

Knowledge in the Air and its Uneven Distribution: A story of a Chilean Wine Cluster

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Introduction

Industrial policies are emphasising the role of ‘clusters’ of firms as important sources of competitiveness in a country. Different theories have analysed the strength of clustered firms both from a static and dynamic point of view. The former refers to Marshallian externalities and agglomeration economies (Becattini, 1979), the latter shifts the attention to knowledge as a crucial asset that is shared and created through a process of ‘collective learning’ in the cluster (Camagni, 1991; Belussi, Pilotti, 2001).

The cluster is in fact considered as a locus of localised learning (Mansell, 2001), that eases the diffusion of knowledge (‘spillovers are in the air’) and might foster the generation of new ideas (e.g. innovations, patenting etc.) (Feldman, 1999).

This paper provides an insight into this latter issue. It is presenting empirical evidence of knowledge flows in a Chilean wine cluster: the Colchagua Valley. And it is testing the hypothesis that knowledge does not flow freely in the air by virtue of geographical proximity, but it flows within ‘cliques’ of actors and firms, characterised by similar absorptive capacity and belonging to the same epistemic community.

The methodology adopted is based on Social Network Analysis (SNA) (Wasserman, Faust, 1994), which analyses relational data between intra- and extra-cluster’s firms and institutions.

The study will further explore the existence of private actors (firms), which channel external sources of knowledge to the cluster and contribute to the diffusion of acquired knowledge to other localised firms (‘technological gatekeeper’).

The empirical evidence shows that the cluster is characterised by an ‘open’ knowledge system (Bell, Albu, 1999) and the elaboration of data with SNA, allows to detect and ‘measure’ the existence of technological gatekeepers, which introduce process innovations and new techniques in viticulture and vinification. Such actors are interacting with other localised firms, thus transferring knowledge (both tacit and codified) and by joint problem solving. Hence, consistent to received theory and empirical evidence, they seem to produce benefits to other localised firms by virtue of spillovers and knowledge transfer.

Nevertheless, SNA, which allowed mapping inter-firm interactions, knowledge exchange/transfer, and new knowledge joint generation, showed that private technological gatekeepers (firm) tend to interact with firms with similar and high absorptive capacities and to leave separate those with lower absorptive capacities.

To conclude, the research sheds some light on the dynamics of knowledge diffusion (and creation) in clusters of firms, questioning the existence of some ‘knowledge in the air’ which is evenly

absorbed by localised firms and it is reassessing the role of social and geographical proximity as means of 'localised collective learning'. On the contrary, it shows that learning patterns are occurring only within limited knowledge circles, which tie together professionals of different firms, who belong to the same epistemic community and share a common code of communication and overlapping and complementary pieces of knowledge.

The paper is structured as follows: in the first section, the theoretical framework will be presented and relevant research questions addressed; the second section will introduce the methodological underpinnings of the research and the hypothesis formulated. The third and last sections will finally present the main empirical findings of the fieldwork and draw theoretical and policy conclusions.

Section 1

1.1. Knowledge 'in the air' and local learning processes

"The concept of external economies is one of the most elusive in economic literature. Our understanding of it has been greatly enhanced by the active controversy of the twenties over the "empty economic boxes"; but full clarity has never been achieved" (Scitovsky, 1954, p. 143). Scitovsky starts in this way his 1954 article with the aim of improving the definition of external economies that he further defines as "services (or disservices) rendered free (without compensation) by one producer to another" (p. 143). And he distinguishes between pecuniary and technological external economies: the former derive from market interdependence to bring about the optimum situation: "when these benefits accrue to firms, in form of profits, they are pecuniary external economies- Marshall called, or would have called, them (together with the benefits accruing to persons) consumers' and producers' surplus respectively" (Scitovsky, 1954, p. 147); the latter are instead due to non-market direct interdependence among producers, such as the case in which: "a firm benefits from the labour market created by the establishment of other firms and that in which is free but limited in supply" (Scitovsky, 1954, p. 145).

Indeed, the presence of technological external economies derive from a series of facts that are not easy to find in economic reality. Such externalities are nevertheless to be found in geographical agglomerations of firms operating in the same or connected industries ('clusters').

Firms localized in clusters are said to benefit from technological externalities bounded in space (knowledge spillovers) that facilitate technological change and promote a process of local 'collective learning' (Capello, 1999, Maskell, Malberg, 1999). Already in Marshall 'industrial atmosphere', the "mysteries of the trade become no mysteries; but are as it were in the air, and children learn many of them, unconsciously" (Marshall, 1920, p. 225); firms of the industrial districts benefited from the availability of a pool of skilled labour force and new ideas were

circulating easily from one firm to another promoting processes of incremental and ‘collective’ innovation (Allen, 1983).

Indeed the link between geography and innovation has been subject to extensive study by different schools of thought. They all question the importance of localization for innovation and competitive advantage. This view is underpinned by the fact that innovation is a: a) cumulative and path dependent (Dosi et al., 1988); and b) an interactive process (Lundvall, 1988).

On the basis of this, clusters facilitate virtuous processes of collective learning because: a) they are repositories of tacit and idiosyncratic knowledge embedded in local firms and institutions (Maskell, Malberg, 1999; Belussi, Gottardi, 2000) and accumulated over time and because b) firms are interlinked in the local productive chain and possibly socially embedded (Granovetter, 1985), which lead them to interact, exchange information and foster joint innovation. Interaction is said to be eased by a common social and cultural background (Becattini, 1998) and promoted by inter-firm division and specialisation of labour.

While it is acknowledged that industrial clusters (districts) support the adoption, adaptation and diffusion of innovations among SMEs (Asheim B.T., 1994) as well as a process of incremental learning, it is still unclear how these facts can support a process of endogenous innovation (Asheim, 1996) capable of generating ruptures with the existing technological paradigm or radical innovations.

Certainly, the potentiality of a cluster to generate breakthroughs depends on local learning patterns, which in turn are influenced by the technological capabilities (Lall, 1992; Bell, Pavitt, 1993; Caniels, Romijn, 2001) and absorptive capacities (Cohen, Levinthal, 1990; Antonelli, 1996; Giuliani 2002) of its constituent firms. Indeed this helps to interpret the differences between different producing areas in the world like the Tuttlingen and the Sialkot surgical instruments’ clusters (Nadvi, Halder, 2002) or the footwear cluster of Guadalajara (Mexico) and Brenta (Italy) (cf. Rabellotti, 1997), to cite but a few.

In addition, even *within* the same cluster, one observes different learning patterns (see Bazan, Navas-Aleman, 2001 for an example), which casts some doubts on the ‘localised knowledge spillovers’ and ‘knowledge in the air’ stories as smooth explanations of new knowledge generation at local level (Breschi, Lissoni, 2001). Indeed, knowledge generation fails to materialise in contexts (even within a sub-group of firms in a cluster) where low technological capabilities and absorptive capacities hinder even ‘knowledge in the air’ to be absorbed or exploited locally. In spite of knowledge flowing *freely* in the air, such contexts do not undertake any virtuous collective learning path.

Hence, it seems that the dynamics of knowledge diffusion and generation in clusters of firms are still a black box rather than a solution for development.

As stressed in one of his last works by K. Pavitt (2002) “the emphasis on tacit knowledge, and the example of either the Italian regions or Silicon Valley has led to an excessive emphasis on regional clusters of knowledge creation and exploitation as the basis for analysis and public policy. Whilst these are clearly important, they are only part of the story.” (p. 8).

1.2. The issues at stake

In order to shed light on the damp ‘industrial atmosphere’, three main issues are emphasised here:

- the understanding of the nature of localised knowledge;
- the role of ‘epistemic communities’ that can be viewed as a highway of learning;
- the firm’s absorptive capacities (Cohen, Levinthal, 1990) as a variable that influences and shapes the local knowledge system.

The nature of knowledge spilling over within a local area is debated and differently emphasised by different conceptual approaches. On one hand, knowledge is said to be a public (Marshall, 1920), quasi-public (Bellandi, 2002) or club good (Capello, 1999). It is therefore seen as available to firms localised within the boundaries of the cluster. On the other, it is said that local knowledge is inherently tacit and diffuses via face-to-face interactions, which are eased, by social embeddedness and geographic proximity (Belussi, 2001; Feldman, 1999). “Indeed, the concepts of ‘spillover’ and ‘tacitness’ form an odd couple” (Breschi, Lissoni, 2001; p. 976) and it seems difficult to conceive knowledge that is stuck in people and places as flowing freely in the air. It seems as if tacit knowledge, which is inherently private (Lundvall, Johnson, 2001) becomes public and it’s easily shared in clusters.

Indeed, identifying the *nature* of localised knowledge is a way to define the cognitive advantages of clusters and to understand the economics of knowledge diffusion and creation in such spatially bounded areas.

Recent contributions (Cowan, Foray, 1997; Cowan, David, Foray, 2000) reassessed the role of tacit knowledge and its pervasiveness in economics. In fact, they argue that the boundaries between tacit and codified knowledge vary according to incentives and costs to codification. Not denying the importance of the former, which is necessary to apply codified knowledge in a real context, they propose a framework in which knowledge is not only either *codified* (articulated) or *tacit* but it can be *unarticulated* cum displaced codebook (Cowan, David, Foray, 2000). Accordingly, the latter can be codified but understandable only by the members of a group or community that share a common

code of communication (jargon, technical terms etc.) which is unknown to non-members so that “to the outside observer, this group appears to be using a large amount of tacit knowledge in its normal operations” (Cowan, David, Foray, 2000, p. 230). In other words, “‘a displaced codebook’ implies that a codified body of common knowledge is present, but not manifestly so. Technical terms figure in descriptive discussion but go undefined because their meaning is evident to all concerned; fundamental relationships among variables are also not reiterated in conversations and messages exchanged among members of the group or epistemic community” (Cowan, David, Foray, 2000, p. 230).

The distinction between tacit and unarticulated cum displaced codebook knowledge seems to be relevant in the analysis of this present work. At least it is useful to discern between “knowledge which is passed on “by doing things and seeing how other people do things” (which can be unarticulable, as long as there is no other way to transmit it) and knowledge that is transmitted “through informal chit-chat” which is necessarily codified (otherwise it could not be articulated) no matter whether the code is displaced, written down, hidden to outsiders or difficult to understand without a full immersion in the local community.” (Lissoni, 2001: p. 1482).

More importantly, it suggests that knowledge flows within groups of knowledgeable people, which possess overlapping knowledge bases and the capability to decode such knowledge. In this view, the ‘mysteries of trade’ are, therefore, not in the air but stuck in people (i.e. professionals) that embody tacit and codified knowledge all at once. And it is possibly within such circles that the most *valuable* knowledge circulates and produces changes (von Hippel, 1987; Lissoni, 2001).

Circles of professionals can thus be conceived as ‘epistemic communities’ defined as “small working groups, [which] comprise knowledge-creating agents who are engaged on a mutually recognised subset of questions, and who (at very least) accept some commonly understood procedural authority as essential to the success of their collective activities”¹ (Cowan David Foray, 2000, p. 232).

Creplet et al. (2001) distinguish further ‘epistemic communities’ from ‘communities of practice’: “within communities of practice, the privileged knowledge is essentially the know-how (Brown and Duguid, 1991) which is *tacit* and socially localised” (Creplet et al. (2001) p. 1529) whereas, epistemic communities share a common goal of *knowledge creation*: “within an epistemic community, agents are bound together by their commitment to enhance a particular set of

¹ Haas (1992) defines Epistemic Communities as a “network of professionals with recognised expertise and competence in a particular domain and an authoritative claim to policy-relevant knowledge within that domain or issue area” (Haas, 1992. p. 2). In his view, epistemic communities comprehend interdisciplinary professionals which share a common ‘view of the world’ because they have a) a shared set of normative and principled beliefs; b) shared causal beliefs; c) shared notions of validity and d) a common policy enterprise.

knowledge” (Creplet et al. (2001), p. 1530). As opposite to communities of practice, shared knowledge is considered as *explicit* because of the need to express and combine knowledge to create a new one (Nonaka, Takeuchi, 1994) and the lack of deeply shared values.

Similarly to Cowan, David, Foray (2000) and Creplet et al. (2001) ‘epistemic communities’ are conceived here as groups of highly skilled knowledge workers (*experts*) that share a common technical language on the basis of a common scientific background². Such experts embody *dynamic capabilities* (Teece, Pisano, 1994) because they not only accumulated practical tacit knowledge (know-how) through experience over time but possess such theoretical and scientific understanding that is conducive of improvement and possibly knowledge creation.

Indeed, the critical element of an epistemic community is a common goal for *knowledge creation* and improvement of its constituent members that share a *complementary* and *overlapping language* and operate with their own set of *incentives* and *procedural authority*.

Under uncertainty, members of epistemic communities are an important source of technical advice because they can elucidate the cause-effect relationships and shed light on the complex interlinkages between issues (Haas, 1992). Moreover, the understanding of a common unarticulated but codified language facilitates knowledge sharing and technical advice not only over the boundaries of firms (von Hippel, 1987, 1988) but also over the boundaries of a cluster, fostering the alignment of local and global knowledge systems.

Accordingly, epistemic communities can be conceived as a sort of trans-local highway of learning which raises the issue for local firms to be part or to have access to such communities.

Local firms’ cognitive structures (Cohen, Levinthal, 1990) are determining the capacity of the firm to exploit any critical external knowledge: “the ability to exploit external knowledge is thus a critical component of innovative capabilities. We argue that the ability to evaluate and utilize outside knowledge is largely a function of the level of prior related knowledge. At the most elemental level, this prior knowledge includes basic skills or even a shared language but may also include knowledge of the most scientific or technological developments in a given field. Thus, prior related knowledge confers an ability to recognize the value of new information, assimilate it, and apply it to commercial ends. These abilities collectively constitute what we call a firms’ ‘absorptive capacity’” (Cohen, Levinthal, 1990, p. 128).

² In this sense, our understanding of Epistemic Communities differs from Haas’ (1992) because of the lack of shared normative commitment: “Epistemic communities must also be distinguished from the broader scientific community as well as from professionals and disciplines. Although members of a given profession or discipline may share a set of causal approaches or orientations and have consensual knowledge base, they lack the shared normative commitments of members of an epistemic community” (Haas, 1992, p. 19).

Absorptive capacity is hence the capacity of a firm to *recognize, assimilate* and *exploit* external knowledge and corresponds to the *knowledge base* (or *knowledge stock*) accumulated by the firm.

Within a cluster, firms have undertaken different paths of learning (Nelson, 1991), which differentiate them in terms of absorptive capacities and contribute to give a shape to the local knowledge system.

In fact, the existence (or lack) of virtuous learning patterns within the cluster depends on the knowledge accumulated by firms (path dependency) and on their different contributions to the enhancement of the local knowledge base.

Empirical evidence³ suggests further that firms play a different role in the cluster's knowledge system according to their degree of interconnectedness with intra and extra-cluster sources of knowledge. Drawing it from Allen's (1977) terminology, one can isolate three different types of firms:

- *technological gatekeepers*, defined as those actors that have a high level of knowledge interconnectedness with other local firms and also with extra-cluster sources of knowledge. These actors are basically channelling new knowledge into the cluster and diffusing it locally;
- *external stars*, that are highly interconnected with external sources of knowledge but have hardly any cognitive interaction with other local firms;
- *isolated* firms when they are scarcely interconnected both locally and externally.

Such different positions inevitably influence the way in which knowledge is acquired, diffused and eventually changed in the local area. And identifying the nature of *vital* actors, such as technological gatekeepers, might be important in informing technology policy. At the same time, understanding the factors that produce cognitive exclusion and isolation from the technological gatekeepers might also be of help to correct such distortions, e.g. by supporting public or institutional gatekeepers⁴.

Hence, being or not being part of a virtuous knowledge circle, which is well connected in and out of the cluster, might be a matter of cognitive assonance (dissonance) among wineries, which is inherently tied to the firms' knowledge base and their absorptive capacities (Cohen, Levinthal, 1989, 1990). As said, it is the cognitive assonance of firm's technical and scientific personnel that ultimately determines the membership to given epistemic communities.

In sum, the theoretical framework suggests that firms are heterogeneous in their absorptive capacities and hence that are able to *absorb* differently intra and extra-cluster knowledge flows.

³ For a review on this in developing countries' clusters, see Giuliani, (2002).

⁴ Institutional gatekeepers are to be considered as institutional bodies (consortia, associations, centres for technology transfer and the like) that promote knowledge transfer to the firms in the cluster (see also Gambardella, 1993).

This is bound to influence also the participation to local virtuous learning patterns and to epistemic communities. In this way, there seems to be a link between firms' absorptive capacities, participation to epistemic communities and the local process of knowledge diffusion and generation; this link is investigated in the following paragraphs.

Section 2. Methodological introduction

The interest of the paper is that of analysing cognitive linkages of clustered firms in order to find patterns of learning, which differ according to firms' absorptive capacities.

Two remarks need therefore to be made before this analysis is introduced.

To start with, the empirical research was carried out in a wine cluster that has some peculiarities with respect to other (industrial) clusters. In fact, the degree of specialisation and productive division of labour is limited being the process divided only into two main parts: grape growing and wine producing⁵. In addition to that, in recent years wine producers integrated backwards, with the objective of gaining direct control on their viticulture and grape growing. In this case study, on average firms acquire one fifth of their grapes from local grape-growers but with difference according to firms: big national brands subcontract on average more to grape-growers because of their need to comply with a higher supply of varietals wines⁶ (71% declare acquisition of grapes from local producers, on average they acquire 18% on total grapes). Whereas, small firms tend to produce their grapes internally (only 36% declare acquisition of external grapes), with only small starting-up firms relying almost exclusively on the supply of local grape-growers.

Hence, the degree of vertical division of labour is not high and the relations between clustered firms are above all 'horizontal'. Production linkages among firms are based e.g. on the trade of bulk wine (10% of the firms interviewed sell bulk wine locally) and on the provision of 'maquilla' services⁷. Such relations have a mere commercial character while co-operative relations in the valley are scarce⁸. For brevity's sake, this work limits the analysis to horizontal knowledge flows, thus focusing only on wine producers⁹.

⁵ This refers to the activities performed locally, because the industry is strongly interlinked with pharmaceutical and chemical industries and with other providers of materials and machinery. Such producers nevertheless, are not located within the wine cluster.

⁶ 'Varietal' is a wine that has not undergone a process of aging and is of a more 'standard' quality.

⁷ Starting up firms or firms that do not possess their own processing plants (vinification tanks) use to process their grapes in other firms' plants.

⁸ Rivalry and competition tend to prevail between firms in the area that declare that both formal and informal bilateral co-operation is very limited. Instead, multilateral horizontal cooperation is reinforced by the presence of a local business association (Viñas de Colchagua), aimed at promoting worldwide the quality of the wines produced locally. One third of the firms interviewed are affiliated to the association.

⁹ Vertical linkages between grape-growers and wine produced have not been included in the present study.

Secondly, the analysis has been led taking into consideration the knowledge flowing among ‘professionals’ or other ‘knowledge skilled workers’ (predominantly oenologists) that operate on a permanent base in the firm. This choice has been made after pilot fieldwork (March-April 2002) which suggested that such professionals are depositories of scientific knowledge base and hence were those that manage the technical choices, solve the problems and introduce novelties in the firm. Their scientific background has been associated to a ‘general-purpose’ scientific knowledge base which could be incrementally improved adding new pieces of specialised knowledge over time, in a modular way (Arora, Gambardella, 1994). In this sense, their capabilities are *dynamic*, that is, are capable of self-evolution and improvement. The results of this fieldwork also confirmed that much of the knowledge flowing between firms takes place via such professionals, while owners and managers are quite reticent in releasing information. Moreover, the latter are normally less concerned with the technical part of the process.

Another possible channel of knowledge transfer is through technical people (e.g. the cellar men) operating in the firm. Such people are normally experienced technicians, depositories of tacit knowledge. This channel can be important in transferring information (esp. static pieces of codified knowledge) as well as tacit knowledge, which they accumulated during their fieldwork experience. Furthermore, such actors are probably the most socially embedded in the local environment as they have grown up in the area and ‘know what’ and ‘who’ very well. Nonetheless, the main focus of this analysis is mapping those knowledge flows that might potentially generate or induce most of the changes and improvements in the economic and technical activities. Hence, the ‘decision taker’ as well as the ‘problem solver’ is of utmost interest here. As a consequence, oenologists and agronomists are the key agents within the firm capable of capturing external knowledge, decoding it, understanding the ‘why’ of the processes and adapting to the idiosyncrasies of the firm. Potentially those actors might even generate new knowledge.

Accordingly, professionals were asked to indicate on a roaster of firms, which of other professionals operating in other nearby firms in the cluster they turn to when they have a technical problem to solve or need advice¹⁰.

The question did specifically address *problem solving* and *technical assistance* because they involve some effort in producing improvements and change within the economic activity of a winery. It is somewhat deeper than the mere transfer of information, which might not be ‘ideas producing’, in Romer’s terminology (1990). It is assumed in fact, that what is more important is not the transfer of

¹⁰ The professionals interviewed were asked four questions, our analysis in this paper limits to one, which is a directional: inbound; valued question (**R3**: *When you have a technical problem to which of the firms/professionals working in the local area do you turn to for technical advice?*).

static pieces of knowledge (e.g. know who or know what) but that of knowledge which encompasses problem solving, technical advice and ultimately joint experimentation.

Finally, the hypotheses formulated are described below:

Hp1: Knowledge is not flowing freely in the air; on the contrary, it is circulating within 'circles' of agents and/or firms that share a common knowledge base or belong to the same epistemic community.

Hp2: Firms with higher absorptive capacities are more likely to acquire extra-cluster knowledge and transfer it locally and hence work as 'technological gatekeepers'.

In addition, interviews were led to identify the nature of such technological gatekeepers as they can play a central role in the long-term development of the cluster.

Hp3: Firms with low absorptive capacities tend to cognitive isolation and do not benefit from the proximity of other local firms.

Hp 4: There is a relation between firms' learning pattern within the cluster and performance.

Section 3

3.1. The Colchagua Valley: an overview

The Colchagua valley is a rural area located in the 6th Region of Chile, about 180 Km south-west of Santiago. Together with the Cachapoal sub-valley it is part of the Rapel Valley, one of the wine producing areas delineated by the recent '*Denomación de Origin*' legislation.

The valley is closed off to the east by the Andes and to the west by the Coastal Range mountains and divided by the river Tinguiririca. Eight main villages and towns populate it in a range of approximately 80 Kms: San Fernando, Chimbarongo, Placilla, Nancagua, Chepica, Santa Cruz, Lolol, Pumanque, Palmilla and Peralillo. The main economic activity of the area is agricultural, with mais, grain and rice as the traditional crops¹¹. More recently, as a result of the wine export-led boom such cultivars have been eradicated and substituted with a more profitable one: the *vitis vinifera*.

But production of wine in the valley dates back to the end of 19th century when Bouchon, a young man from Bordeaux, settled down in the area of San Fernando (Angostura). He planted a vineyard with French vines which gave rise to a renovation of the viticulture of that time. In the same period

¹¹ The economic activity of the VI region is predominantly based on agriculture which accounts for 30% of regional gross product (1996 data: Banco Central del Chile, Anuario de Cuentas Nacionales 1998) and employ 34,4% of the work force (1999 data: Encuesta Nacional Empleo, INE).

other pioneers (Familia Ignacio Valdés Ortuzar) planted vineyards in 1870 in Cunaco, a village close to Santa Cruz. In addition to which, one of his sons contracted an oenologist from France (Mauricio Wackez). Such a property would then be acquired by two of the main wine producers of the area (Viu, Bisquerrt). The pioneering wineries of that time, were not as advanced as the big wineries of the capital (Santiago), nevertheless it has been reported a certain dynamism of the area which always emulated the French style in production (Tapia P., 2001).

Since those early times, Chilean viticulture has gone through ‘slowing down’ periods of wine production (8 crises of overproduction between 1909 and 1931 and Ley of Alcoholes in 1939 that prohibited new plantations). And it was not until the 1980s that the valley flourished, “boutique”¹² wineries emerged that produced and embottled wines with their own brand¹³.

This trend was boosted by trade openness and growing market opportunities, which in turn raised the price of grapes and wines in the course of the ‘90s. In fact, the second half of the past decade (especially until 1998) is remembered as a golden period for wine producers and grape growers which were paid up to 300-350 Chilean Pesos (C\$) for a Kilo of Cabernet¹⁴.

As a result of this, firms (and farmers) increased their vineyard area and started planting ‘traditional’ French varietals such as Cabernet, Merlot, Syrah and Carmenere¹⁵, as well as Sangiovese, Malbec, Petit Verdot, among others. (S.A.G., Catastro Vitivinicola, 2000).

Statistics show that in 5 years (1995-2000) plantations of *vitis vinifera* more than doubled. And production of wine tripled (S.A.G., Catastro Vitivinicola, 2000).

Recently, starting from 1999, these trends generated an overproduction crisis, which firstly affected grape-growers. Indeed, the demand of grapes by local producers of wine reduced, on one hand because over the course of the decade wineries increased their backward vertical integration. On the other, because wine producers were themselves affected by a global slow down of wine consumption and by increased competitiveness (Anderson, Norman, 2001a, 2001b).

In this scenario, the Colchagua Valley demonstrated a great potentiality for the production of fine wines thanks to the excellent *terroir* and the climatic stability¹⁶. And experts have associated it with the most famous Napa valley in California (Schachner M., 2002).

While there is no doubt that, a wine cluster is there due to natural endowments: “many various causes have led to the localization of industries; but the chief causes have been physical conditions;

¹² Boutiques wineries are small farms that produce fine wines.

¹³ In previous times, grape-growers and wine producers used to sell their products directly to big firm located in Maipo Valley (south of Santiago).

¹⁴ Current prices are around 30-40 C\$/Kg (ODEPA).

¹⁵ Carmenere is a vine that has lived at length in the Chilean *terroir* and has been assimilated and confused with Merlot until recently when a French ampelographer found out that it corresponded to a French varietal from Bordeaux which had disappeared in Europe after the Phylloxera outbursts in the XIX century.

¹⁶ This is very similar to other regions of the country (VII, V and Metropolitan Region). Climatic stability has so far limited the problems of pests and diseases which e.g. diffuse in unstable and rainy periods.

such as the character of the climate and the soil, the existence of mines and quarries in the neighbourhood, or within easy access by land or water”, (A. Marshall, 1920, p. 223), its long term development and prosperity is tied to other forces, which have only partially to do with climate and soil conditions (s.c. *terroir*).

In fact, in the Colchagua Valley, together with the excellent *terroir*, the imports of frontier machine-embodied technology and the diffusion of new methods of production, have determined the recent success of the area. Most of the firms have invested in new vintage technologies being the cellar the first step done towards modernisation: French (sometimes Chilean) steel tanks for fermentation, French or American *barriques*, Italian embottlement lines are not difficult to find in the cluster. And firms are very dynamic in introducing new methods and techniques in pruning, irrigation techniques and canopy management. Some of them also perform organic production or integrated farming. While in other cases firms adopted ‘precision viticulture’ (with the support of GPS technologies) for the management of their vineyards.

Indeed, in the past few decades, the wine industry has undertaken a path of change in the techniques and technologies adopted in the production, which was also due to the advances in the science of grape-growing and wine-making. A novel knowledge paradigm has been introduced in the production of *fine* wines, which has rendered the traditional methods obsolete. In addition, attaining high quality standards, new challenging tastes, competitive prices, specialists’ worldwide appreciation, does require dynamic capabilities (Teece, Pisano, 1994) to upgrade continually and gain new space in the market. In sum, there is a whole new world of oenologic and agronomic understanding which needs to be applied in the real economic practice of wine making and which does not allow firms to ‘rest’ for too long.

The strategic importance of knowledge in this industry and the attitude of firms to cluster naturally, does provide ideal conditions to test our hypothesis and investigate whether the local learning patterns are bound to improve upon nature.

3.2. Sample features

In order to collect cognitive relational data of the local network, the theory suggests that the whole population is selected and interviewed (Wasserman, Faust, 1994). In fact, in this type of analysis it is critical to be able to identify the *full* structure of relationships within the cluster otherwise the risk is that of missing critical links.

Of course, this task is not easy for highly populated clusters but in our case, this was feasible. The object of this research was in fact that of mapping extra- and intra-cluster knowledge flows and to identify the nature of bridging agents ('technological gatekeepers'). Hence, it has been necessary to focus first on the producers of *fine* wines as those that were certainly more likely to be acquiring and exchanging knowledge. As a consequence, the entire population of fine wine producers (a total of 28 firms) was interviewed¹⁷. A sample of four firms was ultimately selected from other local wine producers, which predominantly produce bulk wine for the national market¹⁸.

Furthermore, among fine wine producers, a distinction needs to be made between local and national producers. The former are firms that base the majority of grape and wine production on the Colchagua Valley, that have been located there since their origins and whose vineyards and cellars are located in the cluster. The latter are instead local vineyard 'subsidiaries' of national big firms that own properties in different areas of the country (e.g. Santa Emilianita, Santa Rita, Undurraga, Montes, Santa Carolina).

The data were collected through a structured questionnaire for wine producers. For the purpose of the research the interviews were directed to the oenologists or agronomists operating in the plant or vineyard¹⁹. The interviews lasted approximately 40 minutes and they were conducted directly in the vineyard or in the cellar.

Professionals working for local or national research and technology transfer institutions (Centro de la Vid y Vino (University of Talca), CEVIUC (Universidad Catolica, Santiago) INIA (La Platina, Santiago and Santa Cruz), INDAP (Santa Cruz)) and Business Associations (CCV, Viñas de Chile,

¹⁷ The population has been defined according to the official source S.A.G. (Servicio Agrícola y Ganadero) to whom wine producers and grape growers declare annually their properties and land extensions. Such sources have been updated with the support of S.A.G. personnel in Santa Cruz, the local business association (Viñas del Valle de Colchagua), the Municipality of Perallillo and the Corporación Chilena de Vino (CCV) (CCV, Directorio Industria Vitivinícola Chilena, 2001).

¹⁸ The SAG provides a list of wine producers in which was possible to isolate bulk wine producers controlling for the type of capacity tanks declared by the firm: bulk wine were those that did not declare any *barriques* in its capacity. The S.A.G. personnel in charge of the area controlled such first approximation. The size was measured according to their storing capacity, which in the case of wine producers ranges from 100.000 to 18 Million Litres.

¹⁹ In the cases in which that was not possible (e.g. the firm did not have any professional employed full time) the interviews were directed to employees working in more direct contact with the productive activity: e.g. the farmer itself in the case of individual grape-growers or the cellar-man. In others, directly to the owners.

Viñas de Colchagua) were also interviewed. The fieldwork was realized in the months of August and September 2002.

3.3. Main empirical findings

3.3.1. Intra-cluster knowledge flows

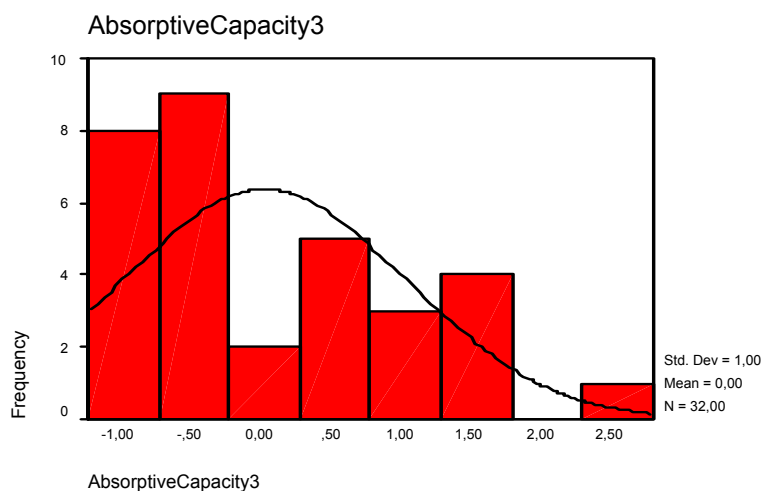
The analysis of intra-cluster knowledge flows was led to test the hypothesis of positive correlation between absorptive capacity and local cognitive interconnection of firms.

3.3.1.a. Distribution of absorptive capacity in the cluster

Absorptive capacity is measured considering firms' *human capital* and internal *experimentation efforts*. Through principal component (PC) analysis, it has been possible to isolate a unique factor that has been named AC3 (see Appendix for details). The values resulting from the PC analysis have been normalised with $\mu=0$, which explains negative AC3 for some of the firms.

In the cluster, firms' absorptive capacity is not normally distributed²⁰ (see Picture 1) and its distribution shows that there is heterogeneity among firms. Hence, firms are not homogeneous in their knowledge bases; in fact, the distribution ranges from cases in which firms have no internal skilled knowledge workers and who do not perform any kind of experimentation, to cases in which firms employ at least one oenologist and agronomist and perform experimentation on all the phases of the productive chain.

Picture 1. Distribution of Absorptive Capacity in the cluster.



3.3.1.b. Local cognitive interconnectedness

²⁰ Kolmogorov-Smirnov test: $p=0,032$.

As mentioned, the position of firms within the local (knowledge) system has been analysed through Social Network Analysis methods²¹ (Wasserman, Faust, 1994). In this respect, three indexes have been calculated:

- 1. Actor Degree Centrality.** It measures the centrality of an actor with respect to others in the network on the basis of the number of vertices adjacent to a given vertex²². It represents a measure of *direct* relationship between actors.
- 2. Actor Closeness.** This index allows measuring centrality according to geodesic distances²³, hence it reflects *how close* an actor is to the other actors in the networks. Accordingly, as geodesics increase in length, the centrality of actors involved should decrease (Wasserman, Faust, 1994)²⁴. This indicator represents a measure of both *direct* and *indirect* relations existing between actors.
- 3. Actor Betweenness Centrality.** It is calculated considering that an actor is central if it lies between other actors on their geodesics. To have a high betweenness centrality, an actor must be on the geodesics of many actors in the network²⁵ (Wasserman, Faust, 1994, p. 190).

All these three indicators have been calculated to evaluate the position of clustered firms in the local knowledge system, following the methodological approach above-mentioned.

Picture 2a and 2b anticipate the results by showing that the degree of the firm's cognitive interconnectedness varies, with some firms being completely isolated (left hand side of the picture) and others interacting or being on other firms' geodesics²⁶.

Picture 2a shows also that there are firms that seem to be at the 'centre' of the local knowledge system: in fact, in the cases in which the arrows terminate into a node, it means that the firm represented by that node is asked for technical advice. The graph nevertheless reports only the existence of a knowledge linkage as it uses dichotomous data.

Valued data are instead shown in Picture 2b below.

²¹ UCINET 6 was used for the purpose, as a software.

²² For non-symmetric data, when relations are directional, the in-degree of a vertex u is the number of ties received by u and the out-degree is the number of ties initiated by u . In addition, if the data is *valued* then the degrees (in and out) will consist of the sums of the values of the ties (Freeman L. C., 1979; Borgatti, S.P., Everett, M.G. and Freeman, L.C. 2002).

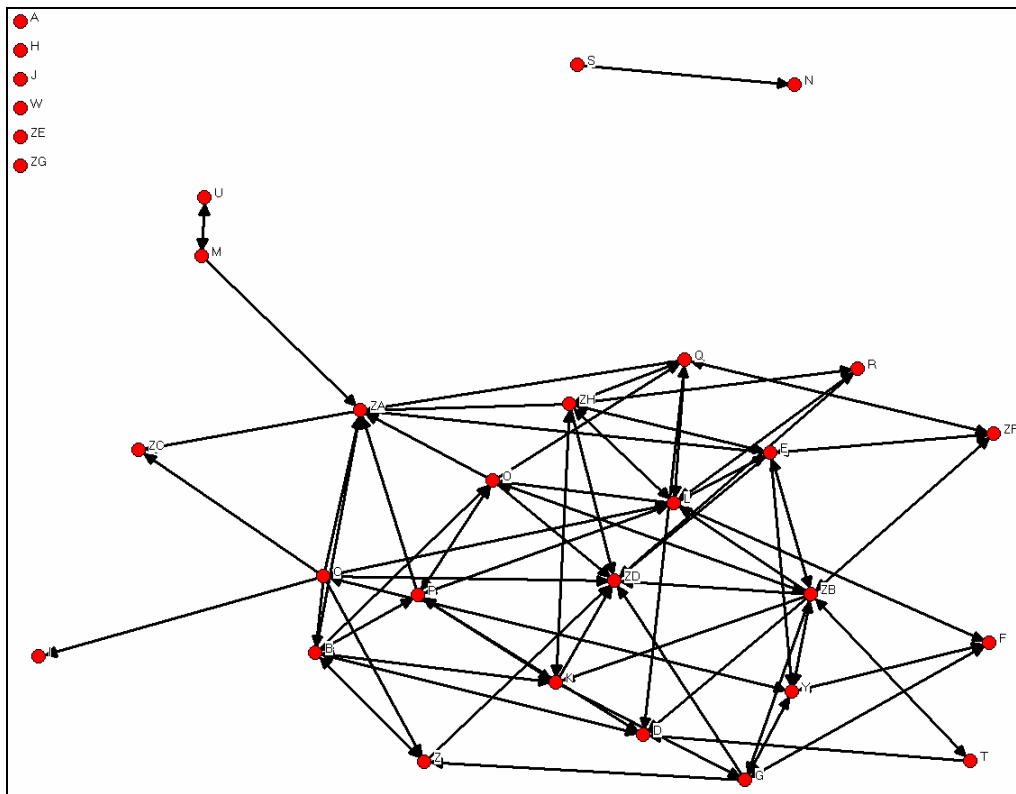
²³ Geodesic distance is defined as the shortest path between any two nodes (Wasserman, Faust, 1994)

²⁴ The farness of a vertex is the sum of the lengths of the geodesics to every other vertex. The reciprocal of farness is closeness centrality (Borgatti, S.P., Everett, M.G. and Freeman, L.C. 2002).

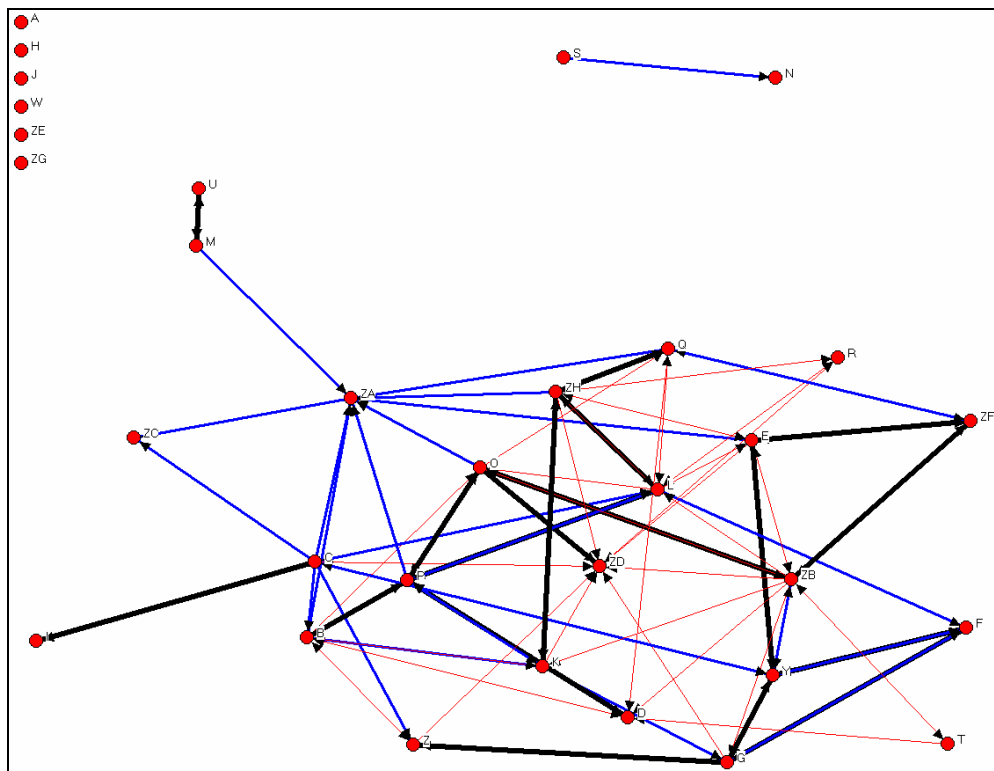
²⁵ Let b_{jk} be the proportion of all geodesics linking vertex j and vertex k which pass through vertex i . The betweenness of vertex i is the sum of all b_{jk} where i, j and k are distinct. Betweenness is therefore a measure of the number of times a vertex occurs on a geodesic. The normalized betweenness centrality is the betweenness divided by the maximum possible betweenness expressed as a percentage (Borgatti, S.P., Everett, M.G. and Freeman, L.C. 2002. Ucinet 6 for Windows. Harvard: Analytic Technologies).

²⁶ The arrows on Picture 2a and 2b go in the direction of the firms to whom technical advice is asked.

Picture 2a: Knowledge system in the Colchagua wine cluster: directional and dichotomous data



Picture 2b: Knowledge system in the Colchagua wine cluster: directional and valued data



Picture 2b highlights the fact that the cognitive interactions between local firms have different degrees of intensity, which reflect the content, quality and frequency of technical advice given by one professional to the other²⁷. Blue and thicker lines indicate highly regarded technical advice, black thinner lines indicate an intermediate degree of importance given to the technical advice and the red thin lines correspond to moderate importance of the technical advice normally received.

3.3.1.c Summing up absorptive capacities and relational data

The empirical evidence shows that there is a positive correlation between the degree of absorptive capacity of firms and their degree of local cognitive interconnectedness (Hp 2 and 3). As shown in Table 1, the correlation coefficient Kendall's tau_b for non parametric data is significant at $p < 0,01$.

Table 1: Correlation between AC and local cognitive interconnectedness

(Source: author's own)

	Kendall's Tau b	** Significance level: $p < 0,01$
In-degree Centrality	0,466**	
Betweenness	0,508**	
Closeness	0,510**	
N=32		

Even though positive correlation does not account for a causal relation between the variables investigated here, there is sufficient scope for further investigation. Certainly, the data show a visible trend in which firms with higher absorptive capacities participate more actively in the local knowledge system, even if differently. In fact, firms do not occupy the same position in the network, as shown in Pictures 2a and 2b.

More specifically, at a local level one can identify 3 different types of actors, according to their cognitive position in the network:

- a) Highly interconnected firms, when *centrality*, *closeness* and *betweenness* indexes are high. This means that they are *transferring* knowledge to other firms directly and indirectly, via other firms.
- b) Firms with moderate degree of interconnection if they have *some* cognitive interactions (knowledge transfer) with other local firms but do not necessarily have high values for the three indexes considered;
- c) Isolated firms for those poorly interconnected either in directly or indirectly.

²⁷ Respondents were asked to evaluate the knowledge transfer according to the 'importance', for the enhancement of the productive activity, of the technical advice received normally by other professionals. The scale used ranges from 0 (low) to 3 (high).

The positive correlation between absorptive capacity and degree of local cognitive interconnectedness spurs the analysis further to observe the nature of firms that are included and excluded from the local knowledge system.

Hence, the empirical evidence collected, shows that firms with lower absorptive capacities tend to isolate themselves and to be excluded from the most advanced knowledge circles and the local epistemic communities of agronomists and oenologists (Hp 3). These are excluded *despite* geographical proximity, social embeddedness and productive linkages. Some of the ‘isolated’ firms have in fact been producing wine in the area for generations and interact with other local firms for productive purposes (trade of grapes and wine) but are excluded from local knowledge circles because they are not capable of decoding the knowledge that is flowing.

Actually, firms that are not isolated tend to form cohesive subgroups or knowledge *cliques*. Through n-clique analysis²⁸ it has been possible to identify 26 overlapping 2-cliques. Each 2-clique comprehends firms that are reachable through at most *one* intermediary so that it includes adjacent nodes/firms (as in cliques) but also actors that are connected via geodesics with a cut off value of two²⁹.

To conclude, these preliminary results offer an overview of local learning patterns, which are highly differentiated, characterized by the cognitive polarization of some firms and the exclusion of others.

3.3.2. Connection with extra-cluster knowledge sources: the role and nature of ‘technological gatekeepers’.

The literature has now long suggested that a process of local collective learning needs to be nurtured by novel knowledge, which is not only, and necessarily, endogenously produced. Hence, as remarked in the theoretical framework, there is a need to identify the existence and nature of actors that channel such external knowledge into the local network.

In order to do that, extra-cluster knowledge linkages have been analysed according to:

- their *origin*; thus tracking the linkages with national (Chilean) and international sources of knowledge;

²⁸ An n-clique of an undirected graph is a maximal subgraph in which every pair of vertices is connected by a path of length n or less. These are found using an adapted version of the Bron and Kerbosch (1973) algorithm. The routine will also provide an analysis of the overlapping structure of the n-cliques. This analysis gives information on the number of times each pair of actors are in the same n-clique and gives a single link hierarchical clustering based upon this information (Borgatti, S.P., Everett, M.G. and Freeman, L.C. 2002. Ucinet 6 for Windows. Harvard: Analytic Technologies).

²⁹ Cut off value is the maximum length of geodesics connecting pairs of nodes/firms [in this case $d(ij) \leq 2$] (Wasserman, Faust, 1994).

- their *nature*; has been distinguished between technical advice, training and similar support technical activities and experimentation/R&D.

In general, what has been observed is a high degree of ‘openness’ of the local knowledge system to external firms and institutions: the cluster is hence *not* isolated. On the contrary the degree of connectedness with external sources of knowledge is quite high with about 90% of firms that declare to receive and have received in the past two years, technical advice and support by different national institutions: CEVIUC (Universidad Catolica) and Centro de la Vid y del Vino (Universidad de Talca) being the most important.

Preliminary results show that extra-cluster knowledge flows originate from the National (Vitivinicultural) System of Innovation and from private suppliers. Firms receive quite often technical assistance, training and up-to-date courses (average participation in training of the technical professional happens 3 times a year in Chile and 1 time or less abroad). The connection is made by professional themselves or by the intermediation of the consultant oenologists.

Indeed, especially on an international level, the strongest link of firms with networks of knowledge is represented by the s.c ‘flying winemakers’: the consultant oenologists that advise firms and keep them informed on the latest techniques. 56% of the firms interviewed have a foreign consultant who predominantly comes from South Africa, Australia and France. In general, flying agents are disseminators of tacit and codified knowledge and normally visit firms from 12 times a year (for Chilean advisors) to less than 4 times a year (for foreign advisors)³⁰.

An indicator has been developed to sum up the degree of connection and openness of firms to extra-cluster sources of knowledge. Such degree has been ordered on a scale that ranges from 0 to 3,5 according to the:

- a) technical support and training received from national and international knowledge sources in the past two years;
- b) joint experimentation with national and foreign firms/institutions in the past two years.

On the basis of this, it has been possible to identify ‘technological gatekeepers’ as those firms that are both internally and externally well interconnected with sources of technical knowledge.

Intra and extra-cluster cognitive propensity to interconnection are correlated, as shown in Table 2.

Table 2: Correlation between extra.-cluster openness and intra-cluster interconnection

	Kendall's tau b
Indegree-Centrality	0,436**
Betweenness	0,423**
Closeness	0,419**

**Significance p<0,01

³⁰ Such agents also play a role in diffusing knowledge within the cluster, as in many cases (45%, in the Colchagua cluster) they advise different firms within the local area.

Thus said, there are cases in which firms are highly interconnected with extra-cluster sources of knowledge and poorly linked with the local knowledge system. And cases of complete isolation from intra and extra-cluster knowledge sources.

Accordingly, it has been possible to identify ‘**technological gatekeepers**’, ‘**external stars**’ and ‘**isolated**’ firms.

The former, show a high degree of intra and extra-cluster cognitive interconnection. In this respect they could be considered as vital actors in the cluster because they *bridge* knowledge into the local area. Hence, they contribute to the diffusion of new techniques and understanding and to its local improvement. Those firms, which tend to have higher degrees of absorptive capacity also frequently take part to local knowledge cliques (Hp 2).

The empirical research suggests that the firms that tend to operate as ‘technological gatekeepers’ are locally-owned firms (70% of cases) but their year of foundation is not necessarily far away in time. Part of them, operate in the area since generations (date of foundation: 1880, 1960, 1970, 1976) while others are relatively young firms (1994, 1996, 2001).

Whereas, foreign owned wineries tend to be strongly related with their parent firm but very poorly interconnected locally and with the NIS. Such firms present learning behaviour typical of ‘external stars’, that is, they tend to interconnect with extra-cluster knowledge sources (their parent firms and consultant oenologist) but very poorly with the local knowledge system³¹.

Finally, subsidiaries of national big firms, show a hybrid learning pattern: in the majority of the cases (67% of cases) they are poorly interconnected from a cognitive point of view with local firms, for two major reasons:

- In the local subsidiary, which in most of the cases is a sole vineyard, the local skilled knowledge workers are very limited as it is normally the flying oenologist that visits the farm periodically to give technical advice and solve problems.
- The subsidiary operates in strong connection with the parent firm and tends to work in isolation with respect to the local area, that is just a source of natural endowments.

Nevertheless, there are few cases in which also subsidiaries of national firms operate as ‘technological gatekeepers’ in the area. In these cases, it is the local knowledge skilled workers, namely the oenologist and agronomist, that interact and are asked for advice by other local professionals.

³¹ In some cases, local personnel are strictly asked by the parent firm not to release any information.

Such professionals are not tied socially and historically to the local district, in many cases they are young and recently established in the area. Their interactions are due to the fact that they belong to the same epistemic community, school and profession. Moreover, they not only share a common technical language but also have the same pests to fight, and common problems to solve.

Then, if on one hand it's true that the firm's consultants technical is primarily asked for advice; on the other, such consultants are 'overbooked' resources, very busy to fly from one firm to the other in the country or worldwide and therefore have a distant participation in the daily working life of the farm. Instead, local professionals intervene in the interstices of the job and contribute to its incremental enhancement.

So far, empirical evidence suggested that there are different learning patterns within a cluster which depend on the participation of those firms in the local knowledge system and on the degree of interconnection with extra-cluster sources of knowledge. It has proved that there are firms that work as technological gatekeepers and that knowledge circulates within cliques of actors with higher levels of absorptive capacity. At same time, firms with low absorptive capacities tend to be isolated from the local knowledge cliques and hence excluded from the local virtuous learning circles.

The following paragraph will go further to describe the relationship between firms' learning patterns and performance.

3.3.3. Clusters within the cluster: learning patterns and performance

The trend of firms to cognitive polarisation within the cluster has been finally associated with the performance attained by such firms. Hypothesis 4 was in fact aimed at investigating the relationship between learning patterns and performances.

In order to test the hypothesis, Cluster Analysis has been run³² using 'absorptive capacity', In-degree centrality and Performance (see Appendix 1) as variables.

The results of the analysis are reported in Table 3 below.

³² The method used was Within Groups with Euclidean distance. Other methods were also tested but the results did not change.

Table 3: Results the of cluster analysis, three main learning patterns.
(Source: author's own)

	Local lagging behind (N=11)	Outsiders (N=10)	Local forging ahead (N=10)
Average AC3	-0,4874	-0,2236	0,65
Average Performance	- 1,2437	0,4976	0,77
Average In-degree Centrality	1, 0909	1,3	9,5
N=31 (*)			

(*) One outlier has been eliminated from the analysis.

The results show three clear patterns:

1. **Local ‘lagging behind’ firms** with low absorptive capacities (Average AC is $-0,5$), scarce interconnectedness (average In-degree is $1,1$) and low Performances (on average $-1,25$).
2. **Local ‘forging ahead’ firms** that instead have high absorptive capacities (average value $0,65$), In-degree Centrality³³ (average value $9,5$) and high Performances (average value $0,77$).
3. **Outsiders:** an intermediate pattern shows low levels of average absorptive capacity ($0,22$) and degree of interconnectedness ($1,3$) but rather high performances ($0,5$).

The results show a relation between performances and learning patterns, which is possibly dynamic and mutually reinforcing. It is of no surprise, then, that firms with low absorptive capacities tend to be cognitively isolated and also perform poorly. At the same time, such performances might also hinder these firms from investing in the improvement of absorptive capacities and indirectly condemns them to isolation. In fact, such local ‘lagging behind’ firms have barely any cognitive connection with the more dynamic ‘forging ahead’ subgroup. The latter is composed by firms with higher absorptive capacities that are also members of the local knowledge cliques and benefit from them. In addition, such firms are on average highly interconnected with extra-cluster sources of knowledge, thus contributing to the rejuvenation of knowledge that is shared within the local cliques.

Finally, ‘outsiders’, so named because they include local subsidiaries and foreign firms, have, for the reasons explained in previous paragraphs, limited cognitive interaction with local firms but still show average high performances due to their commercial strength on the national and international markets³⁴. At the same time, as already suggested, a limited number of such outsiders have

³³ Average agents’ betweenness and closeness indexes are also high: $7,3$ and $8,4$ respectively.

³⁴ These types of firms are either part of national or foreign large firms and benefit from strong competitive power on the national and international markets.

cognitive interactions with local ‘forging ahead’ firms. Hence, while the group of lagging behind firms is quite isolated, the other two groups are somehow interconnected via the network of professionals involved in the local area.

Conclusions

Is knowledge flowing freely in the air, fostering processes of collective learning and hence improving and creating new knowledge in clusters of firms?

The first hypothesis addresses this issue, challenging the idea that knowledge flows in the air and diffuses easily in clusters on the basis of social and geographical proximity. In fact, the picture is much more complex than this.

From one point of view, one needs to recognise that there is some knowledge which is potentially *available* to *all* the firms in the local area, but its role and weight needs to be reduced. Indeed, skilled labour forces are locally available and new machineries and methods might easily be imitated by the nearby firms. Concentrating here on the latter, one should remember that the *adoption* and *adaptation* to the specific conditions of the imitating firms is by no means automatic. As remarked by a respondent, “firms imitate each other very much in the area but this is not necessarily beneficial for the imitating firms. Viticulture in particular is not managed by standardised recipes and applying a novel irrigation or pruning method implemented by other local firms can be harmful when the soil is not the same”. In other words, flowing *information* about new techniques, products, materials and equipments does not automatically lead to their successful adoption and exploitation.

For this reason, it seems more useful to track knowledge flows that imply some form of effort in changing the present knowledge base, such as problem solving and technical advice. In this way, one can observe the attempt of firms to produce an enhancement of their competencies and undertake a path of improvement and change.

Once this insight has been made, one observes that there is a trend towards cognitive polarization in the cluster. Knowledge flows are hence unevenly distributed, leaving aside firms that are not capable of absorbing local available stocks of knowledge.

This case study seems to suggest that firms have a different capacity of grasping knowledge ‘in the air’ and that knowledge circulates within restricted groups of firms characterised by similar knowledge bases. In addition, there is enough scope to suggest that the local communities of oenologists and agronomists are very close to what has been defined as ‘epistemic community’ (Cowan David Foray, 2000; Creplet et al., 2001), which constitutes a local highway of learning and technical improvement. Being a common technical knowledge base, the ‘glue’ of such

communities, they go easily beyond the boundaries of the cluster connecting professionals on a national and international scale. They are, as already said, trans-local knowledge networks.

This does facilitate the alignment of intra- and extra-cluster knowledge flows, thus guaranteeing the cognitive advancement of the local area and reducing the risk of lock in.

Despite this, one needs to remark that the presence of a group of ‘forging ahead’ firms and of ‘outsiders’ does not necessarily produce beneficial effects, from a cognitive point of view, for firms that are lagging behind.

Furthermore, while ‘forging ahead’ firms and ‘outsiders’ have the right incentives to upgrade and to participate in virtuous knowledge systems, ‘lagging behind’ firms are not making the jump themselves and might possibly need institutional support to improve their absorptive capacities.

Finally, the step between geography and innovation still appears too wide to be made blindly, also for what concerns policy. And this is particularly important in those contexts that are not Silicon Valleys where firms have deep gaps and backwardness in capabilities which neither geography nor social embeddedness of interlinked producers can fill.

In fact, the interest in the issue was initially raised by the need to fill the vacuum of literature on the dynamics of knowledge adoption, diffusion and generation in developing countries’ clusters (Bell, Albu, 1999). In such contexts, geography, social embeddedness and productive division of labour are not sufficient to explain the (lack of) competitiveness of different productive areas and its perspectives in the long term. Focusing on knowledge stocks and flows would instead offer a better interpretation of the local learning dynamics and potentiality for knowledge enhancement and change on an endogenous basis. It would, furthermore, be important in informing innovation policy when support for local lagging behind firms is needed.

At the same time, the theoretical issues addressed and the empirical results of this study suggest that the subject is of relevance for both advanced and developing countries and that it needs to be studied in a more integrated and conscious way in the two contexts.

APPENDIX

1. Measuring Absorptive Capacity

Absorptive capacity was computed considering *human resources* and *experimentation effort*. Human resources are evaluated on the basis of:

- i. Level of education of the knowledge skilled workers.
An *index for Human Resources* [HUMAN RESOURCES: ru] was calculated through a weighted mean according to the degree attained [degree (gu); master (m) and PhD (d)] and to place of graduation (national (n); foreign (I)).
 $ru = 0.1 * b5gu_n + 0,15 * b5gu_I + 0,2 * b5m_n + 0,25 * b5m_I + 0,3 * b5d$
- ii. Months of experience in the sector [TOT.MONTHS_POND: tm_p] of each skilled knowledge worker.
 $tm_p = 0,4 * n^\circ \text{ months(national)} + 0,6 * n^\circ \text{ months (international)}$
- iii. Number of firms in which each knowledge skilled worker has been employed previously [NUM.FIRMS_POND: n1_p]
 $n1_p = 0,4 * n^\circ \text{ firms(national)} + 0,6 * n^\circ \text{ firms(international)}$
- iv. Experimentation [EXP]: in this case, the level of experimentation at firm level has been calculated according to the following scale:
 - (0) for no experimentation
 - (1) when some form of experimentation is normally carried out but only one of the activities of the productive chain is marked.
 - (2) When at least two activities of the productive chain are marked
 - (3) When at least two activities of the productive chain are marked and the firm has been engaged at least in one joint research project with a university or a research lab in the last 2 years.

The need to define a unique value to measure absorptive capacity, suggested applying **Principal Components analysis**, which combines correlated variable into one factor.

The correlation matrix (see Table below) shows that the correlation between the four variables is statistically significant ($p < 0.01$) and it allows us to proceed with data reduction.

Table 1: Correlation matrix

Correlation Matrix					
		HUMAN RESOURCES	TOTALMONTHS_POND	NUM.FIRMS_POND	EXPERIMENT(DEGREE)
Correlation	HUMAN RESOURCES	1,000	,794	,863	,425
	TOTALMONTHS_POND	,794	1,000	,728	,525
	NUM.FIRMS_POND	,863	,728	1,000	,533
	EXPERIMENT(DEGREE)	,425	,525	,533	1,000
Sig. (1-tailed)	HUMAN RESOURCES		,000	,000	,008
	TOTALMONTHS_POND	,000		,000	,001
	NUM.FIRMS_POND	,000	,000		,001
	EXPERIMENT(DEGREE)	,008	,001	,001	

One factor was extracted that explains 74% of variance and was named **AC3**. See Table 2 and 3 below for details.

Table 2: Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2,963	74,084	74,084	2,963	74,084	74,084
2	,646	16,145	90,229			
3	,280	7,006	97,235			
4	,111	2,765	100,000			

Extraction Method: Principal Component Analysis.

Table 3: Component matrix

Component Matrix ^a

	Component
	1
HUMAN RESOURCES	,916
TOTALMONTHS_POND	,896
NUM.FIRMS_POND	,921
EXPERIMENT(DEGREE)	,688

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

2. Measuring Firms' Performance

The performance indicator has been calculated through a factor analysis using Principal Component method. The variables that have been taken into account for purpose are:

1. Dimension of the firm in terms of revenues³⁵
2. Price per litre of wine sold
3. Percentage of export on total production

Principal Component analysis has allowed the isolation of a single factor (Perfo3). It explains 69% of the total variance.

Table 1: Correlation Matrix

Correlation Matrix

	PRICE_LT	EXPORT(%)	DIMENSIONE
Correlation	PRICE_LT	EXPORT(%)	DIMENSIONE
	1,000	,675	,367
	,675	1,000	,551
	,367	,551	1,000
Sig. (1-tailed)			
a) <i>micro</i> if revenue from 2400 to 2500 UF	,000	,019	,001
b) <i>medium</i> if revenue from 2500 to 100.000 UF	,000	,001	,001
c) <i>large</i> if revenue from 100.000 UF	,001	,001	,001

UF stands for Unidad a Chilean indexation instrument, whose values vary according to the past month's increase in consumer price index. In the period in which the fieldwork was carried out an UF corresponded roughly to 16.500 Chilean Pesos (C\$).

Table 2: Total Variance Explained

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2,072	69,077	69,077	2,072	69,077	69,077
2	,644	21,458	90,536			
3	,284	9,464	100,000			

Extraction Method: Principal Component Analysis.

Table 3: Component Matrix

Component Matrix^a

	Component
	1
PRICE_LT	,828
EXPORT(%)	,907
DIMENSIONE	,750

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

References

Allen R.C. (1983), "Collective Invention", *Journal of Economic Behaviour and Organization*, 4.

Allen T.J., (1977), *Managing the flow of technology: technology transfer and the dissemination of technological information within the R&D organization*, MIT Press.

Anderson K., Norman D. (2001a), "Global wine production, consumption and trade: 1961- 1999. A statistical compendium", CIES Discussion Paper, 0143, Adelaide.

Anderson K., Norman D., (2001b), "Globalisation and the worlds' wine markets", CIES Discussion Paper, 0143, Adelaide.

Antonelli C. (1996), "Localized knowledge percolation processes and information networks", *Journal of Evolutionary Economics*.

Arora A., Gambardella A. (1994), "The changing technology of technological change: general and abstract knowledge and the division of innovative labour", *Research Policy*, 23.

Asheim B.T. (1994), "Industrial districts, inter-firm co-operation and endogenous technological development: the experience of developed countries", in *Technological Dynamism in Industrial Districts: An alternative approach to industrialisation in Developing Countries?*, pp. 91-142, NY and Geneva, UNCTAD and UN.

- Bazan L., Navas-Aleman L. (2001), "The Underground Revolution in the Sinos Valley: a comparison of Upgrading in global and national value chain", Paper for Workshop 'Local Upgrading in Global Chains' held at the Institute of Development Studies, University of Sussex, 14-17 February.
- Becattini G. (1979), "Dal settore industriale al distretto industriale", *Rivista di Economia e Politica Industriale* n. 1.
- Becattini G., (1998), *Distretti industriali e made in Italy : le basi socioculturali del nostro sviluppo economico*, Bollati Boringhieri, Torino.
- Bell M., Albu M. (1999), "Knowledge systems and technological dynamism in industrial clusters in developing countries", *World Development*, Vol. 27 (9).
- Bell M., Pavitt K. (1993), "Technological accumulation and industrial growth: contrast between developed and developing countries", *Industrial and Corporate Change*, Vol. 2(2).
- Bellandi M., (2002), "External economies and local public goods in clusters and industrial districts", EUNIP Conference, Turku, Finland 5-7 December.
- Belussi F., Gottardi G. (2000), "Models of localised technological change", in Belussi F., Gottardi G. (eds.) "Evolutionary patterns of local industrial systems. Towards a cognitive approach to the industrial district", Ashgate Publishing Ltd,.
- Borgatti, S.P., Everett, M.G. and Freeman, L.C. (2002), Ucinet 6 for Windows. Harvard: Analytic Technologies.
- Breschi S., Lissoni F., (2001), "Knowledge spillovers and Local Innovation Systems: A Critical Survey", *Industrial and Corporate Change*, 10 (4).
- Camagni R. (1991), "Local Milieu, uncertainty and innovation networks: towards a new dynamic theory of economic space", in Camagni (ed.) *Innovation Networks: spatial perspectives*, Belhaven Press, London.
- Caniels M., Romijn H. (2001), "Accumulation of technological capabilities by small and medium enterprises in developing countries: how does clustering matter?", Paper for EADI book *Linking the local to the global. Small enterprises in global markets: technology transfer, export opportunities and organizational upgrading*, Version 4th June.
- Capello R., (1999), "Spatial transfer of knowledge in high technology milieux: learning versus collective learning processes", *Regional Studies*, 33 (4).
- Cohen W.M., Levinthal D.A. (1990), "Absorptive capacity: a new perspective on learning and innovation", *Administrative Science Quarterly*, 35.
- Cohen W.M., Levinthal D.A. (1989), "Innovation and learning: the two faces of R&D", *The Economic Journal*, 99, Sept.
- Cowan R., David P.A., Foray D. (2000), "The explicit of economics of knowledge codification and tacitness", *Industrial and Corporate Change*, 9 (2).

Cowan R., Foray D. (1997), "The economics of codification and the diffusion of knowledge", *Industrial and Corporate Change*, 6 (3).

Creplet F. et al. (2001), "Consultants and experts in management consulting firms", *Research Policy*, 30.

Dosi *et al.*, *Technical change and economic theory*, Pinter Publ., 1988.

Feldman M.P. (1999), "The new economics of innovation, spillovers and agglomeration: a review of empirical studies", *Economic Innov. New Techn.*, 8.

Freeman C. (1991), "Networks of innovators: a synthesis of research issues", *Research Policy*, 20.

Freeman L. C. (1979). 'Centrality in Social Networks: Conceptual clarification', *Social Networks* 1, 215-239;

Gambardella A. (1993), "Innovazioni tecnologiche e accumulazione delle conoscenze: quale modello per le piccole e medie imprese negli anni '90?", *Piccola Impresa/Small Business*, 2.

Giuliani E. (2002), "Cluster Absorptive Capability: An evolutionary approach for industrial clusters in developing countries", Paper Presented at the DRUID Summer Conference, Copenhagen/Elsinore 6-8 June.

Granovetter M. (1985), "Economic action and social structure: the problem of embeddedness", *American Journal of Sociology*, 91 (3).

Haas P.M., (1992), "Introduction: epistemic communities and international policy coordination", *International Organization* 46, 1 (Winter).

Johnson B., Lundvall B-A. (2001), "Why all this fuss about codified and tacit knowledge?", DRUID Winter Conference, January 18-12.

Lall S. (1992), "Technological capabilities and Industrialization", *World Development*, 20 (2).

Lissoni F. (2001), "Knowledge codification and the geography of innovation: the case of Brescia mechanical, cluster", *Research Policy*, 30.

Lundvall B-A. (1988), "Innovation as an interactive process: from user-producer interaction to the national system of innovation", in Dosi *et al.*, *Technical change and economic theory*, Pinter Publ.

Manskill P., (2001), "Towards a knowledge-based theory of the geographical cluster", *Industrial and Corporate Change*, 10 (4).

Manskill P., Malmberg A. (1999), "Localised learning and industrial competitiveness", *Cambridge Journal of Economics*, 23.

Marshall A., *Principles of Economics*, MacMillan, 1920.

- Nadvi K., Halder G. (2002), "Local Clusters in Global Value Chains: exploring dynamic linkages between Germany and Pakistan", IDS Working Paper n. 52, Institute of Development Studies, Sussex, UK.
- Nelson R.R. (1991), "Why do firm differ? And how does it matter?", *Strategic Management Journal*, 12.
- Nonaka I., Takeuchi H. (1994), *The knowledge-creating company. How Japanese companies create the dynamics of innovation*, Oxford University Press.
- Pavitt K., (2002), "Knowledge about knowledge since Nelson&Winter: a mixed record", SPRU Electronic Working Paper Series, Paper n. 83.
- Peres W., Stumpo G. (eds.), (2002), *Pequeñas y medianas empresas industriales en America Latina y el Caribe*, CEPAL, Siglo XXI Ed.
- Rabellotti R., "External economies and cooperation in industrial districts. A comparison of Italy and Mexico", MacMillan Press Ltd London, 1997
- Romer P.M., "Two strategies for economic development: using ideas and producing Ideas", *The Review of Economics and Statistics*, August 2001, N. 83, 3.
- Schachner M., "The Next Napa? Chile's Colchagua Valley is aiming for big time", *Wine Enthusiast*, March 2002
- Scitovsky T., (1952), "Two concepts of External Economies", *Economic Journal*, LXII, 54-67.
- Tapia P., *Los Vinos de Colchagua*, PMC Pinnacle Worldwide y Ed. Planetavino, 2001.
- Teece, D.J., and G.P. Pisano (1994), "Dynamic Capabilities: An Introduction." *Industrial and Corporate Change*, 3 (3).
- Von Hippel E., (1987), "Cooperation between rivals: informal know-how trading", *Research Policy*, 16.
- Von Hippel E., (1988), "Trading trade secrets", *Technology Review*, February/March.
- Wasserman S., Faust K., (1994), *Social Network Analysis. Methods and Applications*, Cambridge University Press.