

Local Systems of Innovation in Developing Countries: Evidence from a Brazilian Furniture Cluster

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Abstract

Recent research on industrial clusters in developing countries has increasingly focused on knowledge related issues to explain clusters' competitiveness. In particular, several empirical studies have shifted their attention from the analysis of production system to innovation system, considered the appropriate conceptual framework to give full account of clusters' dynamism. This paper aims at contributing to such literature providing further evidence on the innovation behaviour and on the organisational changes occurred to a Brazilian furniture cluster: Sao Bento do Sul.

Although Sao Bento is a well-established production system and a good export-performing cluster, our results show the existence of a disarticulated innovation system. Our aim is to explore to what extent the changes occurred to cluster's sources of knowledge and to systemic interactions among cluster's members may contribute to build up a more structured innovation system. We argue that the existing institutional framework may hinder knowledge absorption and diffusion and in turn could seriously undermine firms' innovative opportunities.

1- Introduction and theoretical context

A great amount of studies have been recently dedicated to analysing how local factors have been affecting the innovative and competitive performance of clusters, both in developed and developing countries. Such interest has seen the convergence of different fields of economics, from industrial and knowledge economics to development economics and geography¹. Most of these studies share the assumption that knowledge is one of the main determinants of economic growth, and that clustering firms originate their dynamic competitive advantages from their ability to adopt, diffuse and generate knowledge. This idea goes back to the marshallian concept of external economies, which identifies knowledge spillovers and labour mobility as the main ingredients of district's competitive advantages.

Nevertheless, disputes on how knowledge is produced and diffused locally have brought a lively debate. Divergent views mainly revert to different interpretations of the knowledge concept itself. We may roughly distinguish between two opposite views: a cognitive interpretation of knowledge versus an 'information' approach.

The latter refers to the absolute rationality assumption. It implies that no cognitive differences exist among individuals. According to this view, knowledge is interpreted as a commodity, so it assumes the feature of a public good: every one can use and exploit it freely. This interpretation, which does not make differences among information and knowledge, avoids to focus on the crucial issue of knowledge acquisition, in other words on learning activities (Arrow, 1962). Mainstream economics, in particular the new economic geography can be ascribed to this vision (Krugman, 1991, 1995). The idea that knowledge is a localised public good or a club good, also pervades a heterogeneous literature dealing with regional spillovers in a non-mainstream perspective, such as Saxenian's case studies of Silicon Valley high-tech cluster or the 'milieu innovateur' studies in Europe (Camagni 1991, Capello, 1997).

According to the regionalist perspective, dynamic collective learning processes take place within the 'milieu' (Crevoiseir et al, 1990, quoted in Camagni, 1991: p.130). In Camagni words: "the milieu performs most of firms' functions, in strict integration and 'synergy' with the firm, through a *collective and socialised process* allowing cost reduction and enhancing the effectiveness of the dynamic decisions-making of local firms" (p.130). These studies point out that 'proximity plays a necessary (but not sufficient) role in the creation of local synergies' (Camagni, 1991: 142), in fact network linkages play also a relevant role in information exchanges.

The Italian industrial district literature - IDL - assumes that knowledge is tacit and complex, so it implicitly adheres to the idea that its transmission should follow a sticky path and can be circulated through institutions; nevertheless, many empirical studies within this tradition treat knowledge as a commodity that freely circulates among cluster members, in a way that firms are able to capture it as it was a public good.

¹ Among the others: the neo-marshallian school on Italian districts: Becattini, 1979 and 2000; the innovative milieu school: Camagni, 1991; Capello, 1999; the regional and local system of innovation approach: Cooke, 1997; De la Mothe and Paquet, 1998. We mention also studies focused on developing countries, among others: Cassiolato and Lastres 1999; Cimoli, 2001; Schmitz, 1999; Rabellotti, 1997.

Similarly econometric contributions support the thesis that firms' localised close to sources of knowledge may benefit from knowledge *spillovers* (Audretsch, 1998; Audretsch and Feldman, 1999; Jaffe, 1989). The point they made is that knowledge, especially some pieces of scientific knowledge, is mainly tacit, so proximity will ease personal contacts among researchers, which is the only mechanism through which such knowledge can circulate.

Among the former (the cognitive approach), an earlier attempt to introduce the tacit knowledge argument into an economic context has been firstly made by Nelson and Winter (1982). They recovered the Michael Polanyi's distinction between tacit and explicit knowledge (Polanyi, 1958; 1967). In Polanyi's view, knowledge is personal and embedded into skills. Therefore it cannot freely circulate since learning is a complex activity, which requires time and endeavours. Explicit knowledge is just a representation of knowledge, its transmission depends on codification. Individuals or firms set codes in such a way constrain the boundaries of knowledge diffusion. Nelson and Winter point out that overall firms' decision about the right degree of *tacitness* is basically a matter of incentive.

Recent contributions on this issue, recovering the Nelson and Winter legacy, have come from scholars working in the field of economics of knowledge and innovation (Cowan and Foray, 1997; Cowan, David and Foray, 2000; Breschi and Lissoni, 2001). They maintain that knowledge codification and tacitness became fuzzy concepts, especially when have been used in the context of industrial districts. As Lissoni points out, *'industrial districts are seen as the reigns of tacit knowledge, with the complementary view that only personal relationship can vehicle it, being tacitness connected inextricably to the broader culture and language of people'* (Lissoni, 2001: 3).

According to Lissoni, this view led many researchers to pay less attention to key issues such as firms' network linkages; at the same time suggested misleading policy measures, as for science parks. Such clarification seem to be relevant when assessing the importance of knowledge transmission within industrial districts.

In a similar way clustering and knowledge diffusion became priority issues for development scholars. Among the main approaches that addressed this issue we can mention: the 'collective efficiency' approach; and the 'technological capability' approach.

The 'collective efficiency' approach focuses on the benefit that clustered firms would gain from the combination of external economies and cooperative action (Schmitz, 1995, 1999). Main emphasis is placed on firm's opportunity to upgrade by implementing joint actions with other clustered firms and local institutions (Schmitz, Rabellotti, Nadvi *et al.*, 1999). Horizontal cooperation, as in the IDL literature, has been interpreted as a relevant channel for knowledge transmission.

The 'technological capability' approach has addressed the issue of clusters' dynamic pointing out the importance of the technological dimension (Bell and Pavitt 1997; Bell and Albu; 1999). In their view, research agenda should shift its focus from production system to knowledge system. The former identifies the basic features of the cluster (e.g. input linkages among cluster members, providing a static picture of what are the actors and the relationship between them. The latter identifies those factors which contribute to foster clusters technological capabilities, among them: advanced training activities, contacts with innovative firms, either internal or external to the cluster; research and development activities jointly developed by firms and local or international research centres, etc.

Apart from the dispute on knowledge concept, a broader convergence exists among those approaches that have focused on local innovation systems (either coming from the industrial or geography schools). Space and territory matter, since institutions are shaped by a particular social and cultural context. In this context firms has been considered as learning organisations characterised by routines, which are embedded within specific institutions. Innovation is a complex, cumulative process resulting from continuous interactions either between firm's units or between user and producers. Most of these studies adopt a systemic perspective, even if different weight is attributed either to spatial issues or innovation issues in order to explain firm's competitive advantages.

This theoretical debating leads to a major empirical conclusion. When research concerns clustered firms and the focus is on their innovation capacity, more attention should be paid to sources, channels and mechanisms through which knowledge circulates. On the basis of these theoretical suggestions, we aim at reinterpreting the evolution of a well-studied Brazilian industrial cluster, adopting the conceptual framework of local system of innovation. We carry out our analysis providing a vast array of innovation and relational measures. In particular, we first explore the innovative dynamism of firms controlling for the type of innovation introduced; we then reconstruct linkages between external and internal sources of knowledge and evaluate the content of these knowledge flows. IN doing so we also aim at identifying the boundaries of the innovation system.

This paper is structured as follows. In section 2, we present a definition of local innovation system, which is further specified according to three organisational aspects. We will provide a conceptual framework for measuring the existence of a structured system of innovation. In section 3, we illustrate the historical background of the Sao Bento furniture district, we delineate its latest developments and its main characteristics. In section 4, we will discuss some methodological issues,

with a brief description of the firms' sample and a presentation of the basic features of the Sao Bento industrial district.

In Section 5, we will present the main findings of a fieldwork research conducted on local firms and organisations. Questionnaire results will provide information about the openness of the system, its technological capabilities and its innovative attitude. Finally, we will draw some conclusions on the evolution of the organisational structure of the cluster and how it affects the absorptive capacity of the system.

2- Local innovation system: relevant issues

Let me briefly say what we intend for innovation or knowledge system. This is as a set of localised network of actors (firms and organisations) devoted to generate, transform and diffuse knowledge. Many of its properties are derived from the national innovation system literature (Nelson, 1993; Lundvall, 1992; Edquist, 1997). Obviously not all clusters are local innovation systems. Such statement suggests that we can empirically observe industrial clusters wherein a set of organisations and institutions devoted to learning and innovation activities is in place. However, as to prove that a system of innovation is working, theory suggests to explore the black box of these relationships: the content of the information/knowledge exchanged; its outcome; the characteristics of actors involved. It seems that contextualised factors, such as untraded interdependences, informal knowledge flows and socio-cultural conditions, may affect innovative behaviours. In addition, clusters specialised in traditional industries, where innovation is less dependent on formal R&D, require further investigation on informal mechanisms of cooperation and on intangible assets. In such a cases, traditional innovation indicators (R&D expenditure, patents, number of engineers, etc) fail to give full account of firms' dynamism.

Innovation system concept is different from the production system one. Recalling Bell and Albu (1999: 1723): 'the knowledge system concept (...) encompasses those flows of knowledge, stocks of knowledge and organisational systems involved in generating and managing changes in the products, processes or organisation of production'. On the contrary 'the production system encompasses the product designs, materials, machines (...) involved in production of goods to a given specification (...). It defines only the status quo'.

It turns out that the organisational characteristics of the innovation system represent a main issue to be analysed as to give account of the innovative patterns followed by industrial agglomerations. More specifically, at least three aspects are worth being investigated: the boundaries of the system; its systemic interactions; the actors' characteristics. We present their features below.

Actor characteristics: As recent studies have shown, clusters, rather than appearing as an undifferentiated community of firms, seem to be populated by networks of medium and large enterprise, which play a central role in promoting new firms and establishing connections with the external world (Viesti, 1992, 2000; Lazerson and Lorenzoni, 1999; Rabellotti and Schmitz, 1999).

Even more than that, cluster' members differ in terms of their ability to generate, acquire and diffuse knowledge. According to their degree of absorptive and relational capabilities they may affect cluster's learning opportunities. In particular some of them, acting as gatekeepers (Allen, 1977), may assume a key role in acquiring external technologies and practices and socialising such knowledge locally. However, high absorptive capacity at firm level does not automatically imply that other cluster's members would be able to access and exploit the incoming flows of knowledge. We could suggest that gatekeepers release external knowledge asymmetrically, depending on their institutional and technological features and on their power

within the cluster. At the same time, it could be also the case that local firms would not be able to acquire such knowledge, either because they lack of competencies or lack of economic incentives.

Systemic interactions: The idea of searching for systemic interaction at local level relies upon the idea that learning is mostly produced collectively. Firms and individuals interacting build up a 'base of shared and common knowledge which allow them to coordinate their actions in the resolution of the technological and organisational problems they confront to' (Lorenz, 1996, quoted in Keeble and Wilkinson, 1999: 296). Conscious and unconscious efforts made by local actors sustain such flows of knowledge and information. Knowledge diffusion may be mostly driven by input exchanges between specialised firms within unorganised clusters (vertical cooperation). Horizontal cooperation is also often mentioned as a relevant channel of diffusion, more specifically it may take place among technicians belonging to competing firms, which try to solve out common problems. Spatial proximity and a certain degree of division of labour are basic ingredients for those knowledge flows.

More structured and organised clusters support such exchanges through more active and voluntary mechanisms, which are either supported within firm (ie training scheme, cooperation among subsidiaries, etc) or at cluster level through research collaborations, consortia, training and technological organisations.

Different organisational arrangements affect both firms and cluster learning opportunities. Higher organised and structured clusters may show higher degrees of absorptive capacity as opposite to informal and unstructured ones (Bell and Albu, 1999, Mytelka, 2000). In addition, sector specific factors and knowledge characteristics may affect firms' interaction. Clusters specialised in traditional sectors seem to be characterised by informal cooperation between users and producers, whereas horizontal cooperation is likely to be limited to generic exchanges of information. For example, contacts among firms could be limited to *know-who* exchanges (Lissoni and Breschi, 2001), or eventually to monitoring and watching rivals (Maskell, 2001: 30).

The boundaries of the local system: As far as openness is concerned, we recover the suggestion that external sources of knowledge allow clusters to escape lock-in effects and 'entrophic death' (Camagni, 1991). Clusters oriented towards external environments are able to absorb new knowledge, hence avoiding the risks of declining innovative capabilities. On the other hand, external firms may decide to locate in specific clusters searching for complementary assets and aiming at profiting from their internal synergies and culture.

Local firms may also enter into 'global value chains' (Kaplinsky, 2000) and learn from foreign buyers and retailers. Global buyers often support the introduction of international quality standards among local producers. They provide technical assistance and facilitate contact with foreign machine providers. Whether learning opportunities arise from these interactions strongly depend on the hierarchical structure of such networks. For instance, buyers' strategies may limit their assistance to upgrade producers' production capabilities rather than no-production ones (ie design, marketing, etc) (Schmitz and Knorriga, 2000: 195).

International buyers may also have negative effects on local networks, by obliging local producers to choose foreign suppliers instead of local ones. Therefore, external linkages may revert into factors hindering local dynamism.

In the following sections we provide qualitative evidence related to the above dimensions of the innovation system. We adopt this framework to verify to what extent a emerging local innovation system in Sao Bento do Sul.

3- Origins and development of the Sao Bento furniture cluster

The region of Planalto Norte, within the Santa Catarina state, is a small area comprised between Sao Bento, Rio Negrinho, Campo Alegre and Mafra and accounts for 52% of the Brazilian furniture exports and generates 50% of the local income (Abimovel, 1997). A one-century tradition in furniture manufacturing, since the first immigration wave at the end of the 19th century, explains partly this performance. Sao Bento also hosted the main furniture enterprise in Latin America, from which originated many firms presently operating within the district. Firms located in the Planalto Norte survived many cyclical crises by restructuring their business activities through a creative-destructive process that set the conditions for building a new institutional and organizational structure for the cluster. We will briefly outline the major lines of those restructuring processes and the main features of the present productive system.

Table 1 Main exporting regions

Sate	Export (in US\$ f.o.b.)	%
Santa Catarina	191.730.940	49,77
Rio Grande	118.777.814	30,84
Other	74.693.766	19,39
TOTAL	385.202.520	100

Source: adapted form Denk, 2000; Abimovel (2000)

3.1 - A short history of the cluster

The Sao Bento furniture industry's origin dates back to the late 1800s, when immigrants arrived from Central Europe in order to colonize this fertile area. It is worth mentioning that this region at that time was fully covered by forests, which represented an impediment for farming activity. The incipient forest depletion gave rise to the earliest aggregate of carpentries (Mafra, 1993). Many immigrants started this business activity, especially those arriving from Europe after the 1890s, which had already some expertise in handicraft activities (Kaesemodel, 1990).² Local demand for houses allowed these businesses to profit.

² Moreover, many of them were skilled workers trained at the German technical schools, which were founded after the unification in the 1870s (Mafra, 1993: pag. 43).

In between the beginning of the century and the 1920's the furniture and wood sector boomed due to the construction of the railway between Sao Bento and Curitiba (Parana capital), to the west, and to Joinville (main Santa Catarina business town) to the east (Mafra, 1993: 41). During these years the move from craftsmanship to furniture industrial production becomes observable³. Since then, the regional economy, which was previously very much dependent on '*erva mate* exports, began to revolve around the furniture business. Despite its increasing economic significance, the furniture manufacturing business saw the culmination of the industrialisation process only after the Second World War (Kaesemodel, 1990). At that time, firms were family based, mostly founded by immigrants' descendents, who had acquired skills from their German fathers. There were already some exporting firms, for example Cimo and Zipperer. However local demand still represented the main source of income.

During the sixties and seventies, Brazil experienced a forced industrialisation process. Furniture became, among others, a priority sector for the federal government. Sao Bento firms had access to credit and imported machines. Meanwhile the cluster underwent structural changes; it became more concentrated, many firms merged while SME also grew as subcontractors of large industrial groups (Lanzer, 1998). There was also a big boost in exports (Brancaleone, 1999; quoted in Denk, 2001: 73). Other relevant factors were: the foundation of the Banco Nacional de Habitacoes in 1964, which gave a strong impulse to the national demand for furniture and sofas, and other wood products (Mafra, 1993:53); the depletion of the local forest reserves (*imbuia* trees), which led firms to look for new supply sources⁴; the shortage of trained workers, forced the local government to set up the FETEP (Foundation for training, technology and research)⁵.

The seventies represented the consolidation age, small firms turned into industrial companies, moreover the furniture sector became dominant in Sao Bento manufacturing industry⁶.

In the eighties, a major restructuring process hit the Brazilian economy, forcing firms to look for new markets abroad (Lanzer et al, 1998). High indebtedness sent many enterprises into bankruptcy and cost cutting strategies led to a slow down in investment. Moreover Sao Bento firms had to face with a shift in consumer tastes. The highly appreciated colonial style was replaced by modern and simple designs, better suited for small city apartments (Denk, 2000). Sao Bento specialisation in colonial style resulted in a strong lock-in effect, which impeded many firms to tackle the external crisis. The supply side produced further obstacles: wood shortages obliged firms to shift entirely to pine as their basic raw material. Therefore, new competencies were now needed to cope with these changes: new models were required and local designers had few skills to introduce product innovation; furthermore the adoption of pine wood

³ Railways provided workers to firms by favouring access to Sao Bento and eased wood export by dropping transport times towards harbours.

⁴ reforestation (*pinus* trees) became in a few years the most important supply source for many local firms.

⁵ This organisation aimed at providing the industry with trained workers and at fostering the local industrial activities.

⁶ with almost 40 factories out of 100 were dedicated to furniture at the same time, the decade was marked with an impressive rate of growth of new firms, around 86% (Mafra, 1993, quoted in Denk, 2001: 74). In 1973, the Centenary exposition took place (EXIBE 100), consecrating Sao Bento as the Brazilian capital of furniture (Denk, 2000).

required firms to introduce new manufacturing techniques in order to guarantee reasonable quality standards. The FETEP had not enough internal competencies to cope with these challenges, so it went soon into a irreversible crisis (Denk, 2000). New local actors emerged, searching for new markets and sources of innovation. For example, brokers played a catalyst role, attracting the interest of major international furniture firms and traders towards the Sao Bento furniture cluster.

In the nineties, the transition started in the previous decade came to an end, transforming the Sao Bento cluster into the main Brazilian furniture exporter. Several changes characterised this decade. Sao Bento rapidly renewed its stock of fixed capital, thanks to a stable macro-economic setting, which favoured imports, but firms became highly dependent on international purchasers and on local brokers.

Table 2 The evolution of the production system

	1970	1980	1990	1999
Units	28	81	120	199
Employees	1.916	4.580	5.970	4.820
Value (US\$)	6.800	77.143	172.428	215.873

Source: Bercovich (1993)

Cheap labour and cheap inputs (*pinus*), jointly with a long tradition in furniture manufacturing, made Sao Bento an ideal place to invest. Local institutions and private firms invested strongly in infrastructures, both physical and immaterial. Several new fairs were organised in the cluster, attracting national and international producers and buyers. Local universities promoted specialised courses in industry-related technology and entrepreneurship, many consulting firms sprung up and Fetep created a new training school in partnership with Senai, which in turn gave rise to the CTM, a local technology centre.

3.2- Background of the production system

Sao Bento furniture cluster is populated by many small and micro firms. Considering the whole region, they amount to 335 firms, most of them, 171, situated in the main district, Sao Bento (Denk, 2000). Among those, almost 60% are micro firms, and only two of them have more than 500 employees.

Table 3 Number of Firms and Employees (Sao Bento do Sul)

Size	Units	Employees
From 1 to 19	115	716
From 20 to 99	36	1.913
From 100 to 499	18	3.228
More than 500	2	1.449
TOTAL	171	7.306

source: Denk, 2000; Prefeitura Municipal de Sao bento do Sul, 1997.

The high degree of verticalisation and diversification is a distinguishing feature of Sao Bento's furniture industry. Along the production chain just few stages, such as transport and packaging, have been outsourced. Whereas production of components, carpentry, drying, painting and finishing are still considered critical stages that have to be developed in-house. We have to notice that import-substitution policies produced a strong incentive to internalise most of these stages and explain why such highly verticalised production structure emerged.

Recent studies suggest other reasons to give account of the persistence of this organisational structure. They maintain that fact family-run factories in Sao Bento tended historically to manage their business through direct control, hence keeping in-house most of the mentioned activities (Lanzer, 1998). A more urgent one concerns the low reliability of local subcontractors, which would not offer enough guarantees in terms of delivery time and quality standards (Denk, 2000). For example, painting requires either a good expertise or strong fixed capital investments, requirements, which small subcontractors cannot usually meet. In the case of drying, costs and delivery times are still critical factors that lead firms to keep in-house these activities. Local entrepreneurs also showed a great concern with respect to wood shortages, this could be the reason why a great deal of local producers, either small or large ones, are still involved in forestry and carpentry activities.

Looking at providers, we observe that cluster density has been growing during the last decade: local firms can easily access to input and machines produced locally (less than 100 km from Sao Bento) (Denk, 2000: 127). However, such input exchanges are mostly referred to raw materials and basic machines, whereas the bulk of sophisticated high value tools still come from abroad.

4- Methodology

The empirical analysis has been carried out in the Planalto Norte region, which includes Sao Bento, Campo Alegre, Rio Negrinho and Mafra, in 2001. This fieldwork is based on a questionnaire submitted to 18 furniture manufacturers. Firms in the sample has been selected according suggestions from local informants.

The sample includes only furniture firms, while informations about suppliers and specialised subcontractors have been gathered using secondary sources, mainly surveys conducted by local universities, entrepreneurial associations and national development agencies.

In-depth interviews with enterprise managers provided first-hand material concerning the innovative behaviour of firms and their propensity to develop partnerships. These interviews represented a further step in order to deepen our knowledge of these processes. We visited most of plants surveyed in order to test the respondents' reliability⁷.

The inquiry had the aim of collecting information on the innovation activity developed by local firms and on their network of linkages, both local and external to the cluster. Questionnaire has been structured in the following six sections: firm production activity; technological capabilities; the evolution of the innovative behaviour; the evolution of the co-operative relationship for a specific innovation; the co-operative behaviour with innovative organisations and productive linkages with customers and suppliers. Questions were asked for two time periods, the beginning of nineties and the year 2000, with the aim of highlighting the dynamic of the cluster and the relative importance of each actors within the local innovation system.

Information collected through the questionnaire include:

- Information about firms characteristics: firm's location and core business; information about subcontracting firms.
- Information about technological and innovative capabilities in terms of employees' education, training activities and qualified personnel.
- The type of innovation developed, whether it was new to the firm or to the sector.
- Whether the innovation was developed in-house or through a collaboration agreement.
- Information about organisations involved in joint innovation activities.
- The relative importance of different sources of knowledge for developing a specific innovation and their geographical location.
- The relative importance of sources of knowledge used to obtain innovative ideas and their location.
- The mechanisms used to transmit information, whether they are formal or informal.
- The relationship established with the other members of the production system: the type of relationship, its stability and its evolution over time.

Answers' reliability may vary according to the type of question asked⁸. In order to reduce such bias we conducted extensive interviews with key informants and collected data from secondary sources⁹. In the following sections we show the sample characteristics and some preliminary results of the analysis.

⁷ In many cases guided visits to factories were enthusiastically offered by respondents, keen to boost the wonders of their newly imported machinery. Visits offered the chance to observe directly who was involved in, and where was taking place, the innovation process. Interviews were mainly conducted during these journeys.

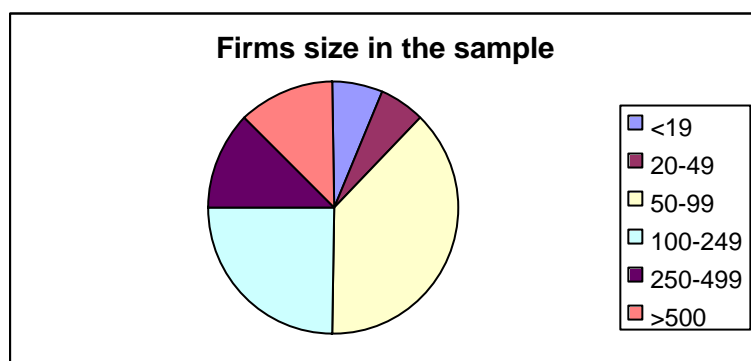
⁸ Problems arise when respondent did not correspond to the profile required by the topic researched. In some cases a general misunderstanding between interview participants around the goals of the research resulted in a serious

5- Survey results: innovation behaviour and knowledge flows

5.1- Description of the sample

Sao Bento furniture industry is predominantly characterised by a population of micro and small firms, with a not irrelevant share of medium ones. Our sample is skewed towards medium firms. This is due to the fact that innovation dynamism is almost absent among micro firms¹⁰ (figure 1).

FIGURE 1



Source: author's survey

Therefore we included those firms which are, according to our key informants, among the innovative ones in their size classes.

Their basic characteristics are very close to those of the firms' population. With few exceptions, their organisational structure is verticalised; they are exporters; household furniture is their core business; production is highly diversified (i.e. chairs, dormitories, armchairs, living rooms, etc.). No cases of foreign ownership were come upon.

5.2- Technological Capabilities

Building up technological capabilities is a complex process, which requires the interaction of many actors, either researchers within firm's units or between organisations and firms belonging to the cluster. Human capital and relational capabilities are increasingly identified as strategic assets to access knowledge, and in turn to build up technological capabilities. Hence, we firstly paid attention to basic indicators of schooling, as proxies of human capital. Data from our survey (figure 2) show that a quarter of firms' employees did not finished yet the primary school and only a third attained

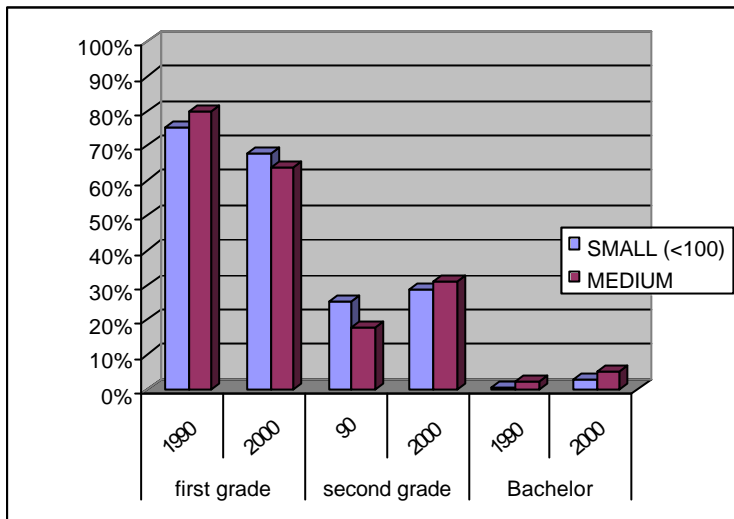
hindrance to collection of data. Reluctance to disclose detailed information was also observed in case of interviews undertaken in largest firm.

⁹We had interviews with local consultants, university professors and researchers.

¹⁰ One more reason concerns the sample's geographical distribution. We interviewed more firms located in Sao Bento town (which is the centre of the district and the biggest city among the three), where medium and large firms are generally located (see also Lazer, Casarotto et al, 1998: 71).

the secondary school. Employees with a bachelor have an insignificant share for small firms, even if they grew considerably in recent years (up to the 3%).

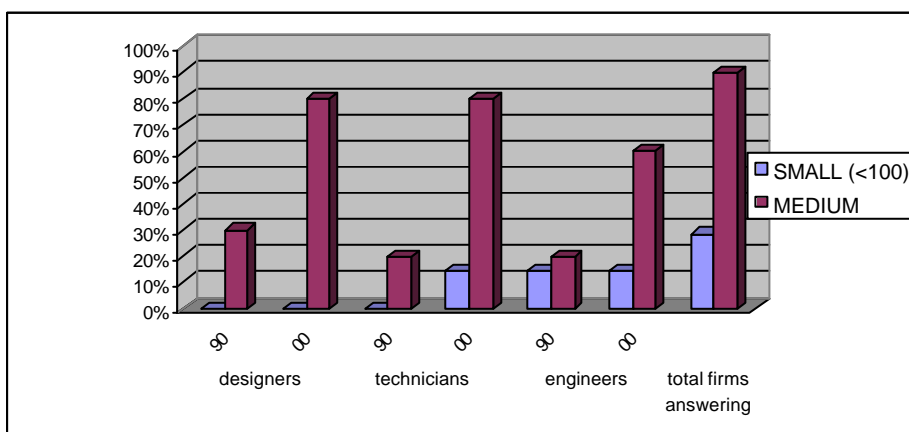
FIGURE 2 INTERNAL CAPABILITIES : DEGREES ATTAINED BY WORKERS



Source: author's survey

Looking at figure 3 a mixed picture emerges. On the one side, small firms introduced few internal qualified skills, for example designers and engineers are absent; on the other side, medium firms trained and employed new qualified personnel during this last decade.

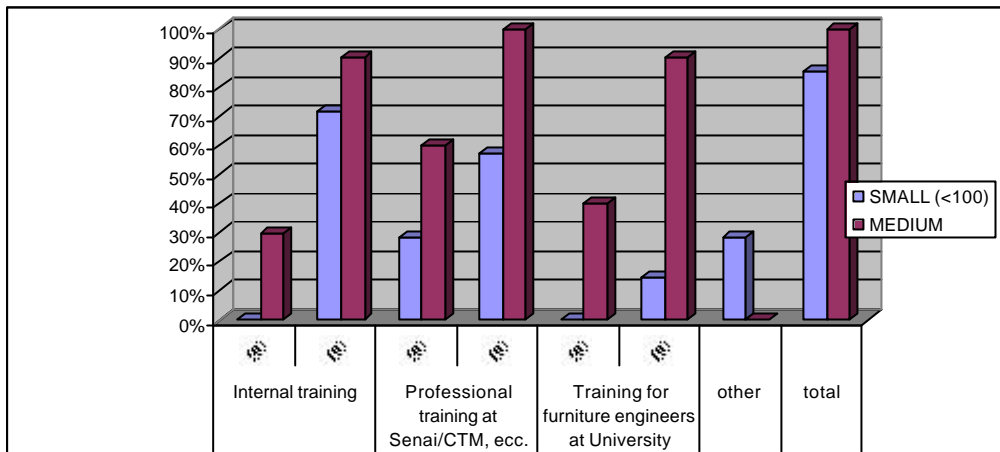
FIGURE 3 INTERNAL CAPABILITIES : HIGH SKILL WORKERS



Source: author's survey

Looking at training activities, which are organised jointly by firms and local business associations, it clearly emerges that only medium and large firms participate massively to training courses organised by CTM (figure 4). On the contrary Smes mostly rely on informal 'on the job' training. Such a result could be interpreted in terms of targeting-policy failure, in fact training courses, which should in principle have been designed to meet small firms' needs, finally address large firms needs.

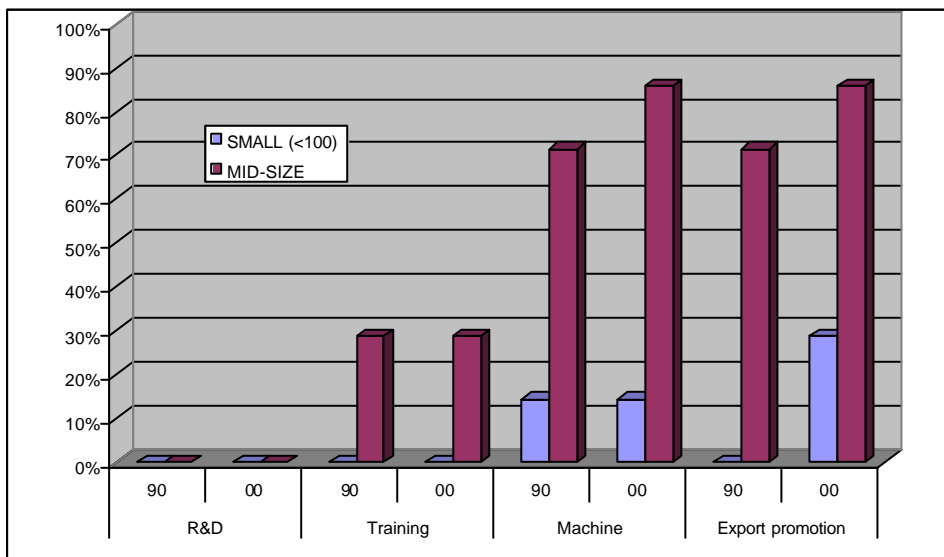
FIGURE 4 INTERNAL CAPABILITIES: TRAINING ACTIVITIES FOR WORKERS



Source: author's survey

Figure 5 illustrates to what extent benefit from public funding. It clearly comes out that most of this financial aid is mostly oriented towards the purchase of new machinery; on the contrary R&D activities have not been mentioned as a priority. Such findings confirm that the main policy concern during the last decade was to increase firms' productivity rather than fostering technological change.¹¹

FIGURE 5 INTERNAL CAPABILITIES: ACCESS TO EXTERNAL FUNDING



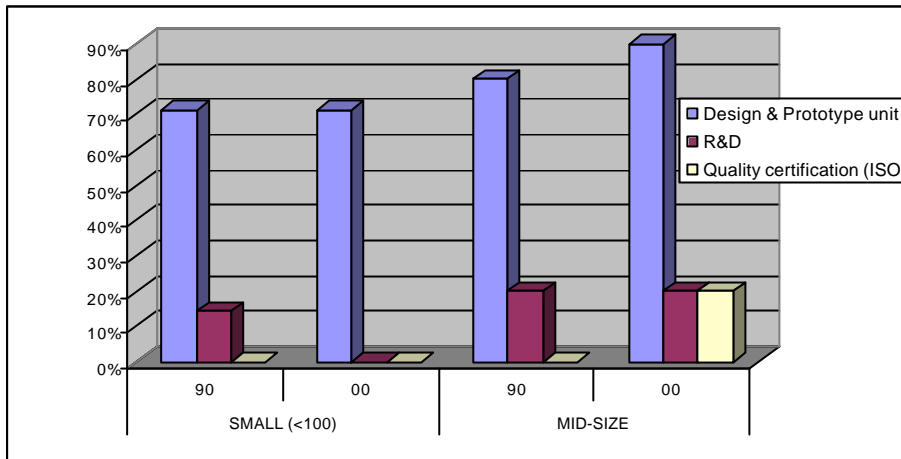
Source: author's survey

In conclusion we provide some measures of absorptive capacity such as: presence of R&D department, prototype, design laboratory and the adoption of quality certification. At first glance R&D is the basic indicator of such ability, however in many industries this indicator could be misleading since firms do not

¹¹ Data from Lazer et al (1998) confirm that productivity grew considerably.

carry out any formal R&D. This is why our inquiry broadened the range of variables to be analysed in order to take into account the low-tech nature of this sector.

FIGURE 6 INTERNAL CAPABILITIES : R&D, QUALITY CERTIFICATION AND DESIGN



Source: author's survey

Results on R&D indicators do confirm previous findings. R&D activities and process certification are infrequent, even among medium and large firms. As far as design and prototype departments is concerned, most of the respondents answered positively.

On this respect, it is worth mentioning that most of the small firms operating in foreign markets do not elaborate designs internally. This is also the case of medium and large firms. In fact foreign buyers provide them with all the technical specifications.

5.3- Innovation patterns

For a start, 100% of the firms sampled considered themselves innovative. Another ambiguous finding regards small firms, where 100% answered to have introduced product innovation in the last year. It should be noted that in the furniture industry, new models come out every new season or every time firms take part to a major national or international fair. A matter of discussion should be whether or not design remodelling (new colours, new ornaments, change in components shape, etc.) or some other refinishing may be considered as new products.

A related issue concerns the structure of the industry. We have to remind that most of Sao Bento exporters operate as subcontractors of global buyers. It means, as we pointed out in the previous section, that buyers provide product specification and designs to local producers, therefore the latter are allowed to introduce very few alterations to the final product. This kind of buyer-producer relation has two main implications:

- it reduces the opportunities to create local (to the firm and to the cluster) qualified skills,

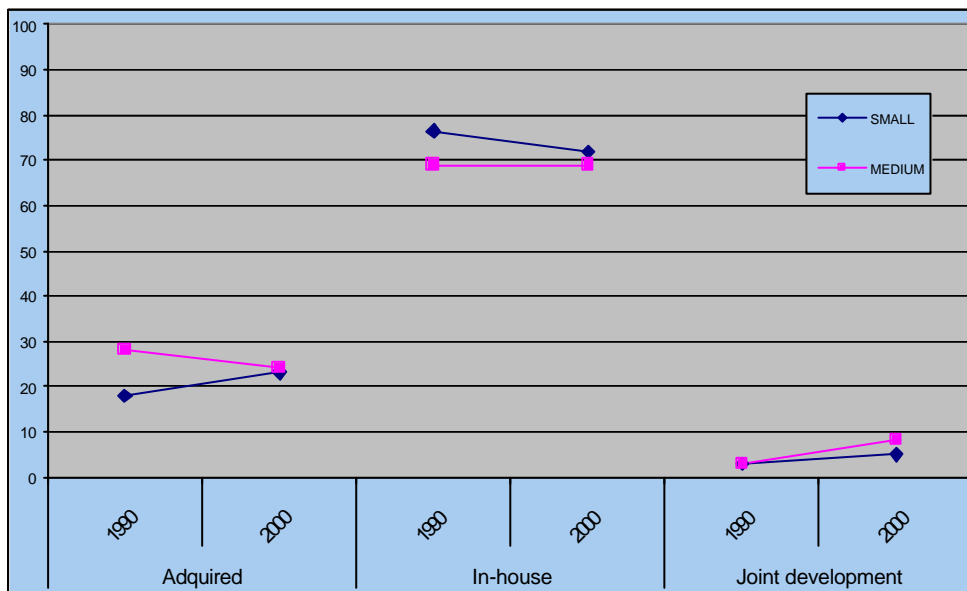
- it hampers direct contacts with consumer markets, that is feedbacks generated by users-producers interactions are impeded.

The inquiry showed that, apart from few medium and large firms, and a single small one, there was scarce evidence of product innovation, at least if we consider new products as those based on original design developed by the firm.

Process innovation is quite common, even if it consists mainly in purchasing new machines¹². Some entrepreneurs established direct link with foreign machine producers and visit regularly international fairs¹³. Even if most of these investments are devoted to increase production capacity, some others to build up in-house design capabilities. Results shows that most of the firms adopted Cad-Cam technology in the 1990s, moreover other surveys confirm that Sao Bento invested more than other Brazilian furniture clusters in advanced technologies¹⁴

The last figure suggests that firms develop their innovations mostly using internal resources, or purchasing them as a ready-made package. Firms do not share, at least during the innovation process, their expertise with other firms, either inside or outside the cluster. We definitively did not find any evidence of significant cooperative agreements dedicated to investigate or to develop new processes, products or organisational matters.

FIGURE 8 METHODS ADOPTED TO DEVELOP AN INNOVATION



Source: author's survey

¹² A Sebrae/Unicamp survey on Brazilian clusters confirms that 80% of firms investments were devoted to import machines (Dos Santos *et al.*, 1999: 40).

¹³ Strong internal demand has favoured a nascent national and local industry. It recently reached good reliability, turning to be a real alternative for imported machines, at least in some specific production phase.

¹⁴ .60% of Sao Bento firms adopt cad-cam technology, whereas the average for the other Brazilian clusters is about 30% (Dos Santos *et al.*, 1999: 33).

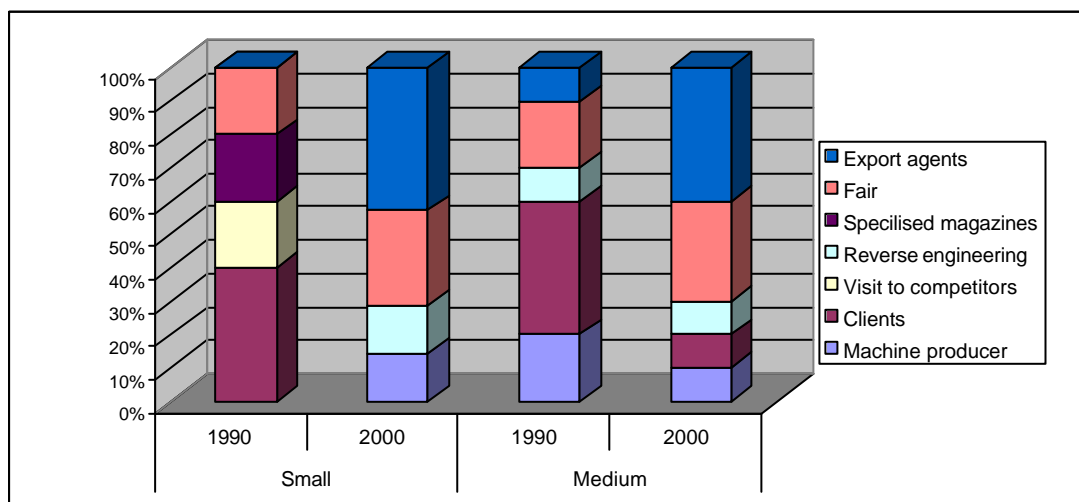
Summing up, these results provide a first sketch of a relatively low innovative cluster. Another important result from the last figure shows that very few innovations have been developed jointly with other local actors. Although this picture appears to be rather discouraging, we argue that, according to the evidence produced so far, some local producers, especially large ones, would be able, in term of expertise and technology, to upgrade either in product or in functions. Their role of subcontractors within the global value chain may represent a serious hindrance to accumulate internal capabilities, design capabilities¹⁵.

5.4- Knowledge sources

This section is dedicated to analyse firms' external sources of knowledge. We focused on information sources, which provide innovative ideas to firms, we also identify those knowledge flows generated by co-operation activities between firms and public or private organisations. Furthermore, we explored the communication mechanisms that firms make use of, in order to understand whether formal or informal contacts prevail. In the last subsection we show to what extent the use of these sources of knowledge evolved over time.

Firms were first asked to identify which were the main sources of information among those illustrated in figure 9⁶, then to choose the most important. Results show that brokers represent the most important channel. Brokers provide relevant information about new innovative ideas, new products, customers tastes, but also, as interviewees pointed out, brokers works as service providers (see following section).

FIGURE 9 EXTERNAL SOURCES OF KNOWLEDGE



Source: author's survey

It is not surprising that fairs appear to be another significant source of information. Fairs offer the opportunity to gather ideas about new products and, for small firms, are a gateway for establishing links with

¹⁵ A Sebrae/Unicamp study has recently reached a similar conclusion. They argue that Sao Bento firms should create their own models, suggesting a mix of strategies and actors that could implement such policy (Dos Santos *et al.*, 1999)

¹⁶ The questionnaire included many other questions; we listed the main ones.

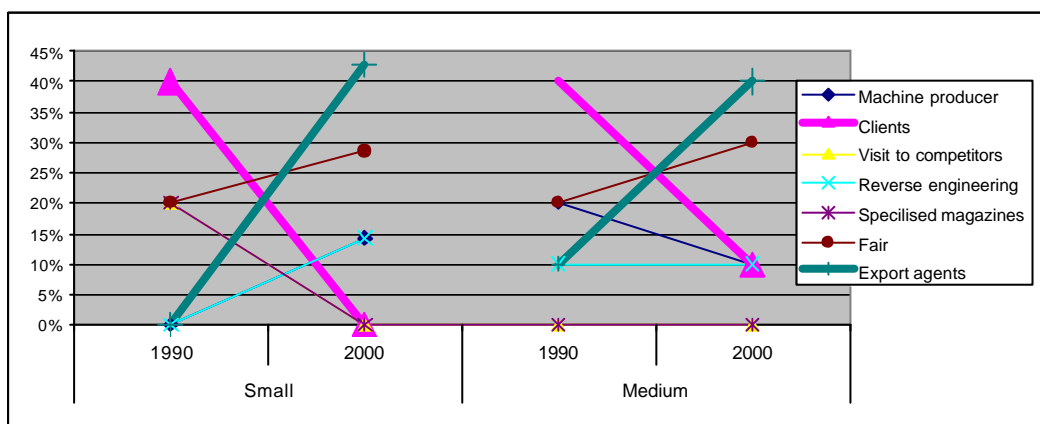
potential new buyers. We also observe that international fairs increased considerably their importance for both small and medium firms. Such a result also confirm the increasing degree of internalisation of the cluster.

5.5- The evolution of knowledge flows by firm size and by location

At a closer look, changes occurred in the distribution of sources seem to have affected both small and medium firms. Since Sao Bento became an export oriented cluster, traditional channels of information, such as clients-producers linkages, have lost their importance in recent years, while brokers have taken over the role of clients in providing crucial information about market demand. Such a change modifies the traditional mechanisms of transmission and the amount and the characteristics of information provided. In addition it affects the opportunities of receiving feedbacks from customers.

Looking at other sources, we observe a common trend for small and medium firms. In particular small firms assign higher weight to machine producers, which is partly due to their strong investment in physical capital. Similarly, the growing importance attributed to reverse engineering activities results from investments in human capital, mainly training activities for technicians.

FIGURE 10 THE EVOLUTION OF THE MOST IMPORTANT EXTERNAL SOURCE

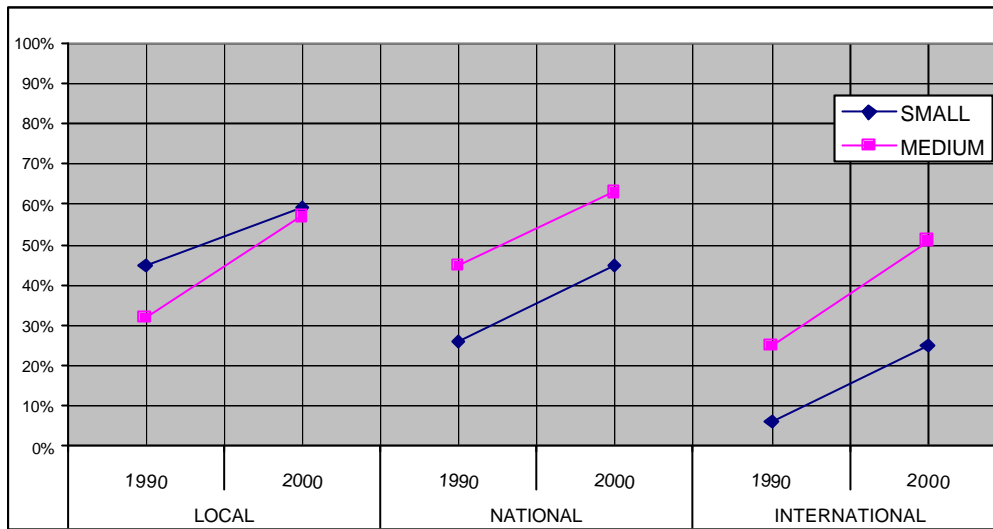


Source: author's survey

Proximity is undoubtedly an important factor for choosing external sources. Figure 11 shows that small firms rely mostly on local sources. We would have expected this result. Small firms may lack of competencies to maintain contacts abroad, therefore they have to rely on bridging organisations.

Both small and medium firms become more and more export oriented. This phenomenon is particularly pronounced for small firms that accessed very recently to foreign markets. Medium firms, as expected, show a stronger capacity to establish contacts with foreign sources. Nevertheless few differences appear by firm size when comparison is made by type of sources. In fact, both small and medium firms have stable international commercial ties, but few related to research and design activities or concerning product development agreements.

FIGURE 10. THE EVOLUTION OF KNOWLEDGE SOURCES' LOCATION



Source: author's survey

5.6- Brokers: Gatekeepers or bottlenecks of knowledge?

We mentioned above that brokers became an interface between international buyers and producers. The emergence of brokers seems to be relevant for a number of reasons. Brokers have been carrying out a crucial role in transferring know-how and relevant information within the cluster. Apart from easing contacts, brokers have developed a great array of functions, such as:

- controlling for quality standard and selecting producers,
- suggesting technical and product specifications,
- giving suggestions concerning organisational issues,
- facilitating contacts with foreign input providers.

Generally speaking, they constitute a bridge between buyers and producers and at the same time a gatekeeper of external information for the cluster. Their ability in finding solutions to either commercial or technical firms' problems affected undoubtedly the absorptive capacity of the system as whole.

We may argue that the role they have played during the opening phase of the cluster has been essentially to avoid lock-in effects, helping firms to learn by exporting¹⁷.

Brokers are mostly locals, former employees of furniture firms. They are very well connected with local producers and local institutions by personal contacts. Their experience varies according to the position they had in past jobs. Those having intermediate positions, both at the commercial or

¹⁷ Other studies confirm that brokers have contributed to foster the cluster's dynamism (see Denk, 2000; Brancalone, 1999).

at production units, cumulated relevant experience and embodied a deep stock of knowledge. Such versatility helped them to enter in contact with manufacturers and global buyers. In doing so they set up a vast network of relationships with local firms, so they acquire a strong centrality as firms' consultants. Moreover they developed a dense network of linkages outside the district with input providers and global buyers. Nonetheless, it should be asked whether brokers still have such a role in stimulating the internal dynamism of the system.

We may suggest that other institutions could govern the organisational structure of the system¹⁸. A new institutional framework could assign higher weight to public actors engaged in technological activities, such as local technological centres, or in business activities, such as incubators of firms. It could be argued that these organisations, being participated by the majority of firms and local public institutions, would better accomplish the goal of diffusing knowledge among cluster's members.

Summing up, the risks that could originate from the centrality of brokers as gatekeepers are the following:

- They may lack of stimuli and competencies to undertake efficiently a vast set of functions they presently develop.
- They may reduce firms' opportunities to have direct access to customers, so in turn brokers may represent a bottleneck for information flows and feedbacks coming from the demand side.

5.7- Co-operative behaviour: Joint action and research firms' network

The Sao Bento innovation system has been characterised by several public initiatives, most of them implemented in the last decade. Figure 4 already provided some initial evidence of government commitment for supporting training activities. Private and public actors, such as business associations, local governments, national training organisations, regional universities and local firms, have carried out most of these actions in partnerships.

For what knowledge activities are concerned, the CTM (Centro de Tecnologia do Mobiliario- SENAI/FETEP) is the central institution providing technical assistance and training to local firms. CTM has been established in 1998, as a joint action between the local branch of SENAI, the UDESC, the FETEP, the local government and other industrial associations¹⁹. CTM fostered the modernisation of Sao Bento industry allowing firms to access the newest technologies; several consultancy services and a wider range of

¹⁸ Other clusters' experiences provide examples of different institutional arrangements (Schmitz, 1999).

¹⁹ Senai is the national industry service. It has branches all over Brazil providing training, consultancy services; established in Sao Bento since 1972 (Brancaleone, 1999). Fetep is the Foundation for training, technology and research. It was created in 1975. UDESC is the State University of Santa Catarina.

information sources. CTM also conducts research activities in product and processes and testing activities for furniture components.

Another important example of institutional activism is Promovel, a project supported by many local and national actors, among which: Abimovel, the furniture industry association, the ministries of industry and foreign affairs, the national centre of R&D and the export promotion agency. Promovel has been set up to support Brazilian furniture firms abroad through many different initiatives, most of them related to product and process upgrading. For example, firms joining this programme are trained and counselled in many fields, related to: ISO norms, marketing research; participation to international fairs; management training; new design technique; visits to foreign firms, etc.

A final example is Promosul, a local foundation aimed at promoting fairs and exhibitions, either at national and international level. Founded in 1996, Promosul already organised several fairs for the furniture industry²⁰.

At least a couple of factors seem to explain this recent institutional dynamism. We can mention the strong Sao Bento industry specialisation, which makes this region culturally, no less than economically, dependent on furniture. Therefore industrial associations and local government alike are fully aware of local industry problems. Secondly, the recent crisis of this sector hit strongly, pushing local actors to adopt urgent policy measures.

Summing up, we collected substantial evidence of joint action between private and public actors. This is a major change with respect to the era when entrepreneurs were waiting for State intervention before taking any initiative. We also have noted that such intervention is comprehensive and it involves aspects related to both the production system and the innovation system. All these examples suggest that industrial policy tools are evolving towards a systemic approach.

A related issue concerns firms' attitude towards co-operative agreements, either formal or informal, with other furniture firms (horizontal co-operation), subcontractors, input providers (vertical linkages) or research centres.

As far as horizontal co-operation is concerned we found evidence of a growing trend of co-operation between producers. Such co-operation is however very scarce in quantitative terms. Both questionnaire results and interviews suggest that firms still resist co-operation with their local competitors. Our conclusions reaffirm previous studies results, for instance Meyer-Stamer (1998: 1495) found that '[in Santa Catarina] emerged an extremely non co-operative business culture which does not change easily even under the overall

²⁰ among the most important are: 'Feiranorte', the first industrial fair of the North of Santa Catarina and 'Movel Brasil', one of the main Brazilian furniture fairs.

incentive structure has changed dramatically due to the transition from import-substituting industrialisation to an open economy'. This suggests that path dependency is still bounding horizontal co-operation .

In terms of vertical co-operation, we have found evidence of increasing systemic interactions. This is mainly due to subcontracting processes taking place within the cluster, though very slowly. In quantitative terms, vertical links are scarce due to the already mentioned verticalised structure of the cluster.

The final issue we present concerns co-operative activities developed by firms to implement a specific innovation project. We asked firms to specify whether they developed a main innovation in partnership with other firms or organisations, either from inside or outside the cluster. We then asked whether or not they hired researchers or technicians from partners and which mechanisms were adopted to communicate with them (formal vs. informal).

In Figure 8 we have already showed that a small percentage of firms develop innovation jointly with other partners. Among them, very few hire temporarily technicians from outside, whereas mechanisms of communication appear to be mostly informal.

Evidence provided so far on this point shows that firms' research network is still very limited, since few and very recent organisations have been setting up to assist firms in technological matters.²¹ As far as horizontal co-operation in innovation is concerned, this is absent. This result can be explained either referring to the sector characteristics or to scarce firms' innovation capabilities. Firstly, research in furniture is very close to the development stage, therefore pre-competitive research activities are limited. Secondly, Sao Bento firms would hardly find complementary inputs and competencies, in the region, which in turn prevents them from establishing direct co-operative agreements.

In conclusion, although co-operation is not widely observable, an institutional environment favourable to co-operation has been set up. Firms are reluctant to establish direct links, either vertical or horizontal, but they demonstrate a growing propensity to co-operate through public institutions. In particular, linkages are mainly referred to input and information flows, rather than knowledge flows, although joint partnership have been created to support the local sectoral innovation system.

6 Local system of innovation or local production system?

In the previous sections we have provided a sketch of the main firms' characteristics relevant to measure the cluster innovative behaviour. In this section we will go forward suggesting a preliminary answer to following question:

- Does an organised and coherent system emerge out of this cluster? We want to verify to what extent within a successful productive system a complex and structured knowledge system emerged.

²¹ Tables on this issue were not included in this paper.

We articulate such question analysing, on a purely descriptive ground, the large set of indicators presented in the previous sections; this overview will nonetheless provide useful insights on the properties of the cluster organisational structure.

According to the definition of innovation system we adopted, attention was first paid to innovation output and input measures. Apart from few cases, mostly large firms, survey results showed a cluster with a low innovative profile, in terms of both formal and informal R&D activities. Looking at technological capabilities, such a scenario is strongly confirmed: very few firms, mostly the large ones, invested in human capital and workers' training activities. In addition, the higher dynamism observed for process innovation it appeared clearly related to purchase of ready-made packages, so it turns into a strong technological dependence on imported machines. On this point it can be argued that dependence on external technologies, far from producing pure negative implication, has proved to be an incontrovertible key factor in increasing firms' efficiency. Nonetheless, local systems operating in unstable macro conditions, such as those experienced by Brazil during the last four years, have been seriously damaged from external dependence. Product innovation, on the contrary, is almost conceived as replication of the retailers' models. Only few firms, either operating in market niche or selling to the domestic market, produce furniture based on their own design.

We observed that systemic interactions have been intensifying, although they are limited. Horizontal formal cooperation is absent for any field of activity. Vertical cooperation increased as far as firms specialised (i.e. higher division of labour). By looking at joint actions, we noted a growing dynamism, which seem to foster internal cohesion and the system coherence; although, many recent joint initiatives have been often subject to external threats, such as during the Asian crisis. IN this peculiar case national and local public actors played a relevant role in strengthening firms' linkages and promoting projects and institutions devoted to training activities, marketing, design, etc.

System's openness has been investigated analysing a great variety of external linkages developed by firms. Looking at innovation sources, clearly emerge that those external to the cluster overthrow local ones in channelling relevant information. Foreign providers and global buyers resulted to be those actors playing a major role in transmitting new competences/practices and technologies to local producers. Further research should investigate to what extent these channels may foster internal, to the firms and to the cluster, technological and managerial capabilities require. Nonetheless, according to our inquiry, knowledge acquisition through these channels occurred mainly passively, through input exchanges, such as buying new machines or replicating designs provided by retailers. 'Openness' certainly encourage local producers to introduce best practices, however these efforts affect mainly firms' production efficiency, rather than their technological capabilities. Survey findings, either those concerning cooperation with national and foreign research institutions, or those concerning cooperation with other firms, support these conclusions.

The above findings suggest that the local system has evolved during the nineties reinforcing the role of those actors (i.e. brokers, providers) able to improve firms' production efficiency. Timid step forward has been done in order to set up a structured system, either promoting new local actors (a new technological centre, training institutions, a fair, etc) specifically devoted to upgrading activities, or offering incentives to firms in order to introduce product innovation. Overall those efforts seemed to be insufficient to build up a complex local innovation system: where there are systemic interactions, formal structured 'gatekeepers' and external ties contributing to upgrade local capabilities.

7 Conclusion

The main objective addressed in this paper concerned the evolution of the organisational structure of a local innovation system. We provided evidence suggesting that innovation dynamism in this cluster is still limited. Structural deficiencies explain partly the scarce innovative performance, and refer mainly to the inadequate attention paid by firms, both large and small ones, to R&D and design activities.

The 'closeness' of the organisational structure could be a further explanation. In particular, those actors (ie brokers) playing a major role in bridging the gap between the external market and clustered firms, could represent a bottleneck for the evolution of the system.

From a preliminary analysis of knowledge sources, it emerges that brokers have been playing the role of gatekeepers of external information, at the same time reducing the interactive opportunities for local firms.

We argue that during the incipient phase of internationalisation, firms needed such interface to learn how to collaborate with foreign buyers and to receive relevant knowledge inputs from them. Nowadays, policy intervention should set up or promote new organisations in order to replace brokers in those relevant fields, which are not directly related to their core business.

The strong institutional dynamism, which enable the creation of CTM, Promovel, etc., suggests that local actors are willing to promote a new framework, which may eventually help firms to achieve greater learning opportunities.

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