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LOCAL CLUSTERS, INNOVATION SYSTEMS AND SUSTAINED COMPETITIVENESS

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INTRODUCTION

The growing interest in clusters, understood mainly in terms of spatial agglomerations of enterprises and related supplier and service industries can be traced back to a number of changes in the competitive environment of the firm that became increasingly evident over the 1970s and 1980s. The first was the growing knowledge-intensity of production which gradually extended to cover a broad spectrum of traditional industries from the shrimp and salmon fisheries in the Philippines, Norway and Chile, the forestry and flower enterprises in Kenya and Colombia, to the furniture, textile and clothing firms in Denmark, Italy, Taiwan and Thailand. The second was the emergence of innovation-based competition and its globalization, as traditional barriers to trade and investment were dismantled (Mytelka: 1987,1999). These changes have significantly altered the competitive environment for firms in all sectors and placed a greater burden on small and medium-sized enterprises (SMEs) to engage in a continuous process of innovation.

As global competition intensified, industrial economists rediscovered the dynamic potential of Italy's industrial districts (Becattini:1978; Brusco:1982,1986) and the search began for similar innovative clusters elsewhere in Europe and in the developing world (Piore & Sabel:1984, Porter: 1990, Schmitz:1993). In parallel, French industrial economists, based on the work of Francois Perroux (1973) attempted to capture the dynamic linkages within an industrial system between clusters of sectors "…connected by strong technological and behavioral input/output interlinkages" (Dosi & Orsenigo;1988, 28), while those in the Schumpeterian tradition turned their attention to 'National systems of Innovation' (Freeman:1988, Nelson:1993 & Lundvall:1992).

Underlying the system of innovation approach is a resurgence of interest in innovation, a characterization of innovation as an interactive process and a reconceptualization of the firm as a learning organization embedded within a broader institutional context (Nelson & Winter:1982, Freeman & Perez:1988, Lundvall:1988; Kline & Rosenberg:1986). As a conceptual framework, it lays emphasis on the interactive process in which enterprises in interaction with each other and supported by institutions[1] and organizations –such as industry associations, R&D, innovation and productivity centers, standard setting bodies, university and vocational training centers, information gathering and analysis services and banking and other financing

[1] Formal definitions of "institutions" stress the "persistent and connected set of rules, formal and informal, that prescribe behavioral roles, constrain activity and shape expectations…they…give

mechanisms—play a key role in bringing new products, new processes and new forms of organization into economic use.

From a policy perspective the innovation system approach draws attention to the behavior of local actors with respect to three key elements in the innovation process: learning, linkage and investment (Mytelka:2000,18). This is particularly important in developing countries where overtime actors have developed a set of habits and practices with regard to these three underlying processes that are often inimical to innovation. SMEs, for example, are risk adverse, lack the linkages needed for learning and the finance to support a continuous process of innovation. Yet as Schumpeter acknowledged in his *Theory of Economic Development*, for entrepreneurs to become the driving force in a process of innovation, they must be able to convince banks to provide the credit with which to finance innovation (Christensen:1993,147). High transaction costs and risks, however, have meant that Banks are reluctant to lend to SMEs. Under these conditions, care must be taken to tailor, time and sequences policies aimed at stimulating innovative behavior to the habits and practices of local actors[2].

The innovation system approach also breaks ranks with the traditional view of innovation as a processes of radical change at the frontier of an industry. Today, it is increasingly recognized that innovation extends beyond formal research and development (R&D) activities to include continuous improvement in product design and quality, changes in organization and management routines, creativity in marketing and modifications to production processes that bring costs down, increase efficiency and ensure environmental sustainability. As used in this paper, innovation is thus "... the process by which firms master and implement the design and production of goods and services that are new to them, irrespective of whether or not they are new to their competitors — domestic or foreign." (Ernst, Mytelka & Ganiatsos:1998, pp.12-13). To emphasize innovation in this sense is not to deny the role that R&D can play in generating new knowledge. Rather the point is to avoid an overemphasis on R&D and to encourage policy-makers to take a broader perspective on the opportunities for learning and innovation in SMEs and in the so-called traditional industries than they have done in the past.

For SMEs, clustering is believed to offer unique opportunities to engage in the wide array of domestic linkages between users and producers and between the knowledge producing sector (universities and R&D institutes) and the goods and services producing sectors of an economy that stimulate learning and innovation (Meyer-Stamer:1998, Nadvi:1995; Nadvi &

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order to expectations and allow actors to coordinate under conditions of uncertainty" (Storper:1998,24; see also Edquist and Johnson:1997).

[2] Elsewhere I have discussed the nature of policy dynamics that result from the interaction between policies and the traditional habits and practices of actors in greater detail. Case studies in that volume provide evidence for the ability of government to successfully tailor and sequence policies designed to induce change under different local conditions (Mytelka:1999)

Schmitz:1997;UNCTAD:1998). Stable **vertical relationships** between users and producers, for example, can reduce the costs related to information and communication, the risks associated with the introduction of new products and the time needed to move an innovation from the laboratory or design table to market (Lundvall:1988, Lundvall: 1992, Ernst, Ganiatsos & Mytelka: 1998, Nelson: 1993). **Horizontal collaboration** between same- sector small and medium-sized enterprises can also yield **'collective efficiencies** ' (Schmitz:1997) in the form of reduced transaction costs, accelerated innovation through more rapid problem- solving and greater market access. Still other studies have pointed to the **positive externalities** generated by agglomerations --the availability of skilled labor, of certain kinds of infrastructure, of innovation-generating informal exchanges and learning made possible through the adoption of conventions (Storper:1995; Maskell:1996). These studies also stress the **supporting role that political and social institutions and policies play** in the development of partnering activity and in stimulating the transformation of such networks into broader systems of innovation and production at local, regional and national levels (Best: 1990, Brusco:1982 Piore and Sable:1984, Morgan & Sayer: 1988, Storper & Scott: 1993, Wolfe and Gertler:1998).

Since the 1970s, governments in the industrialized countries have come to believe that locational advantages such as these are critical for development. (Best: 1990, Camagni: 1986, Piore & Sable: 1984, Tolomelli; 1990; Saxenian:1994). Governments at all levels--municipal, regional, national and quasi supra-national in the case of the European Union, began to foster the creation of science and industrial parks, incubators, export processing zones and technopoles (Mytelka:1991; Vavakova:1988,1995). More recently, development agencies and governments in the developing countries have taken their cue from such policies and have vigorously pursued similar clustering initiatives.

Yet not all clusters are innovation systems. Counter-intuitively, however, a number of clusters in the developed world, centered on so-called traditional or 'low tech' industries, did successfully undergo such a transformation in the 1970s and 1980s. A number of these, the woolen textile and the spectacle frame clusters in Italy, the wooden furniture cluster in Denmark as well as clusters based on the food industry in Norway (Smith:1999,10,19) and forestry-related industries in Finland (Pajarinen, Rouvinen and Yla-Anttila: 1998) continued to expand output and exports over the 1990s.

This paper explores the sustainability of a process of continuous innovation in clusters based on traditional industries. Section 2 develops a typology that distinguishes among clusters in terms of their potential for dynamic change. It provides a brief overview of cases in the developing world in which informal clusters have become more organized and have upgraded production without however sustaining a process of innovation. Section three examines the evolution of production and exports in the furniture cluster in the Herning/Ikast area of Central Jutland

(Denmark) and the spectacle frame cluster in the Veneto town of Belluno (Italy) and identifies a number of factors that have contributed to sustained innovation in these two clusters. The concluding section draws out the relevance of these experiences for policy in Brazil.

INFORMAL AND ORGANIZED CLUSTERS

Clusters come in many forms, each of which has a unique development trajectory, principles of organization and specific problems. Two broad distinctions, however, can be made. The first is between clusters that originate as spontaneous agglomerations of enterprises and other related actors and those that are induced by public policies. The latter, which elsewhere we have designated as 'constructed' clusters (UNCTAD:1998) range from technopoles and industrial parks, to incubators and Export Processing Zones (EPZs). This paper focuses exclusively upon the spontaneous cluster

From a learning and innovation perspective, spontaneous clusters can be further distinguished in terms of a set of variables that emphasize the potential for dynamic change within the cluster. Drawing upon the innovation system literature, (Carlsson:1997, Edquist & Johnson;1997, Anderson & Lundvall: 1988, Lundvall:1992, Mytelka:2000), these include five actor-level variables-- the configuration of actors in the system, their traditional habits and practices, their competences and the nature and intensity of their interactions-- and one cluster-level variable, the degree of change in the cluster overtime. Each of these can be operationalized through a number of indicators

?? The **configuration of actors** in the system situates critical actors within a dual context: the local and the global. In analyzing the presence of critical actors within the cluster, the concept of 'critical' is thus understood to be a function of both the techno-industrial base of the firms within the cluster and the global techno-industrial system in which these firms are embedded. The latter provides a mapping of the 'knowledge' bases that are required for innovation in a globalized industry. The configuration of critical actors can thus be expected to vary across techno-industrial systems. Table 1 characterizes these configurations with reference to the number of critical actors present in a cluster and within this group, it emphasizes the size of firms located in the cluster.

?? **Actor competence** is broadly defined to include manufacturing and management skills & capabilities as well as technological sophistication. The higher the level of competence, the greater the probability that resources can be found to recombine knowledge bases in new and innovative ways.

?? This must be tempered, however, by the **traditional habits and practices of these actors** with respect to the three pillars upon which an innovation process is based:

learning, investment and linkages. The ability to learn, to invest and to partner increase the likelihood that critical actors in the system will move to assume new roles and develop new institutions in response to changes in competitive conditions. In some instances the level of trust is too low to envisage cooperative interactions. Policies and programs can stimulate and support a process of change provided that their design takes these habits and practices into consideration. Table 1 summarizes these habits and practices under 'innovation' and 'trust'.

Table 1. Types of clusters and their performance

Types	**Spontaneous clusters**		
	Informal clusters	**Organized clusters**	**Innovative clusters**
Examples	Suame Magazine (Kumasi, Ghana)	Nnewi (Nigeria) Sialkot (Pakistan)	Jutland (Denmark) Belluno (Italy)
Critical Actors	Low	Low to Medium	High
Size of Firms	Micro & Small	SMEs	SMEs & Large
Innovation	Little	Some	Continuous
Trust	Little	High	High
Skills	Low	Medium	High
Technology	Low	Medium	Medium
Linkages	Some	Some	Extensive
Cooperation	Little	Some, not sustained	High
Competition	High	High	Medium to High
Product Change	Little or None	Some	Continuous
Exports	Little or None	Medium- High	High

Source: adapted from (UNCTAD:1998, p.7).

?? In the innovation literature, the **nature and extensiveness of interactions** amongst critical actors in a system take on particular significance. In the context of sector-based clusters built around the value chain, relationships between actors have tended to consist mainly in the unidirectional transfer of information from a client to its suppliers. Two-way partnerships were a rarity. In many cases, traditional habits and practices do not predispose actors to a more innovation-oriented form of interaction in which knowledge is shared and learning maximized. The way in which competition among firms takes

place is also a critical element in determining the dynamics of growth in a cluster[3]. Where competition is based on price and wage reductions rather than on quality, technological upgrading and product innovation, cooperative relationships are rendered more difficult. Factors that have stimulated change in these habits and practices thus deserve further analysis. Table 1 summarizes the extensiveness of interactions under the indicator 'linkages' and the nature of those interactions under 'cooperation' and 'competition'.

?? Clusters do change, but not all of these changes will be positive for innovation. The extensiveness of **innovation-oriented changes in a cluster** can be assessed in terms of the nature of changes in the configuration of critical actors, the degree to which actor competences are strengthened, the growth of cooperative interactions within the cluster, the extensiveness of changes in the types and sophistication of products produced by firms in the cluster and the export performance of the cluster overtime

Using these criteria we have classified spontaneous clusters into three main types: 'informal', 'organized' and 'innovative'. Table 1 provides a summary of the principal characteristics of these clusters, with particular emphasis on traditional industries, drawing upon examples, such as, the auto parts clusters in Kumasi, Ghana and Nnewi, Nigeria, the surgical instruments cluster in Sialkot, the furniture cluster in Jutland, and the spectacle frame cluster in Belluno.

Informal and organized clusters are the predominant forms of clustering in developing countries. **Informal clusters**[4]. generally contain micro and small firms whose technology level is low relative to the industry frontier[5] and whose owner-operators have weak management capabilities. Their workers are generally low skilled and little or no continuous learning takes place for sustained skills upgrading. Although low barriers to entry may lead to growth in the number of firms and supporting institutions located there, this does not necessarily reflect a positive dynamic as measured by the upgrading of management skills, investment in new process technology, machinery and equipment, improvement in product quality, product diversification or the development of exports.

The nature of coordination and networking among firms located in informal clusters tends to be low and is characterized by a limited growth perspective, often cut-throat competition, little trust and little information sharing. Poor infrastructure, the absence of critical services and support structures such as banking and financial services, productivity centers and training

[3] See Pyke & Senenberger (1992) for a more extensive discussion of this point.
[4] This and the following paragraphs are drawn in part from UNCTAD:1998, pp.4-8.

program, weak backward, horizontal and forward linkages and a lack of information on foreign markets tend to reinforce this low growth dynamic. The Suame Magazine cluster in Kumasi (Ghana), consisting of nearly 5,000 craftsmen in small garages and workshops making spare parts for and repairing automobiles is one example of an informal cluster that began the process of transformation through the establishment of linkages between clients and suppliers and networking with research institutions such as the Technology Consultancy Center at the University of Science and Technology in Kumasi. Slowly a process of learning and technological upgrading had begun. Of particular interest in the Suame Magazine case was the role of government. After its initial opposition to the mushrooming of informal workshops, the government moved to support their development through the provision of technology services, training and credit[6].

These linkages generated considerable technology capacity-building within the cluster, and this process was reinforced during Ghana's long period of economic crisis by the movement of educated people out of the public sector and into micro and small-scale enterprise. Nonetheless informal clusters such as these are highly fragile. When, towards the end of the 1980s, the IMF structural adjustment programme liberalized imports, including those of used cars, and second hand parts such as engines, as and foreign currency became more available, the cluster's growth slowed. Hundreds of businesses collapsed and thousands of workers lost their jobs. Businesses that had moved from repair to manufacturing fared better than others. From this experience, it became clear that "to survive and prosper, fitters must raise their level of technology and many must change their role from that of repairer to that of manufacturers" (Powell: 1995).

Organized clusters are characterized by a process of collective activity, mainly oriented towards the provision of infrastructure and services and the development of organizational structures designed to analyse and provide the channels to face common problems. Although most firms in these clusters are small, some have have grown to medium-size and their competence level has improved through training and apprenticeship. In terms of technological capability they have also upgraded, though few are close to the frontier. What distinguishes the organized cluster is the cooperation and networking that has emerged among member firms.

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[5] Other examples of informal clusters in developing countries include the clothing cluster in Santa Cruz de la Sierra, Bolivia and the palm sugar and roof tiles clusters in Central Java, Indonesia.

[6] The IDA –supported Transport Rehabilitation project at the Kumasi Technical Institute, the government , for example, provided "…training to upgrade the skills of mechanics in informal workshops and to teach them basic accounting and management methods [and it]…has also helped to establish a pilot program to provide credit to small operators [such as]…a mechanic's cooperative established to purchase and share equipment such as lathes and crank-shaft grinders" (World Bank:1989,p.121).

Firms in these clusters also exhibit the capacity to undertake technology adaptations, to design new products and processes and to bring them quickly to market. The Nnewi cluster of automobile parts manufacturers in Nigeria is an example of how firms located in an informal cluster with virtually no infrastructure have been able to grow, to export informally and upgrade, grouping together and setting up common utilities[7].

Since the mid-1970s, local traders in Nnewi have transformed themselves into manufacturers of automobile parts through close linkages to technology suppliers in Taiwan Province of China. Seventeen firms, ranging in size from enterprises with 40 employees to those with 250, supply Nigeria and other West African markets with switch gears, roller chains for engines, auto tubes, batteries, engine seats, shock absorbers, foot rests and gaskets for motorcycles, as well as other parts. Most of these firms have the design capability to modify products and adapt the production process to the local market. Firms in Nnewi grew despite major infrastructural and credit constraints. Electricity, for example, was only supplied through private generators, water was provided through the company's boreholes, telephone service was poor and tariffs high, land was expensive and scarce, and banks were reluctant to extend the level of credit offered to companies with high inventory costs. Despite all these limitations, Nnewi firms succeeded in innovating, growing and exporting to neighbouring countries while other firms in Nigeria were failing.

Much of this success was due to the acquisition of skills by workers mainly through learning-by-doing, especially during equipment installation and test run, and through inter-firm linkages with foreign technology suppliers, notably those from Taiwan. However, as in the Suame Magazine case, vulnerabilities in the production strategy of the cluster have emerged, especially because firms were not well organized within the cluster to support a continuous process of improvement. As Oyelaran-Oyeyinka (1997) pointed out, "a weak local capital goods capability continues to slow down a full acquisition of major innovation capability…" Here is where policies and new support structures, notably credit facilities are critically needed.

To a greater extent than in Nnewi, the surgical instruments cluster in Sialkot (Pakistan), has steadily increased its exports from the late 1970s to the mid-1990s, with a particularly steep increase in 1995 and 1996. Over this period, exports rose by approximately 10 per cent per year in real terms. Despite a close relationship between exchange rates and export performance, other factors appear to better explain the growth of exports of surgical instruments, particularly their sharp increase in the mid-1990s (Mytelka, Farinelli & Taye:1999).

By the 1960s, Sialkot had already become an export-oriented cluster, selling surgical instruments to countries in the region. Today, some 300 manufacturing SMEs of which 98%

[7] This case is based on Oyelaran-Oyeyinka:1997.

have less than 20 employees, surrounded by 1500 small sub-contractors, 200 input suppliers and 800 service providers - produce one fifth of the world's output of stainless steel surgical instruments and generate exports in excess of US$ 125 million (Nadvi:1998a, p.14) These mainly go to Western Europe and the United States. But at the beginning of the 1990s, after decades of good sales, exports visibly fell due to a quality barrier imposed by the US Food and Drug Administration. Of particular relevance to the relationship between clustering and innovation and with regard to SMEs is the speed with which local producers managed to meet the higher standards required by export markets and neutralize the embargo. How this took place provides lessons for the upgrading of clusters elsewhere.

Sialkot had a deeply rooted manufacturing tradition notably in the steel industry. This constituted the knowledge-base for the manufacture of surgical instruments when during World War II, most of the United Kingdom's production was absorbed by local hospitals. As a solution to the shortage of surgical instruments affecting British India, local doctors approached the blacksmiths and artisans of Sialkot, relying on their longstanding ability in manufacturing sharp and excellent quality swords. To assist the local industry, blueprints, drawings and technical experts were brought from Britain and a technical institution was set up to channel technical advise. (Nadvis: 1998a,b).

Entrepreneurship was also a long-standing characteristic of the local population[8] but not collaboration. Immediately following upon the imposition of import restrictions by the United States, a delegation of local producers visited Washington in a vain attempt to negotiate a deal with the FDA. The impetus for more positive forms of collective action regarding the upgrading of quality standards was subsequently driven by a combination of local firms, their industry association, the Surgical Instrument Manufacturers Association (SIMA), and government actors. At the same time as the local trade association lobbied the Pakistani Government for financial and technical support, it hired a quality assurance consultancy firm to train and upgrade local enterprises. Metal testing laboratories and technical training facilities were set up after federal support was made available. The first firm met ISO quality standards two years later and 75 of the 300 manufacturers have been able to meet good manufacturing practices (GMP) standards (Nadvi:1998b).

Through this process the small firms became more specialized[9], thus benefiting from economies of scale and scope. Changes in their awareness of the benefits to be derived from clustering also developed as the cluster became more organized. In the past, for example, these firms simply

[8] The region is known historically for its development of Basmati rice and more recently for production and export of sporting goods (it is the world largest producer of leather hand-stitched footballs), musical instruments and leather garments.

benefited passively from the externalities spontaneously produced through clustering. These included the availability of inputs, spare parts and machinery repair units, cargo handling and trade services, as well as of skilled labour. In the organizational phase, enterprises engaged actively in the creation of collective efficiencies stemming from a high degree of linkages within and between different sectors, vertical and horizontal ties, a progressive specialization in the various production phases, frequent exchange of information and regular technical discussions among producers and subcontractors. Tacit knowledge flows were facilitated by this conscious, pro-active set of interactions.

Cooperation between the public and private sector also contributed to meeting the challenges faced by the firms in this cluster. SIMA played a pivotal role in obtaining public support for the creation of a technical training facility, a metal testing laboratory[10] and a special credit line to provide short-term loans to local manufacturers. In Sialkot, state support is unlikely to have occurred without the intervention of SIMA (Nadvi:1998a).

Having successfully weathered one crisis, many of the channels for cooperation, however, began to fall into disuse. The role of SIMA as an interlocutor with the government, for example, had been particularly important in the initial period during which the cluster became more organized. Subsequently this function was of lesser importance for the firms in the cluster, but SIMA failed to develop other, more innovation-oriented activities. Sialkot's surgical instruments manufacturers mainly supply the low-end market. As technology changes in this industry, keeping up will require a stronger technological base and closer linkages to materials suppliers than in the past.

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[9] The surgical instruments manufacturing process consists of eight phases. Most of the SMEs are now specialized in only one phase. (ILO:1996)

[10] A critical role in upgrading quality was played by the publicly funded Metal Diagnostics Development Centre, particularly for heat treatment technologies and metal testing. It was the only laboratory facility in the cluster, and some 90 per cent of the local SMEs have made use of its services. (Nadvi:19998a)

INNOVATIVE CLUSTERS IN TRADITIONAL INDUSTRIES

Although organized clusters by definition have the potential to be innovative, simple proximity among firms in traditional industries is no guarantee that this will take place or that it will be sustained as the previous section indicated. In the developed countries, however, clusters based on traditional industries have been demonstrating new dynamism.

In the past, traditional industries that are neither science-based nor knowledge-intensive were thought not to require the kind of learning and innovation that have propelled export growth in 'high tech' industries. The low level of R&D expenditure in such industries gave further support to this belief. The very locus of change in traditional industries, however, makes the level of R&D expenditure a poor indicator of innovation. Nor can the innovativeness of firms in such industries easily be determined from responses to the now classic question concerning the introduction of *new* products[11] since this question often fails to capture changes in design or materials that significantly modify products but do not result in the creation of an entirely new product. Where competitive conditions in these industries are changing, sustained export growth, however, would only be possible if firms in these clusters engaged in a continuous process of innovation. Under these conditions, the trajectory of a cluster's exports overtime becomes a useful proxy for innovation.

Figures 1 and 2 present data on export growth at the four digit SITC level for a number of industries of which spectacle frames whose production is clustered mainly in Belluno and the furniture industry increasingly clustered in Jutland have been selected for particular examination here. As traditional industries, the upward trend in exports from the mid-1980s well into the 1990s requires further analysis.

Fluctuations in exchange and interest rates are unrelated to these trends in both Italy and Denmark. Their impact is, in fact, counter-intuitive. Thus as the lira strengthened against the US dollar in the period 1989-1992, exports of traditional products such as woolen textiles and spectacle frames rose more steeply and when the lira weakened later in the decade, exports both rose and then declined. Interest rates were high, but relatively stable, over this period. In the case of Denmark, periods in which the kroner was at its strongest, are associated with the steepest and steadiest rises in exports of both traditional and high tech industries. A decline of two percent in average interest rates from the early to the late 1990s, may have had a marginal

[11] See , for example, Mytelka: 1978 and recent European Union Innovation Surveys (EU:1994,1997).

impact on telecommunications exports, but does not appear to have affected exports of furniture. How then have exports in these traditional industries been sustained and what role has clustering played in this process?

In addressing the relationship between clustering and export growth, a number of factors stand out in a comparative analysis of these two cases. First is the changing nature of competition in the furniture and spectacle frame industries and within this context, the choice of where and how to compete made by entrepreneurs in each of these clusters. Although both industries are classified as 'traditional' and 'low tech', the spectacle frame industry underwent a radical change in the 1980s as eyeglasses were transformed from a medical product to a fashion good. The way in which the Belluno cluster responded to the new rules of competition in this industry provide an interesting comparison to the furniture case in Jutland. The wooden furniture industry, for example, did not undergo a massive shift towards design-intensity, but it would be incorrect to describe the products of this industry as standardized commodities, despite the near-total absence of patenting and limited brand awareness or loyalty[12]. The industry is niche-market oriented and there are opportunities to produce for up-scale, designer-oriented markets similar to those in the spectacle frame industry. Danish producers, however, have not moved in this direction in order to remain competitive.

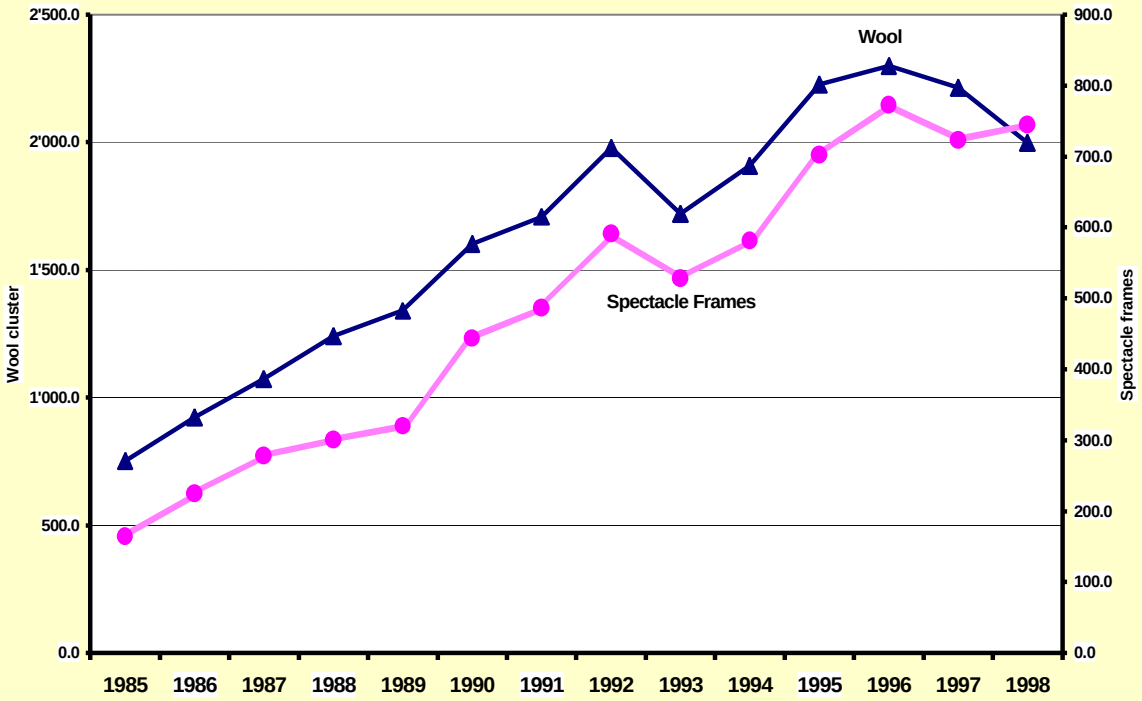
Second is the broad similarity of institutions that have a baring on collaboration and hence on the potential for innovation within the cluster, but the multiplicity of ways in which these habits and practices have been expressed across these two countries and clusters. Both Italy and Denmark have been characterized as countries with a traditional structure of local collective organizations that support economic agents and a specific set of habits and practices that facilitate interactive behavior amongst them (Amin & Thomas:1991, Edquist & Lundvall:1993). Institutions of this sort take time to develop, are tacit in nature, embedded in complex webs of interaction that constitute 'untraded interdependencies' and are therefore locationally specific. (Maskell:1999, Storper:1995,1999). Cooperatives and the 'negotiated economy' in Denmark and 'industrial districts' in Italy reflect these virtues and the locational advantages they confer.

[12] The exceptions are a very few firms in Italy and the United States.

Figure 1

Italy: export growth in the wool cluster and spectacle frames

(in millions of US$)



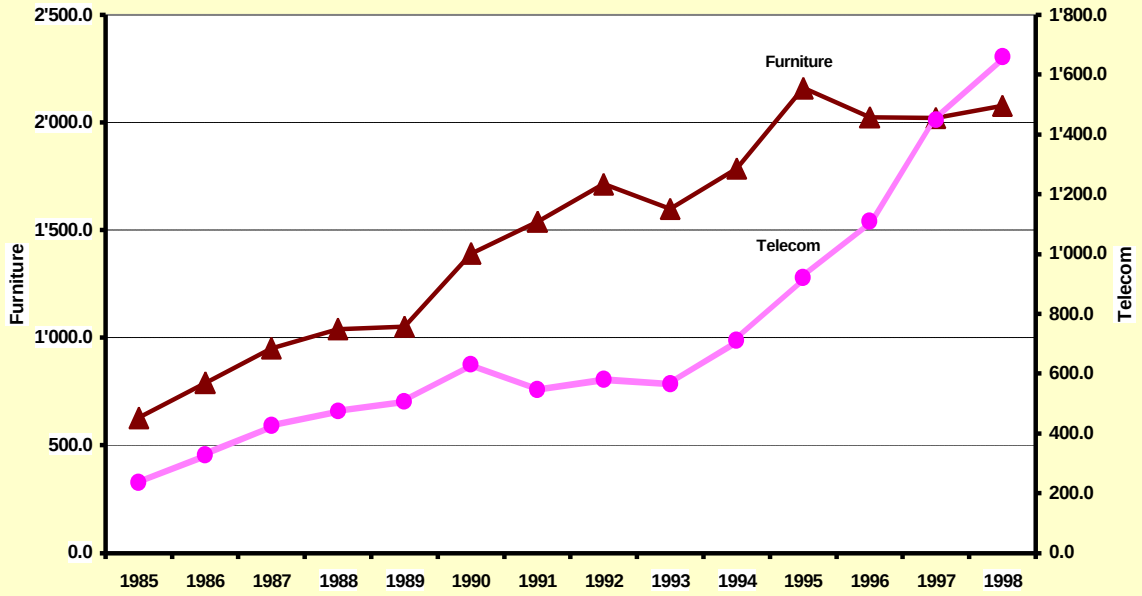
Source: UNSD, COMTRADE database.

Wool cluster (SITC:6542+6543); Spectacle frames (SITC: 88421)

Figure 2

Denmark: export growth in furniture and telecom

(in millions of US$)



Source: UNSD, COMTRADE database

Furniture (SITC: 8211+8212+8219) ; Telecom (SITC: 7641+7642+7643+7648+7649)

Yet not all clusters have been in existence for decades. Some have formed much more recently (Malerba:1993,235; Maskell & Malmberg:1999). The spectacle frame and furniture cases are two such clusters. Although the art of producing "vitreo ab oculis ad legendum' traces its origins back to fourteenth century Venice. Spectacle frame manufacturing is thus deeply rooted in the regional culture of Belluno and the spectacle frame cluster is a post World War II phenomenon. Similarly, the Danish furniture industry was far more dispersed in the past. Today, a high turnover in the number of establishments within this industry[13] is leading to the formation of a stronger cluster. Thus, when firms close elsewhere in Denmark, new ones, created mainly by skilled workers from within the industry, tend to locate in central Jutland (Maskell:1996,12). To some extent learned behavior with respect to linkages and innovation can lead to inter-locational tacit knowledge transfer when artisans who move to Jutland recreate patterns of cooperative interaction in the new location. Inter-cluster tacit knowledge transfer has also been a feature of the Italian experience as we shall see below.

Similarities and differences also exist with regard to the role that government plays in the economies of these two countries. Within a broad consensus on government support for economic initiatives in both countries[14], there are important differences in the extent to which local governments have been critical actors in the local innovation systems of Italy and Denmark. In Belluno, local government was an important actor sand played a central role in the coalition of actors that came together in response to changes in the global industry. A local Committee of Action composed of public and private organizations, trade unions and other economic agents who had traditionally supported the development of the district, for example, was formally set up in 1993. Their vision was to transform Belluno into a 'world center' ("la citta dell'Occhiale") for spectacle frame production. This lead to the creation or strengthening of a variety of organizations, several of which resembled those established in organized clusters such as Sialkot but, they are not identical, are more numerous and reinforce a common set of desired values, habits and practices with respect to innovation.

- A technical school (Scuola per l'Occhiale) created by the University of Padua and located in the Faculty of Engineering was set up to train specialized and highly qualified personnel.
- A certification institute (Certottica) was established with public and private funds.
- A local service and information centre (Centro Servizi per l'Occhialeria), created with public and private funds and designed to support SMEs in this industry, operates in close cooperation with Certottica

[13] From 1972 to 1992 the number establishments declined from 369 to 357 but turnover in establishments was high. In 1992 , 59 percent of the firms were new. (Maskell:1996,23).

?? An observatory (Osservatorio sulle Dinamiche del Distretto) collects and processes qualitative and quantitative data enabling a close monitoring of economic trends in the district.

?? An industrial museum and foundation (Fondazione per il Museo dell'Occhiale) diffuses the culture and traditions linked to the local production of spectacle frames, and re-launched the product's image nationally and internationally..

The role of local government in the Herning/Ikast area of Jutland has not been as prominent. A wood furniture engineering school was set up in Herning but other support structures that involved firms from the furniture cluster were put in place with the support of the national government and other critical actors in the broader National system of innovation. In 1989, for example, the state supported Danish Technology Institute launched a three-year program to strengthen collaboration between small firms as a means to enhance their competitiveness. Over 2000 firms were drawn into 400 networks and through a demonstration effect over 1000 SMEs outside of the formal programme also formed networks. (DTI:1993, Pyke:1994).

Of greater importance for innovation in the furniture cluster were local banking agencies. Through familiarity with the industry and knowledge of the firms local banks have played an important role in serving the SME sector. In Jutland,

> an employee in a local branch of a national Bank will, for instance, have been presented with a large number of loan applications from small furniture and clothing firms over the years, and will gradually acquire an extensive knowledge of these two local industries. Such experience will over the years enable the employee to identify unusual projects and specially promising firms. He/she will be able to grant larger loans than otherwise available without increasing the risk for the bank by utilizing this accumulated knowledge and—more significantly—have a higher tendency on the margin in allocating of loans towards potential high-flyers…[elsewhere a clerk] would have to rely solely on the formal requirements to security and credit rating and a general knowledge of the poor probability of survival for small and medium-sized enterprises.(Maskell & Malmberg:1999, 176-177).

Although neither industry has undergone a technological rupture, process changes have reduced the labor–intensity of production in spectacle frame manufacture far more than in wooden furniture manufacture thus enhancing opportunities for economies of scale and stimulating a process of concentration. The Belluno industrial district currently has 190 medium-sized companies employing 10,200 people and 720 small firms with 2,500 employees. The top two firms, Luxottica and Safilo, have gradually taken over many of their rivals in the district and abroad. Luxottica, for example, absorbed the American Ray-Ban (sunglasses) and the Italian Persol, the only Italian company manufacturing spectacles frames that was not located in

[14] There is also some variation within Italy across clusters. (Rabellotti:1995).

Belluno[15]. Currently, the top five firms in Belluno account for 80% of the district's total production of spectacle frames. Despite a decline in the number of enterprises and the high concentration index, employment in the district remains robust and has been increasing.

In the wooden furniture industry globally, the absence of significant process change has meant that most firms have remained small. In the Danish wooden furniture cluster, the average size of an establishment rose only slightly from 34 employees in 1972 to 39 in 1992, but employment in the industry rose 12% reaching 14,041 in 1992. (Maskell: 1996, Table 2,p.23). Not having the capacity to market on their own, these firms mainly sell to large distributors such as IKEA and only about 10 percent of the firms in the Danish wood furniture cluster produce for an up-market designer furniture niche. (Maskell: 1996). The reverse is true in the spectacle frame industry of today, though this was not always the case.

Changes in the nature of competition within the industry were a major stimulus to exports of spectacle frames from Belluno. Here Italy had a clear advantage, since considerable tacit knowledge had been built up overtime in clothing and other fashion industry products. Inter-cluster tacit knowledge transfer and linkages helped to spread a model of innovation based on quality products, design-intensity, close interaction with the fashion industry and innovative brand name marketing that has transformed the older and more established spectacle frame cluster in Belluno into an innovation system. In just ten years the percentage of locally produced frames marked 'Ralph Lauren', 'Ferrari', 'Ferre', 'Missoni', 'Fendi', 'Gucci', 'Laura Biagiotti', 'Armani', 'Genny', 'Byblos', 'Guigiaro', 'Valentino', 'Pierre Cardin' and 'Yves Saint Laurent', 'Burberry', 'Diesel', 'Christian Dior' , 'Max Mara' and "Fossil' has risen from 3 to 50 percent and the high growth of demand has exceeded all expectations. The composition of products and their level of sophistication has thus changed radically. While South-east Asia dominates the mass market for spectacles, Italy maintains a hold on the top end of the market, where profit margins are greater. Belluno's share of the world spectacle frames market in 1998 thus amounted to 17.6%. (Fortis:1999).

In contrast to firms in the Danish wood furniture industry, major spectacle frame manufacturers in Belluno also market under their own brand names. In January 1990 the Luoxottica group was listed on the New York stock exchange and subsequently took control of the largest US optical chain, LensCrafters, with 778 stores located throught the country. Since then, Luxottica has become the largest supplier of mid and premium priced eyewear in North America.

15 Persol was, however, located in another Northern Italian region. Similarly, Safilo took over Starline, the most important American trading company in the sector, Oxsol, a company from Northern Italy specialized in sunglasses, Optique du Monde, the American licensee of the Ralph Lauren trademark, Smith Sport optics, a leading company in the US with a 50% share of ski eyewear market, and the Austrian Carrera Optyl, with a manufacturing facility in Austria and another in Slovenia, among others.

Of critical importance in understanding the sustainability of the innovation process in Belluno and Jutland is the way in which over the 1980s and 1990s, in both spectacle frame and furniture clusters, the industries have become tacit-knowledge intensive. In the former this is manifest in product design and marketing as well as in production. In the latter, tacit knowledge accumulation is mainly centered in the production process and in the ability to manage a stable network of suppliers and clients. In both industries, links to materials suppliers have become increasingly more important in the development of new products and/or of new process technologies. In the wooden furniture industry, the introduction of paints and lacquers with lower levels of volatile organic compounds, for example, has altered the wood painting process. Intense interaction between furniture manufacturers and the subsidiaries of Akzo Noble and other foreign multinational firms producing these new paints was required in order to ensure the same surface quality (durability, color, coverage, shine and thickness) as before. (Maskell & Malmberg:1999). In spectacle frames, R&D links to university research laboratories and to materials suppliers have led to the development of frames produced in metal, acetate and other new materials, such as technopolymers, aluminum and carbon fibres. New production sites specialized in titanium frames have also emerged. Within the spectacle frame manufacturing establishments themselves, acetate frames and sunglasses are now produced using injection molding techniques. Luoxottica has established a research division whose major tasks are to study new manufacturing technologies and new materials, design and produce plants and machinery and assure continuous innovation. Safilo, the second biggest manufacturer of spectacle frames in Belluno also has a research division. "Fifty engineers design and build the machines that are humming away in the factory next door. Some of the systems developed within Safilo's workshop are patented—machinery to construct a particularly flexible hinge, for example. More often, the engineers modify standard machines that Safilo buys from outside. Vittorio Tabacchi, the chairman, laughs at the idea of asking the company's suppliers to modify the machines they sell him: that would reveal his firm's secrets and allow them to fall into the hands of competitors" The Economist:1999) It is the tacit-knowledge intensive nature of both industries that has served as the major barrier to entry for outsiders and potential newcomers.

CONCLUSIONS

Detailed case studies on the sustainability of export growth in a number of industrialized countries supports the view that innovation is not solely the preserve of science-based industrial sectors. In several of these cases, clustering appears to have been a critical element in the ability of these traditional industries to remain competitive overtime. Traditional sectors thus remain potential platforms for catching up by developing countries but policy makers will have to adopt a broader perspective on the opportunities for learning and innovation within traditional industries than they have in the past.

As the case studies presented here revealed, three cluster-related factors lie at the heart of this process. First is the extent to which clustering has enabled a deepening in the local knowledge base in these industries and its broadening to include design, quality control and information related to markets and marketing. Second is the way in which clustering has facilitated the establishment of linkages to a wider set of knowledge inputs, particularly those related to materials and machinery suppliers. Third is the ability of firms in these clusters to collectively transform 'low tech' industries, such as spectacle frame and wooden furniture manufacture, into tacit knowledge intensive industries and to internalize this competitive advantage within the cluster.

Underlying these changes has been a continuous process of learning through linkages and inter-cluster tacit knowledge transfer, government stimulus and support and the availability of financing for innovation-oriented investments. Having said this, however, one should not jump to the conclusion that these case studies have provided a singular path to sustained innovation in these clusters. To the contrary and indeed in contrast to much of the literature on clustering these two case studies have illustrated the multiplicity of paths that might be taken in transforming spatial clusters into innovation systems.

A number of lessons might be drawn from this analysis. As the differences in the market niches chosen by firms in Belluno and Jutland has shown, it is not always necessary to compete in the upscale, designer segment of an industry. But it is imperative to find ways to be innovative and to sustain that process. Local linkages were especially important here.

Having a cooperative culture, however, did not necessarily predict to linkages and learning. Despite the broad similarity in institutions, habits and practices with respect to innovation were not identical in Italy and Denmark, nor were both of these cases illustrative of an historical process of cluster formation. While longevity of the cluster may not be as significant as

previously thought, this does not imply that institutions can be built overnight. Well designed policies and support structures are needed to stimulate new habits and practices and a longer time horizon than is usually the case in policy-making should be adopted. Which structures and policies will be needed to stimulate learning, linkages and investment in the case of a specific configuration of actors endowed with their particular level competences and traditional habits and practices, will require careful analysis.

In this respect, financing innovation does not always require venture capitalists or Nasdaqs. Though the larger firms in the spectacle frame cluster are listed on the stock market, in the furniture cluster, populated largely by SMEs, cluster-oriented banking was a critical component in the change process. In-house R&D, though modest when compared to 'high tech' sectors, now contributes meaningfully to the development of new materials for spectacle frames. Small incremental innovations in production are still effective in sustaining competitiveness in the wooden furniture industry. In all cases, however, transforming a spatial cluster into an innovation system has required a conscious effort to widen the industry's linkages to new knowledge bases and deepen the tacit knowledge intensity of the cluster as a whole.

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