm; core-ring with lead firm, and all-core, no ring. At the root of this typology are structural characteristics such as hierarchy, leadership and command, as opposed to market relationships and cooperation, which define the space for policy action. When Storper and Harrison (1991), pp.419–20 come to policy discussion they recognize that, although the region may be formed by a complex set of production systems, “in most cases the ‘view from the region’ is different from the standpoint of the production system, and it is the regional standpoint that must inform local policy makers”. Thus, the degree of division of labor, the degree of hierarchy, and whether connections among firms are local or non-local are the relevant dimensions for policy-making.<sup>11</sup>

After Gereffi’s (1994,1999) analysis of producer-driven and buyer-driven global commodity chains, Humphrey and Schmitz (2000) and other authors, following

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<sup>10</sup> See for instance Storper and Harrison (1991), Markusen (1995), Gereffi (1994, 1999), Humphrey and Schmitz (2000), Dolan and Humphrey (2000), Schmitz (2000), Sturgeon (1997, 2002), and Lombardi (2003).

<sup>11</sup> The paper ends up discussing possible policy problems for specific areas included in each type of governance structure. This discussion is referred to developed countries’ production systems and will not be commented upon in this paper.

the clue about the need of governance studies made by the works in the collective efficiency approach, made several contributions on the implications of local-global interactions for cluster upgrading. Humphrey and Schmitz's (2000) paper is very important for policy discussion because it adds a new layer in the theoretical construction of cluster analysis: the interaction of global value chain governance and local governance. The central question addressed in their paper is "whether insertion in global value chains enhances or undermines local upgrading strategies". Three stages of upgrading are considered: in production, in marketing, and in strategic functions such as design and own brand manufacture. A new notion of chain coordination is introduced: the quasi-hierarchy governance, which describes more properly developing countries' asymmetrical cluster structures participating in global value chains.<sup>12</sup> Local governance and local industrial policy can help in different ways according to different cluster upgrading strategies. In case the strategy aims merely at strengthening the existing position of the cluster, then governance can take the form of

- (i) collective initiatives to promote upgrading in production through, for example, the creation of a local technology institute, and upgrading in marketing through, for example, the formation of an export consortium, or
- (ii) hub-and-spoke structure in which upgrading in production and in marketing depend on R&D activities and opening up of new markets by the local lead firm.

In this case local industrial policy could play a role in "expanding infrastructure and strengthening training, testing and certification facilities" (Humphrey and Schmitz (2000), pp.28–29). But when the strategy aims at repositioning the cluster through functional upgrading, "local industrial policy requires building a coalition of the key actors in the public and private sector" (p. 29). Business associations and lead firms in more symmetrical networks can be major players in such coalitions. Other essential policy ingredients are local institutional support, firms' own strategies for functional upgrading and, at higher policy levels, human resource formation and concurrent national industrial policy.<sup>13</sup>

## 2.8. *Geography of innovation and agglomeration*

The correlation between geography and innovation has been demonstrated empirically by several authors.<sup>14</sup> Feldman (1993, 1994) and Audretsch and Feldman (1996), for example, show that there is a clear relationship between the

<sup>12</sup> The authors state that "the more clusters are integrated into global markets, the more heterogeneous they become and the more they move towards a hub-and-spoke organization in which the lead firms become the gatekeepers of both material and knowledge flows" (Humphrey and Schmitz (2000), pp. 28–29).

<sup>13</sup> We have evidence on independent firms in asymmetrical governance structures which made strategic moves to escape from global chain networks and have been able to advance in functional upgrading, acquiring design and product development capabilities, and are now operating in their own market channels with their own brand names. See Section 2.

<sup>14</sup> See Feldman (2000) for a review of the main contributions.

localization of innovative activities, measured in terms of the number of patent citations, and the geographical concentration of innovative inputs such as R&D in universities, industrial R&D, the presence of related industries, and the presence of firms that provide specialized business services, demonstrating the importance of “geographically mediated spillovers”. They also show that there is an important correlation between the location of innovation production and the location of industry value added, but that it is the presence of related industries that is more relevant to innovation activities, indicating the significance of regional innovation systems.

There are in fact several schools of thought with different approaches to the theoretical and empirical explanation of the relations between geography and innovation, including the formation of geographically concentrated clusters of firms in many economic activities, but above all in technology-based industries.<sup>15</sup> For the purpose of this paper, it will suffice to summarize the key points that are common to several approaches, and to highlight some policy issues.

The foundation shared by all the approaches discussed here is the perception that geographical proximity facilitates the transmission of new knowledge characterized as complex, tacit, and specific to certain production and innovation systems and activities. This may seem paradoxical in the age of information and communication technology but, as noted by Audretsch and Thurik (2001), it is important not to confuse knowledge with information. While the marginal cost of transmitting information is not proportional to distance, the cost of transmitting knowledge, especially tacit knowledge, increases with distance. This type of knowledge is best transmitted through interpersonal contacts, frequent interaction, and mobility of workers from one firm to another. Hence the advantage of geographically concentrated configurations of production such as clusters.

However, although all approaches have this common foundation, two groups of approaches can be distinguished by their emphasis on differing mechanisms of knowledge transmission. One group, comprising the innovation economics and innovative systems approaches,<sup>16</sup> attributes a key role to spillovers in the transmission of knowledge among neighboring firms. These spillovers are triggered by innovative firms or institutions that generate new knowledge. The other group, comprising approaches based on regional economics, seeks to explain what makes firms localized in clusters more innovative than isolated firms. In doing so these authors emphasize a different set of key factors in knowledge transmission. According to Breschi and Malerba (2001), pp.819–820, the main points of these approaches are as follows:

- (i) learning through networking and interacting, including user-producer relationships, formal and informal collaborations, inter-firm mobility of skilled

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<sup>15</sup> For an introductory discussion of these approaches, see Breschi and Malerba (2001).

<sup>16</sup> The systems approach includes national, regional, sectoral and local innovation systems and technological systems.

workers, and spin-offs of new firms from existing firms, universities and research centers;

- (ii) the deep embeddedness of local firms in a very thick network of knowledge sharing, supported by close social interactions and facilitated by shared norms, conventions and codes, and in institutions that build trust and encourage informal relations among actors in a collective learning process;
- (iii) the availability of a common set of resources, such as universities, research centers, technology centers, and a pool of specialized and skilled labor, all of which help reduce the costs and uncertainties associated with innovative activities.

Policy issues are framed in this literature by those key points. Breschi and Malerba (2001), on the basis of several contributions to the *Industrial and Corporate Change* Special Issue on The Geography of Innovation and Economic Clustering,<sup>17</sup> summarize the policy conclusions by stating that: “papers presented in this special issue show a remarkable convergence in pointing out the ineffectiveness of public policies attempting to direct the formation of new clusters through top-down interventions, such as technopoles, science parks and firm incubators. Rather, government policies can play a very important role in clusters by accommodating the formation of new firms, investment in education and the provision of supportive infrastructures”.

Besides being very general, such policy recommendations are mostly referred to developed countries. There is no evidence that in less-developed countries technopoles, science parks and firm incubators are equally ineffective. Some detailed policy guidelines are suggested in the individual papers in *ICC* Special Issue, pointing out the need of supportive social capital, including institutions, entrepreneurial services, venture capital funds, active research universities, multinational investments, export orientation, and so on.

On the other hand, Audretsch (1998) is more emphatic on the role of public policies in the location of innovative activities. He sees two fundamental shifts in public policies:

- (i) in the policy focus, “away from the traditional triad of policy instruments essentially constraining the freedom of firms to contract – regulation, competition policy or antitrust in the USA, and public ownership of business” (to) “a new policy approach (...) which focuses on enabling the creation and commercialization of knowledge. Examples of such policies include encouraging R&D, venture capital and new-firm start-ups”;
- (ii) in the “locus of such enabling policies, which are increasingly at state, regional, or even local level” (Audretsch (1998), p.26).

The author concludes by characterizing these changes as “a silent policy revolution currently under way” (p.27).

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<sup>17</sup> For the purpose of policy discussion the most relevant contributions are those by Breshnahan et al. (2001); Feldman (2001); Saxenian and HSU (2001), Maskell (2001), and Cooke (2001).

## 2.9. *Systemic and evolutionary nature of local production systems*

In the last decade a new, cognitive and evolutionary approach to analyze industrial districts or local production systems has been developed. The most important contributions on this line of thought are those by Belussi (1995); Belussi and Gottardi (2000), Belussi and Gottardi (2000), and Lombardi (2000, 2003).<sup>18</sup> Our discussion will be centered in Lombardi's contribution.

In Lombardi's (2003) paper the new theoretical framework is explained in great detail. Although specifically referred to the Italian industrial districts, the framework takes into account international trends in industrial organization, technical change and competition, which affect local production systems (LPS) all over the world. For this reason, the essential elements of Lombardi's analysis may be considered as generally applicable.

The paper analyses the evolution of Italian LPS in the last three decades as the result of the "dynamic matching between systemic properties of (...) LPS and the characteristics of the competitive environment" (Lombardi (2003), p.1443). After a stylized description of the evolutionary phases in the development of traditional LPS, the author discusses the evolutionary dynamics of LPS, which he characterizes as adaptive, self-organized, complex systems of collective order.<sup>19</sup> In such complex systems, he argues, evolution is determined by "how information and knowledge flows are created and organized" (p.1444). Thus the focus of the approach is on the key idea of the "centrality of information" in the "interactions between agents and entities which exercise functions" that must be specified by information and knowledge (p.1444). Information asymmetries between strategic agents, who have access to market trends and other information, and operational units in the production network, produce an "informational divide". The strategic agents become holders of hidden information, which they translate into parametric information for the operational units. Coordination is automatic, organized by an "invisible mind".

The informational divide turned traditional LPS incapable to innovate, since technological choices and investment decisions are made by operational units which do not have access to market information. Thus, when new competitive factors became relevant in the last 15 years, the systemic properties and the adaptive behavior of LPS were weakened. A new cognitive architecture then emerges, in which the informational divide tends to disappear, the techno-organizational structures become vertically integrated, and coordination becomes explicitly designed as "more visible minds" (Lombardi 2003).

<sup>18</sup> On similar lines, but not strictly related to the cognitive approach, is the excellent paper by Lazerson and Lorenzoni (1999).

<sup>19</sup> Lombardi's paper draws on a great number of contributions by other authors on this line as well as on other approaches like complex systems analysis, cognitive science, evolutionary systems, industrial organization, regional science. . . For reasons of brevity we are not going to trail his sources and influences in this paper.

Policy issues are not discussed in Lombardi's paper. The only suggestion is to create special agencies to help LPS to adapt to the new trends. The agencies would perform two main roles: (1) in the supply of infrastructure, logistics and other public services or goods. This would be a systemic function that would reinforce the LPS systemic properties; (2) in the "strategic coordination of operators, through associations of firms, consortiums, etc". In this function, the agency would reinforce the evolutionary trend towards the centralization of decision-making (Lombardi (2003), p.1459).

It seems plausible that, as long as industrial clusters in developing countries are affected by those evolutionary trends – as appears to be the case – they should design policies to improve the clusters capacity to innovate, both in product differentiation and in industrial organization. Belussi and Gottardi (2000) is more emphatic on the need of such policies, but her work is also referred to Italian LPS. Focusing on learning processes in knowledge-intensive LPS, she draws a detailed outline of specific policy options to mobilize and create new knowledge and for the coordination and distribution of technical information, production of codes and languages for interpreting knowledge, reinforcement of the local identity and production of culture, and preservation of specific accumulated knowledge (Belussi and Gottardi (2000), pp.121–2). These are undoubtedly useful general guidelines, but a policy agenda for clusters in developing countries should be necessarily ample in scope and extended to all types of industrial clusters.

### 3. Methodology and Evidence from its Application

Designed with the specific purpose of producing evidence for cluster policy-making in Brazil, our methodology comprises four consecutive steps:

- (i) the application of quantitative indicators for the identification and structural characterization of industrial clusters;
- (ii) the use of regionalized quantitative indicators of innovation inputs and outcomes as proxies for the regional distribution of industrial clusters' innovative capabilities;
- (iii) the statistical account of the regional distribution of educational systems, labor training courses, laboratories, research centers, and technology support institutions as a proxy for regional or local capabilities, and
- (iv) the field research work, collecting data and information about the local production system as a whole and the firms that operate in it.

This section focuses the results of several applications of our methodology.<sup>20</sup> Specific indicator formulas and other methodological details can be seen in our previous works, especially Suzigan et al. (2003, 2004, 2005) and Suzigan (2005).

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<sup>20</sup> Case studies have been made in eight states, covering several manufacturing industries (leather and shoe, furniture, jewelry, information and communication equipment, ceramics, medical equipment, clothing, marble stones, wood products, agriculture machinery, plastics) and software. Approximately 400 firms and institutions have been visited in the last five years.

The application of our methodology allowed us to map a great number of industrial clusters, to characterize their production structure in statistical terms, and to suggest a typology of LPS (see Section 3). Additionally, it brought evidence on the regional distribution of ST&I activities, and of firms' supporting institutions. The results of the statistical work, plus the evidence on ST&I activities and on institutions, informed field research work in a selected number of LPS, producing case studies with a rich and varied spectrum of system features and problems.

The results offer strong evidences not only to support our quantitative methods but also to confirm the various theoretical approaches. A stylized description of the cases we have studied may be summarized as follows. All of them have deep historical roots: they started either by some historical accident, e.g. the development of local skills or knowledge, or by initial conditions related to, e.g., a pioneer entrepreneur, the presence of education and research institutions. External economies attract the first firms. A development process ensues when the site becomes an attractive location in the investment decisions of other firms in the industry, forming an agglomeration. As it grows, supplying regional markets, the agglomeration of firms becomes attractive to other related industries. Local inter-relationships in production increase, facilitating cooperation with suppliers, knowledge spillovers among firms, and collective actions to organize business associations and labor unions. As local production structure diversifies to include suppliers of raw materials, parts and equipment, a greater division of labor takes place and a sophisticated industrial organization is shaped, with more inter-relationships in production that, in turn, enhances learning processes, but with fewer horizontal interactions and cooperation. Increasing returns reinforces the process and stimulates new firm entries. Competition increases and new competitive factors other than price become relevant. Local firms increase their demand for higher skills and for technical and technological services that would enable them to improve their capacity to differentiate their products and to develop new products and processes. Professionals, institutions and firms providing those services are attracted. Some firms become dominant for their capacity to control market information, to open new domestic or international market channels, and to dominate strategic assets like capabilities in R&D and brand names. The morphology of the system tends to change, and some form of governance is established, either by system self-regulating mechanisms or by intentional planning. In the latter case governance may be exercised by local dominating firms with their own market channels, production networks and brand names, or by domestic or international firms controlling buyer- or producer-driven commodity or value chains, or by a collective organization of local firms and institutions.

The results have also produced useful evidence on problems usually affecting most of the LPS. To facilitate policy-making discussion, the problems are summarized below first at system level and then at firm level. They are generally present in some degree in all types of LPS.

At system level there are five major problems, which could be the object of policy measures or collective action. The first has to do with infrastructures. In most

cases there is no planning of land use for industrial plants and residences. The urban area becomes congested, urban infrastructures deteriorate, transportation costs increase, logistic problems start to weaken firms' competitiveness, and agglomeration diseconomies halts LPS growth and development. This is aggravated by additional urban infrastructure problems related to water supply, sewage, and pollution. Other more general infrastructure problems like the cost and quality of highway transportation and port services also diminish firms' competitiveness. The latter is a regional or state policy-making problem, but local firms and government bodies can act politically to get the state government to improve roads and port services.

The second major problem at system level is the insufficient development of local institutions. In general, local government bodies are not relevant actors in the LPS studied, but this is a political and cultural, rather than a policy-making problem. More important from a policy-making point of view is the insufficiency of local technology-service institutions, collective R&D centers and laboratories, and local-specific technology-focused degree courses.<sup>21</sup> Local educational systems are also weak in the supply of undergraduate and graduate management and business administration courses. Labor training, on the other hand, is well structured in most LPS, either by firms' on-the-job training schemes or by technical and professional schools.

The third usual problem at system level is the absence of a collective organization to deal with crises and evolutionary trends. All studied LPS had at some time to overcome crises caused by domestic or international market trends, or to face major technological or organizational changes, and usually the crises were lengthened and deepened and the adaptation to changes was slow for lack of an adequate forum to discuss this kind of system problem, which also impairs foresight and strategic actions of a collective nature. In some cases organizational changes like the decision of firms to enter a production or value chain network breaks the LPS social cohesion and undermines trustful relations. The consequences are increasing difficulties for collective actions with a view to, e.g., create an export consortium or a technology services center, and more generally for local governance.

The fourth problem is precisely governance. Evolutionary changes produced hybrid structures in most of the LPS studied, in the same way and by the same mechanisms as those observed by Humphrey and Schmitz (2000) and Lombardi (2003). Hybrid structures brought with them hybrid forms of governance. Usually there is a structural divide of firms: on one side are some large, lead firms that either operate their own network of local producers and have their own market channels, or are themselves producers for domestic or international buyers or subcontractors,

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<sup>21</sup> In some LPS the interaction with the educational system is better focused. For example, the ICT industry cluster of Campinas (SP) benefits from courses in that industry area at UNICAMP (State University of Campinas) and other local educational institutions. ICT firms in Campinas also interact intensively with the local R&D centers and labs, which have been historically present in the region. In Votuporanga (SP), the furniture LPS has managed to create a specific furniture technology degree course in a local university.

and on the other side are a great number of small (in some places also large) independent firms. The firms in the first segment have their own governance structure or are subordinated to external, domestic or international governance structure. The firms in the second segment usually have greater and varied local interactions, are socially more embedded, being as they usually are the product of spin-offs from other local firms, and tend to cooperate or act collectively. But in many LPS that we have visited the initiatives of small firms of the second segment are impaired by the firms of the first segment, which usually have the political control of the local business association.<sup>22</sup> So, what is the policy problem? It is to make possible for the small, independent firms to organize themselves in a local governance structure. We suggest that the best way to do that is for firms to have a coordinating agent to organize collective actions and to bridge local firms and institutions with state or federal government financial or technological institutions.<sup>23</sup>

Finally, the fifth problem at system level, although not in all of the LPS, is environmental pollution. The LPS of industries that produce toxic residues or effluents, such as leather and shoes, leather products, and jewelry, or that explore natural resources, such as ceramic tiles and wood furniture, must not only comply with state environment legislation but also have their own environment control policy in order to avoid social costs. Problems are aggravated where the number of informal firms is larger. Cluster policies could stimulate firms and local governments to build adequate disposal sites, to treat effluents in the industrial plant, and to exploit only environmentally certified natural resources.

At firms level the problems are more numerous, albeit easier to solve from the point of view of policies. Some of them have the same origin as those at system level. They have been observed in all LPS that we have visited. The most frequently observed problems are listed and briefly commented upon in the next paragraph.

One of the problems that affect most firms and especially small firms are those related to plant layout and to production and technology bottlenecks. Production lines are inefficiently organized, increasing production time, or are bottlenecked because of one or more equipment with incompatible production capacity or inadequate technology. Another frequently observed problem is the deficiency in management and business administration. Many entrepreneurs are former blue-collar workers who acquire only rudimentary knowledge in those areas. Thus, many small firms are cost-inefficient and badly managed. A third problem is that most of the small firms, but some of the large ones too, are trapped in competition

<sup>22</sup> The most conspicuous example is that of Franca (SP), a men's leather shoe manufacturing LPS, where several initiatives of smaller, independent firms, to organize collective actions were sabotaged by the large, dominating firms that are subcontracted producers for international buyers.

<sup>23</sup> We base our suggestion in the most successful experience of a group of 25 small firms from Votuporanga who hired a coordinator to manage them out of a crisis. The coordinator organized a total quality control program, introduced management best practices, helped to create a course of furniture manufacturing technology in the local university, and managed the financing and establishment of a technology, R&D and labor training center that became the second most important in the country. The results were production growth, increasing exports, and technological progress, with several firms ISO certified.

based on low prices, usually combined with large quantities of production and standard quality. That happens because they get locked-in into subordinate trade relations with retailers or network producers and into inferior technologies. Fourth, as price-competition becomes fiercer, firms tend to be unwilling to cooperate, although production inter-relations and learning interactions continue to exist. This makes collective actions more improbable. Fifth, there is a general deficiency in the so-called strategic assets: R&D structures, product development knowledge, design, patenting, and brand names. Again, firms producing for supply chains or production networks, although they manage to upgrade in production, they fail to develop capabilities in those strategic assets.<sup>24</sup> Sixth, although information and communication technologies have been widely diffused lately, most firms still find it difficult or costly to gather information on new products, technologies and market trends.<sup>25</sup> Seventh, quality problems are widespread. Firms, above all small firms, tend to focus end-of-production line quality control, with a considerable rate of rejection and re-elaboration. There is insufficient quality control in the production chain, and few firms get ISO certificates. Eighth, there is a general scarcity of specialized professionals or firms in services related to the local production. This includes design, total quality control, production management methods, and professionals like laboratory technicians, financial managers and other business administration specialists. Ninth, environmental problems: in LPS where production processes generates toxic residues and effluents, environmental control at plant level is usually deficient.

#### **4. Policy-Making for Local Production Systems: A Suggested Approach**

The body of evidence produced by the application of our methodology, with the background of the theoretical and analytical framework discussed in Section 1, offers secure bases for suggesting an approach to policy-making for LPS. Although referred to Brazil, we hope that this approach can serve as a guide for discussion of policy-making for the development of LPS in general.

Some basic principles are needed: First of all, the methodological approach we developed, by mapping and characterizing existing LPS, respects market principles and private decisions and does not consider it feasible simply to create LPS. Thus,

<sup>24</sup> The case of Franca comes to mind once more. Most of the large firms producing for foreign buyers are technically upgraded but devote much less attention to product and process innovations. Independent, small and large firms, on the other hand, are innovative and successful in opening their own market channels with their own brand names all over the world. The same happens in other LPS such as Votuporanga (furniture) and Limeira (SP) (jewelry).

<sup>25</sup> A creative solution was found in Birigui (SP), a LPS that manufactures children shoes made predominantly from synthetic material. There, a specialized-service firm was created by a former manufacturer, who travels abroad twice a year to gather information on new products and market trends for a number of local manufacturers. Data and information are then compacted in a CD-ROM and supplied to the manufacturers, who pay a fraction of the cost they would have to pay to collect those data and information by themselves. The service was so successful that it was extended to firms in other similar clusters in the country, which was of course against the interests of the local manufacturers.

policies should never have this objective. Secondly, some general principles must be observed:

- (i) Policies must offer the conditions for local actors – firms, entrepreneurs, workers, government bodies, private institutions, and society – to make use of their capacity to mobilize the system to favor development. That means policies should never substitute for local actors, and must avoid measures that could inhibit the autonomous development of the system and its social forces;
- (ii) Policies must require local actors to commit themselves to policy measures either by contributing with a fraction of the allocated public resources, or by taking up complementary collective actions;
- (iii) Specific policy measures must be differentiated by types of LPS and according to their stage of development.

There are, however, some policy measures of general application to all kinds of LPS. Keeping those principles in mind, and considering the LPS problems evidenced by our case studies, the remainder of this section develops some suggested policy guidelines.

#### 4.1. *Policy measures of general application*

At first, policies should address general problems that are common to most of the LPS. These include:

- (i) the five areas in which we identified problems at system level, namely infrastructures, local institutions, organization for strategic actions, governance, and environment pollution, and
- (ii) some problems that usually affect the efficiency of almost all firms. Why are those two kinds of general policy measures necessary?

By tackling infrastructure problems, the policy would eliminate sources of external diseconomies to local firms. In order to do that, it would be necessary first to identify those sources of external diseconomies and then mobilize local actors to invest and/or to find the means of bringing investors in. Financial mechanisms or incentives could be adequate instruments to start the process.

Deficiencies in services related to the main local economic activity, which are provided by institutions, increases firms' costs of labor training, R&D and other technology and managing activities, and limit firms' abilities to absorb new knowledge and to develop learning processes. Policy measures in this area should facilitate the assessment of such deficiencies and offer support for the development of existing institutions or for the establishment of those that could match the needs of the LPS.

General policy measures should also stimulate local actors to organize some form of collective organization for the discussion of problems and long-term trends.<sup>26</sup>

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<sup>26</sup> This is in agreement with Scott's (1998), p.396 suggestion for the creation of "forums for strategic choice and action", and with Lombardi's (2003), p.1459 similar suggestion for the "creation of agencies

This would help them to anticipate major crises and evolutionary changes, and to limit their costs by finding collective forms of strategic action. In addition, the system social cohesion would be strengthened and the building of trust reinforced.

Policies aimed at the governance of the system should focus on small firms and give them support to organize a local governance structure of their own. The role of a coordinator, a leading local entrepreneur or a hired professional, may be decisive for the success of this initiative. It would help in building ties that could lead to joint actions in exports, gathering of information on market trends, creation of a labor training school, establishment of a R&D and technology services center, and other related activities.

Finally, system level environmental policies should include regulations that require the local public sector and firms associations to build disposal sites, and firms to introduce pollution control equipments and effluent treatment systems at plant level. In addition to that, a clause should condition the benefit of any policy measure to compliance to government environmental norms and regulations.

Firm level general policies, on the other hand, should aim at eliminating the most common sources of inefficiencies observed in case studies. In all LPS there is need of professional services to assist in methods of planning and control of production processes, total quality control, and other related techniques. There is also a general need of courses in management practices and business administration methods. Equally necessary in almost all LPS are information systems that enable firms to follow market trends, technologies, export markets, and other relevant sources of information. Capabilities in product development and in other strategic functions are equally needed, and policies could stimulate upgrading in these areas.

#### 4.2. *Policies differentiated by types of LPS*

Local production systems have characteristics that enable them to be raised to the status of industrial, regional and social development vectors. Moreover, they can also make a valuable contribution to the effort to enhance the nation's balance of payments if their production capacity can be complemented with new capabilities in trade and if they are directed to new markets.

While there is broad agreement on the importance of local production systems, this consensus is lacking with regard to how these clusters should be quantified and qualitatively assessed on an industry-wide and regional basis. How many LPS are there in each region or in the entire country? How important are they and what are their chief characteristics? Questions such as these have received unsystematic answers and research findings in this field are often uneven or downright contradictory.

Using the methodology developed and based on the results obtained, four basic types of LPS have been characterized. The first type comprises LPS that stand

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specialized in favoring the adaptation of decentralized production systems to radical challenges".

out for two reasons: they are enormously important to a region and also to the respective industry. The dual importance of these LPS for a region and the sectors to which they belong makes them *centers of industrial and regional development*. Alongside these doubly important LPS, there are systems which are of enormous importance to a particular industry or group of industries (as reflected in their share of production and employment) but are as it were diluted in a much larger, more diversified economic fabric: despite their considerable importance to industry, regional economic development does not depend on them so strongly. Several typical LPS sectors have sizable portions of production and employment located in regions with such a diversified economic fabric that their local contribution is far smaller: the region is important to the sector but the sector is less important to the region. This occurrence is typically associated with large industrialized cities and above all metropolitan areas. These LPS can be considered highly developed, not least because they have very significant complementary resources, and hence they can be termed *advanced vectors*. If these local systems are important to an industry or group of industries but not to a region, there are others in precisely the opposite situation: they are important to a region but do not make a decisive contribution to the main industry to which they belong. This configuration represents above all a *vector of local development*. Lastly, there is a type of LPS that has little importance for its industry and coexists with other economic activities in the region. It represents as it were an *embryonic local production system*.

This typology may be valuable when formulating a comprehensive and consistent industrial policy for the highly diverse LPS universe. Policy measures designed to foster development of LPS would have to be tailored according to the characteristics of each type. Some general guidelines are suggested below on the basis of the previously discussed evidence.

*Centers of industrial and regional development* have developed vigorously and have a long history in almost every case. Given the intrinsic characteristics of this development process their manufacturing dimension is hyper-developed in relation to their commercial functions, including marketing. For this very reason an appropriate industrial policy designed to help these systems reach a higher stage of development and competitiveness would include a combination of commercial and industrial functions geared to moving beyond dependency on channels and other forms of selling, and to encouraging a focus on product development, brand names, patent registration, design, certification, and quality. Overcoming subordinate market insertion and a production function tied to high volume coupled with low price requires integrated and consistent development in both dimensions. The industrial policy “package” offered to systems of this type should include these two aspects and treat them in an integrated manner. A typical strategy for promoting these centers of industrial and regional development would include education and training in higher technical skills and autonomous selling and marketing capabilities. The former can be provided by extending the present education and training facilities, but the latter involve bringing together dispersed competencies and setting up new business associations or special legal vehicles.

*Embryonic local production systems* are the most numerous type, although the number of cases can be reduced if more rigorous filters are included in the methodology. If the resources required for a policy of fomenting these embryonic LPS can be considered modest in individual terms, the number of such LPS and the probable incipient nature of the local fabric of organizations entails greater risks. Thus the industrial policy package for embryonic LPS should be associated with a concatenated sequence of conditioned stages, each clearly requiring matching local contributions in the form of funds, resources or some other involvement. Although embryonic LPS are diametrically opposite to the previous type described above (*centers of industrial and regional development*) in several respects, it is important to avoid making the mistake of trying to force them to follow in a linear way all the developmental stages of their developed “predecessors”. After all, today these veterans find themselves in the “blind alley” of high volume and low prices, and it will be no easy task to find a way out. To avoid this trap industrial policy must from the beginning take pains to encourage embryonic LPS to conduct market research that will help identify segments or even niche markets capable of being exploited by coordinated promotional activities. This is the best way to sidestep the temptation to focus on mere expansion of production capacity and downward competition, which drives down prices and quality. Industrial policy should include coordinated measures to provide the conditions for acquiring the necessary technical and production-related capabilities for them to develop these market segments.

The systems comprised by *local development* vectors are those industrial policy is best equipped to foment. On one hand they have passed the embryonic stage and have the critical mass for their local importance to be recognized. On the other they do not yet face the difficulties inherent in *centers of industrial and regional development*, such as having to act as trailblazers and possibly make mid-course corrections. Because they are at a certain distance from these centers, *local development vectors* can avoid repeating mistakes and more easily identify opportunities. Their main challenge is to build a trajectory on the basis of sporadic or localized opportunities.

*Advanced vectors*, unlike all the other types mentioned, pose considerable difficulties for policy makers aiming to integrate them with a predominant dimension of regional development. They have minimal significance in regions normally much more developed and with a diversified and integrated economic (and social) fabric. This does not mean this type of local system is less structured or does not have strong links and relationships among its constituent elements, although they may not be very visible. However, the fact is that the surrounding economic fabric has multiple ingredients that can be mobilized to promote the development of the constituent elements of advanced vectors: this is a characteristic that differentiates them clearly from local development vectors and a fortiori from the other types. Thus policy measures to foment advanced vectors should focus on mobilizing local resources to prevent the erosion of competitiveness which insertion of their products at the bottom of the market would inevitably cause if these systems were to depend on a cheap and plentiful supply of factors in areas (urban

or metropolitan) where such factors are certainly far more expensive.

The policy instruments best suited to each of these types of LPS are evidently very different. The activities to be considered for embryonic local systems may be numerous but they will certainly be more basic. Experience in the field shows that in these cases basic ingredients such as courses on cost accounting and management are extremely useful and can be inserted in the initial stages of longer, more ambitious development programs. As for the more advanced types of LPS, be they centers or vectors, the appropriate policy instruments will involve larger volumes of funding and other resources, while also entailing greater risk in terms of the resources involved.

In any of the four cases discussed, policy should offer conditions for local protagonists — firms, entrepreneurs, workers, public and private entities, and the formal or informal associative fabric — to use their capacity for mobilization in favor of development. This means the policy cannot and must not take the place of local actors. Moreover, if it is to avoid failure from the start it must not include measures that weaken or stultify the autonomous development of the local system and its social forces. Local institutions must be preponderant protagonists in any policy for LPS.

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