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Networks and heterogeneous performance of cluster firms

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1. Introduction

This chapter explores the relationship existing among the heterogeneous nature of firms in industrial clusters, their structural position in knowledge networks and their performance. Following the rising interest for spatially agglomerated industrial firms (Piore and Sabel, 1984; Pyke et al., 1990; Porter, 1990; Krugman, 1991) and their learning and innovative potential (e.g. Maskell, 2001a; Pinch et al., 2003), this chapter shows empirically that the performance of firms in clusters is related with firm-level knowledge endowments and their position in the knowledge network. A starting argument of this chapter is that of questioning the widely accepted view that knowledge is diffused in clusters in a rather pervasive and unstructured way, and that this is what affects the enhanced performance of cluster firms as compared to isolated ones. Most economists and economic geographers share this view. On the one hand, in fact, economists stress the public nature of knowledge (Arrow, 1962) and argue that geography facilitates inter-firm learning and innovation because of localized knowledge spillovers (e.g. Jaffe et al., 1993); on the other, recent work done by economic geographers argue that it is not geography *per se* that matters for innovation, but it is a common institutional endowment and firms' relational proximity (later defined), which facilitate the diffusion of knowledge and enhance collective learning in clusters (e.g. Maskell and Malmberg, 1999; Capello and Faggian, 2005). A reason for this is the often presumed co-occurrence of firms' business interactions and knowledge flows - a view consistent with the Marshallian 'industrial atmosphere' metaphor (Marshall, 1920).

An increasing number of studies has, however, started to highlight that, in spite of a general homogeneity of conditions in the cluster, firms perform differently (Rabellotti and Schmitz, 1999; Lazerson and Lorenzoni, 1999; Molina-Morales and Martinez-Fernandez, 2004; Camison, 2004; Zaheer and Bell, 2005). In line with this, some have expressed their conceptual discontent to the pervasive and unstructured view of clusters' innovation (see e.g. Breschi and Lissoni, 2001), and others have examined how key notions of evolutionary economics may be incorporated into economic geography (Boschma and Lambooy, 1999; Boschma and Frenken, 2005). In this vein, some have pointed out the need to understand the heterogeneity of cluster firms' performance and the characteristics of a cluster innovative process, by bringing in the analysis firm-level learning (Bell and Albu, 1999; Maskell, 2001b, Martin and Sunley, 2003).

Using a combination of network analysis (Wasserman and Faust, 1994) and econometrics, this chapter carries out an empirical study of three wine clusters - Colline Pisane (CP) and Bolgheri/Val di Cornia (BVC) in Italy and Colchagua Valley (CV) in Chile. It shows that firms perform differently within clusters and that such differences are due to both firm knowledge bases and to their degree of embeddedness in the local knowledge network. In contrast, inter-firm relational proximity is a less powerful factor affecting firm performance. The chapter concludes with drawing implications for the concept of clusters in economic geography.

2. Geography, relational proximity and the diffusion of knowledge: implications for firm performance

The process of knowledge diffusion and generation in clusters of firms has traditionally been based on different re-interpretations of the Marshallian, externality-driven, world of industrial districts. Several empirical studies have in fact elaborated on the Marshallian notion of knowledge spillovers, referring to Marshall's description of industrial districts as a place where:

> *The mysteries of the trade become no mysteries; but are as it were in the air,* and children learn many of them, unconsciously. […] Good work is rightly appreciated, inventions and improvements in machinery, in processes and the general organisation of the business have their merits promptly discussed: *if one man starts a new idea, it is taken up by others and combined with suggestions of their own; thus it becomes the source of further new ideas.* (Marshall, 1920, p. 225; emphasis added)

He envisaged two mechanisms by which knowledge spillovers were generated, the first one was through the embodied capabilities acquired by workers being part of the district and the second one was the sharing of ideas among businessmen, a process which Allen (1983) has defined 'collective invention' (see also Nuvolari, 2004). In *Industry and Trade* (1919), Marshall defined this as 'industrial atmosphere', highlighting its 'sticky' nature:

> But an industry which does not use massive material, and needs skill that cannot be quickly acquired, remains as of yore loth to quit a good market for its labour. Sheffield and Solingen have acquired industrial "atmospheres" of their own; which yield gratis to the manufacturers of cutlery great advantages, that are not easily to be had elsewhere: and *the atmosphere cannot be moved.* (Marshall, 1919, p. 284; emphasis added)

Thus, the industrial atmosphere was conceived as a highly idiosyncratic *meso* characteristic of districts. Several scholars have advanced in this field and have elaborated on the original Marshallian ideas. My argument here is that most of the studies undertaken in this direction have taken a *meso* perspective to analyse learning, innovation and performance in clustered firms. As such, they have given less emphasis to the *micro*, and to how the *micro* can affect the *meso.*

Among these studies, I will consider here only the most influential contributions of both economists and economic geographers.

As anticipated in the introduction, the economists' view is that knowledge spillovers, which are by definition a public good (Arrow, 1962), tend to be highly localized (Jaffe, 1989; Jaffe et al., 1993), a property that links conceptually geography and innovation. Within this stream of studies, robust empirical evidence has shown that a relationship exists between spatial clustering, knowledge spillovers, and firms' innovative performance (e.g. Audretsch and Feldman, 1996; Feldman, 1999; Baptista, 2000). This empirical evidence has led scholars and policy makers to believe that geography matters for innovation and for competitiveness (e.g. OECD, 2001). As an example, in his work on industrial clusters and nations' competitive advantage, Porter (1998) connects the processes of learning and innovation in clusters to the 'Marshallian atmosphere' concept, stating that "the information flow, visibility, and mutual reinforcement within such a locale give meaning to Alfred Marshall's insightful observation that in some places an industry is in the air" (p. 156). He notes moreover that "more important, however, is the influence of geographic concentration on improvement and innovation" (p. 157), since "proximity increases the speed of information flow within the national industry and the rate at which innovations diffuse." (p. 157). This view supports the idea that geography matters for innovation and, implicitly, for economic performance.

Some economic geographers seem to have moved beyond that. It has been argued that geographic proximity *per se* is not sufficient to generate learning, and that other forms of proximity are required for inter-firm learning and innovation to occur (Boschma, 2005). Among these, a great emphasis is given to the role of social proximity also known as "relational proximity" (e.g. Maskell and Malmberg, 1999; Amin and Cohendet, 2004). Industrial clusters, being a spatially localized set of economic activities, are in fact envisaged as 'embedded' economies (Granovetter, 1985) where social relationships, such as friendship and kinship, are entangled with productive ones. More specifically, relational proximity is believed to favour the formation of relational capital, defined as a sort of productive 'thickening' based on market and cooperative inter-firm relationships (Scott, 1998). The relational capital, favouring the interaction of productive agents and the diffusion of tacit knowledge (Howells, 2002) is finally said to be the 'substratum' of collective learning (Capello, 1999).

Relational proximity and embeddedness are thus considered to operate at the *meso* level and perform several functions in the context of innovation (Oerlemans and Meeus, 2005), favouring firm performance accordingly. In a recent study on several district areas in Italy, Capello and Faggian (2005) find support for the importance of relational capital in fostering the innovative performance of firms. They therefore argue that "regional economists are […] correct in underlining that not only are intra-firm characteristics crucial for innovation, but also (*and maybe most of all*) that the location of firms in an area where the local labour market and the tight links with suppliers foster the exchange of local knowledge are vital for innovation" (p. 82; emphasis added).

In sum, current approaches to the analysis of clusters mainly focus on explaining why firms being part of an industrial cluster tend to perform better than isolated ones. An underlying, implicit assumption, is that firms that are part of the same industrial cluster will more or less equally benefit from the presence of external economies at the local level (Marshall, 1920) and, more specifically, from a common geographical, sectoral and relational proximity. However, an increasing number of studies has recently started to highlight that, in spite of a general homogeneity of *meso* conditions in clusters, firms perform differently (Rabellotti and Schmitz, 1999; Lazerson and Lorenzoni, 1999; Molina-Morales and Martinez-Fernandez, 2004; Camison, 2004; Zaheer and Bell, 2005).

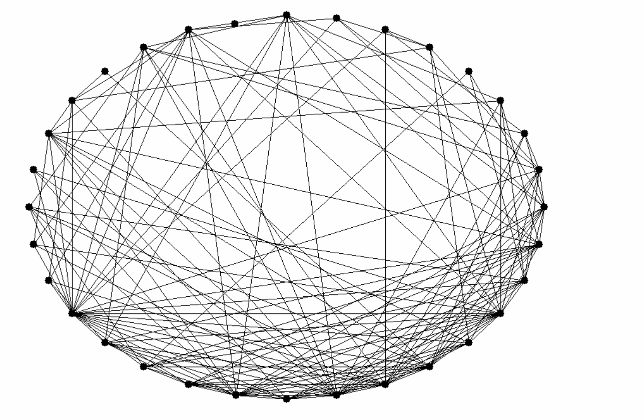
3. What affects heterogeneous performance in cluster firms?

Understanding the factors that lead to heterogeneous firm performance in industrial clusters requires that the focus of analysis shifts from the *meso* to the *micro*. As suggested by Lazerson and Lorenzoni (1999) and more recently by Maskell (2001b), individual firms are the key actors in the development of territorial clusters. In line with this, my argument here is that it is the characteristics of firms, and their inherent heterogeneity, that generate (or inhibit) the conditions at the meso level that ultimately enhance cluster firm performance. Thus, it is a *micro* to *meso* perspective that this paper takes, rather than a *meso* to *micro*, commonly found in the cluster literature. Accordingly, the performance of firms should be explored considering the interplay between their *internal resources* and the external, *meso* conditions present in the cluster.

The relationship between firm internal resources and performance has been investigated by many scholars already (Barney, 1991; Grant, 1996). Starting from the evolutionary theory of the firm (Nelson and Winter, 1982), I consider firms in the cluster as being characterized by heterogeneous knowledge bases. By knowledge base I mean here the "set of information inputs, knowledge and capabilities that inventors draw on when looking for innovative solutions." (Dosi, 1988, p. 1126) Knowledge is seen as residing in firms' skilled knowledge workers, who embody tacit capabilities At the same time, knowledge is not merely the sum of each individual's knowledge, since it resides in the organizational memory of the firm. As Nelson and Winter (1982) put it "[t]he possession of technical 'knowledge' is an attribute of the firm as a whole, as an organized entity, and it is not reducible to what any single individual knows, or even to any simple aggregation of the various competences and capabilities of all the various individuals, equipments, and installations of the firm." (Nelson and Winter, 1982, p. 63) The knowledge base is moreover considered here as the result of a process of cumulative learning, which is inherently imperfect, complex and path-dependent (Dosi, 1997) and which delivers persistent heterogeneity between the firms in the economic system and, understandably in a cluster. Such heterogeneity, in turn, deepens the uniqueness of resources deployed by firms and explains different growth rates and performance (Penrose, 1959). It is reasonable, moreover, that firms that have stronger knowledge bases will perform better than others in the cluster, as they will have easier access to external knowledge and rejuvenate their internal capabilities accordingly (Cohen and Levinthal, 1990). This chapter intends to explore the following research question: *How does the heterogeneity in firm knowledge bases relate with their performance?*

The important issue here is, however, not simply whether micro level conditions affect performance, but what is their interaction with the external environment in the cluster. Innovation rarely occurs in isolation, and, as emphasised by most of the cluster literature, the degree to which firms are embedded in local networks influences their performance (Molina-Morales and Martinez-Fernandez, 2004; Zaheer and Bell, 2005; Capello and Faggian, 2005). Being relationally embedded in a cluster means that firms interact frequently on business related matters. For example, if entrepreneurs are members of the same local consortium they will meet at local events and discuss about their productive activities. Similarly, if two firms share machineries, their technical employees will meet and discuss about their appropriate use. All these interactions generate a trustworthy environment in the cluster, which may facilitate the sharing of information and knowledge, thus enhancing the overall firm capabilities to innovate. In a previous study on wine clusters (Giuliani, 2005), I have shown that business interactions of this type occur in a pervasive way, resembling what Marshall called 'industrial atmosphere'. This means that firms show a rather homogeneous behaviour in interacting with the rest of the firms in the cluster. This is a relevant property because, if it is true that firms benefit from being embedded in the local network of business interactions, their performance will be homogeneously distributed.

The interaction for business related matters is only one of the several informal networks formed by firms in clusters (Boschma, 2005). In fact, different *types* of networks are likely to carry different informational content and they may affect firm performance differently (Gulati, 1998; Rodan and Galunic, 2004). In Giuliani (2005), I disentangle the knowledge network, based on the transfer of knowledge for the solution of technical problems, from the overall network of business interactions (Figure 1, 2 and 3). The structural properties of the knowledge network suggest that it is built on a more selective basis, if compared to the network of business interactions. This means that knowledge diffuses in clusters in a less pervasive and serendipitous way than it is commonly envisaged by the economists and economic geographers. This property may have important implications on the distribution of firm performance in clusters. *Given its selectivity, if firm performance is affected more by the degree of embeddedness in the knowledge network than in the network of business interactions, it is reasonable to expect an uneven distribution of firm performances.*



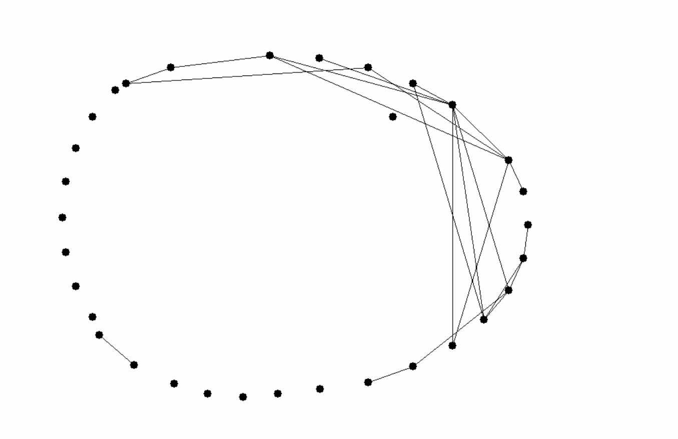
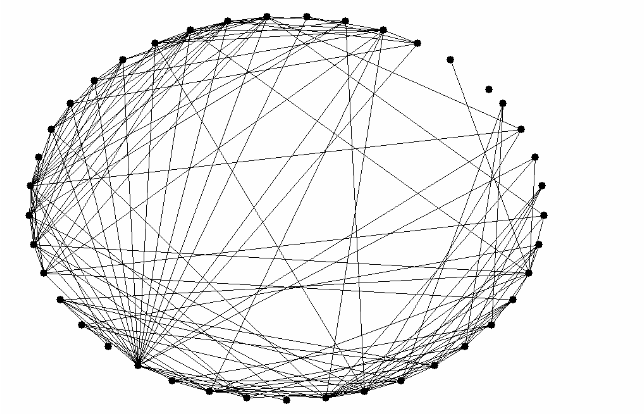


Figure 1(a) BI network in CP **Figure 1(b) KN network in CP**



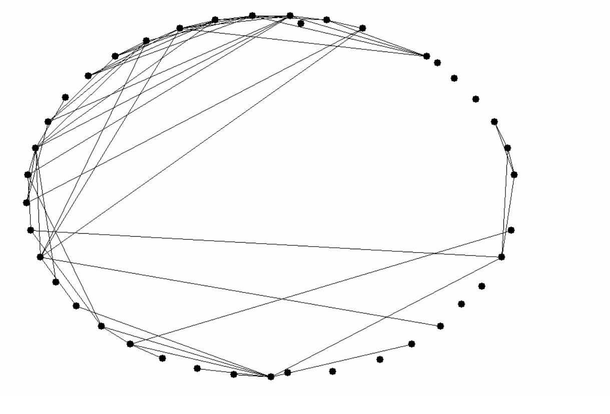
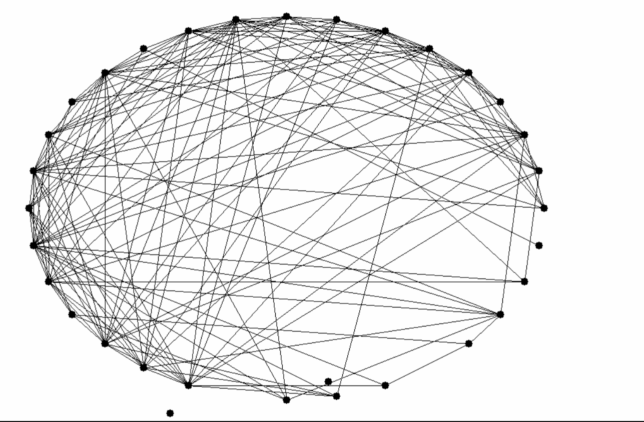


Figure 2(a) BI network in BVC **Figure 2(b) KN network in BVC**



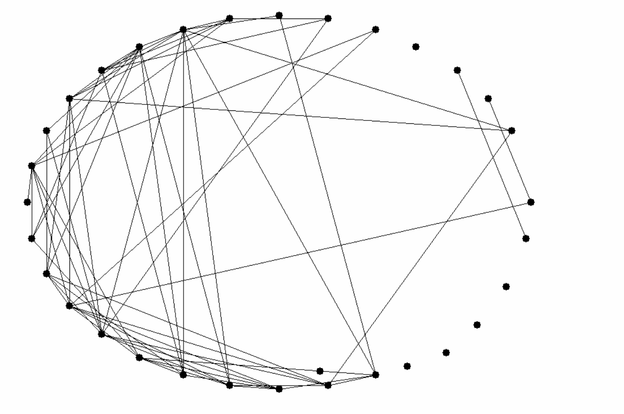


Figure 3(a) BI network in CV **Figure 3(b) KN network in CV**

Note: BI stands for 'business interaction'; KN for 'knowledge'; CP for the Colline Pisane cluster; BVC for the Bolgheri/Val di Cornia cluster; CV for the Colchagua Valley cluster.

Source: Giuliani (2005) (based on UCINET-Netdraw; Borgatti et al., 2002)

4. Data and method of analysis

Collection of Data

This study is based on micro level data, collected at the firm level in three wine clusters in Italy and Chile, namely: Colline Pisane (CP), Bolgheri/Val di Cornia (BVC) and Colchagua Valley (CV). The analysis has required careful data collection through interviews. Interviews were carried out with the skilled workers (i.e. oenologists or agronomists) and the survey was directed to producers of fine wines. This analysis includes only horizontal relationships among firms that operate as wine producers, whereas vertical linkages are not explored here. Data were gathered using the universe of fine wine producers populating the three clusters,[i] which is of 32 in CP, 41 in BVC and 32 in CV, summing up to a total of 105 firms. Further information about the population of firms is reported in Table 1.

Table 1 Firms characteristics by cluster

	Cluster		
Characteristics of firms by:	**Colline Pisane** (N= 32)	**Colchagua Valley** (N= 32)	**Bolgheri/Val di Cornia** (N= 41)
(a) Size (employees)			
Small (1-19)	91	28	90
Medium (20-99)	9	66	4
Large (≥100)	0	6	6
(b) Ownership			
Domestic	100	81	95
Foreign	0	19	5
(c) Organisation Structure			
1 Part of a group, vertically integrated firms	3	22	7
2 Part of a group, vertically disintegrated firms	-	13	-
3 Independent, vertically integrated	88	66	93
4 Other (e.g. cooperatives)	9	-	-
(d) Year of localization			
Up to 1970s	53	24	24
1980s	9	16	22
1990s	31	38	23
2000s	6	19	15

Note: The numbers refer to percentages within the respective cluster.

Apart from general background and contextual information, the interviews were designed to obtain information that would permit the development of quantitative indicators in three key areas: (i) the knowledge base of firms, (ii) the degree of embeddedness of firms in the network of business interactions and (iii) degree of embeddedness of firms in the network of knowledge. These are summarized in Table 2.

Table 2 The collection of key variables

(i) Knowledge base

In the literature, this concept, a key element in the analysis here, is described in terms of the knowledge base of the firm, often associated with training, human resources and R&D. Correspondingly, the structured interviews sought detailed information about:

(i) the number of technically qualified personnel in the firm and their level of education and training (Human resources), (ii) the experience of professional staff – in terms of months in the industry (Months of experience); (iii) the number of other firms in which they had been employed (Number of firms), and (iv) the intensity and nature of the firms' experimentation activities (Experimentation intensity) - an appropriate proxy for knowledge creation efforts, since information about expenditure on formal R&D would have been both too narrowly defined and too difficult to obtain systematically.

(ii) Network of business interactions

In the questionnaire-based interview, relational data were collected through a 'roster recall' method: each firm was presented with a complete list (roster) of the other firms in the cluster, and was asked the question reported below:

With which of the cluster firms mentioned in the roster do you interact for business matters?
[Please indicate the frequency of interaction according to the following scale: 0= none; 1= low; 2= medium; 3= high]

(iii) Network of knowledge interactions

In the questionnaire-based interview, relational data were collected through a 'roster recall' method: each firm was presented a complete list (roster) of the other firms in the cluster, and was asked the questions reported below:

1 If you are in a critical situation and need technical advice, to which of the local firms mentioned in the roster do you turn?
[Please rate the importance you attach to the knowledge linkage established with each of the firms according to its persistence and quality, on the basis of the following scale: 0= none; 1= low; 2= medium; 3= high].

2 Which of the following firms do you think have benefited from technical support from this firm?
[Please indicate the importance you attach to the knowledge linkage established with each of the firms according to its persistence and quality, on the basis of the following scale: 0= none; 1= low; 2= medium; 3= high].

Note: Respondents were asked to rate each of the mentioned relationships on a scale of 0 to 3. A value of 0 is given when no linkage is formed. A value of 1 corresponds to an occasional knowledge linkage with limited content in terms of quality of the knowledge flow, whereas a value of 3 corresponds to a persistent knowledge linkage that carries fine-grained knowledge.
It is worth remembering here that this study was designed to collect cross-sectional data only. Therefore, the relational data gathered through the above-mentioned roster studies refer to the very recent past in which the interviews have been carried out (maximum of two years).

Econometric estimation

The analysis is based on an econometric estimation, using a Probit model with marginal effects. The estimations are carried out on the aggregate data obtained by pooling together the three clusters' variables. Since data are coming from three different geographical clusters of firms, I applied the Moulton method (Moulton, 1990) to control for the possibility that the random disturbances in the regression are correlated within each cluster.

Dependent variable

Performance at the firm level is measured here by an indicator of the quality achieved by each firm's wines. The quality of worldwide wines is annually assessed and rated by international panels of experts and published in several specialized wine journals (e.g. Wine Spectator, Decanter, Wine Enthusiast, Robert Parker's Guide). Having a wine rated by any of these international specialized journals is, first, an acknowledgement of the qualitative properties of the wines, and second, a very powerful marketing device for a firm, since experts' ratings strongly influence market prices (Nerlove, 1995; Landon and Smith, 1997; Combris et al., 1997, 2000). The performance of a firm is therefore seen here as its capacity to develop new wines, which are valued as "quality wines" by international experts.

The indicator adopted in this paper is drawn from one of the above international wine journals: *Wine Spectator*.[ii] This journal wine rating is based on the quality assessment of an international panel of expert oenologists, who review more than 12,000 wines each year in blind tastings. After tasting, oenologists assign a score to each wine brand according to a 100-point scale, ranging from 100, when the wine is of outstanding quality, to 50 when it is of poor quality.[iii] A set of information is listed with each rated wine: the wine vintage, the wine area and the market price. The indicator used here (*RATING*) is valued 1 when any of the firm's wines has been assigned at least 70 points in years 2002- 2004, the minimum threshold for a wine to be considered of drinkable quality and to be recommended by the journal. It is valued 0 otherwise. A lag of two years is allowed between the year in which the interviews were carried out and the vintage of the most recent rated wines.

It is worth noting that the majority of the wines tasted are submitted to *Wine Spectator* by the wineries or their U.S. importers. Additionally, the journal spends substantial effort in buying and reviewing wines that are not submitted, at all price levels. Accordingly, a firm's wines may not be rated for three main reasons: first, due to a selection bias, firms with poor quality achievements will have little incentives to send their wines to the journal for assessment. Second, U.S. importers will not recommend and signal wines to *Wine Spectator* when they consider them of poor quality. Third, *Wine Spectator* itself selects out all the wineries producing very poor quality wines. These considerations suggest therefore that firms whose wines are not rated tend to be poor performers. The same applies for firms whose wines are rated but are assigned less than 70 points.

Using *Wine Spectator* as unique source of information, however, may pose some robustness problems. Even if it is highly unlikely that a good performing winery will not be spotted by the journal, it is still possible that some wineries are overlooked. In order to control for that, I correlated *RATING* and two other indicators drawn from *Wine Spectator*'s ratings – the sum of scores per planted vineyard hectares (*SSH*) and the average price of rated wines normalized by the average price of rated wines in the cluster (*PRICE*) – with an indicator of the relative performance of firms in the cluster as perceived by its members.[iv] I find strong correlations between the perceived performance and the three *Wine Spectator*'s indicators: *RATING* (0.65**), *SSH* (0.65**) and *PRICE* (0.62**). These results suggest that the performance indicator *RATING* is robust enough to measure the quality of wines achieved by cluster firms.

Independent variables

Firm knowledge base (*KB*)

The knowledge base of the firm is measured extracting a factor from the Principal Component analysis of the four variables listed in Table 2 (Point (i)). The factor explains more than 75 per cent of variance and it has been calculated considering the pooled sample of firms.

Embeddedness in the network of business interactions *(BI_DC)*

This variable measures the extent to which a firm has established linkages for business matters with other firms in the cluster. The existence of a business interaction is mapped by question (ii) in Table 2. The degree centrality of the network of business interactions ($BI\_DC_{(j)}$) is considered here a proxy of firms' the relational embeddedness in the cluster. It is measured by the extent to which an actor *j* is central in a network on the basis of the ties that it has directly established with other *i* actors of the network ($\sum(x_{(ji)})$). This measure uses undirected dichotomous data. The value has been normalized by its theoretical maximum (g-1), where g is the number of firms in each cluster.

$$BI\_DC_{(j)} = \sum(x_{(ji)})/g\text{-}1$$

Embeddedness in the knowledge network (*KN_DC*)

This variable measures the degree to which a firm is central in the knowledge network, mapped using questions (iii.1) and (iii.2) in Table 2. Also in this case the embeddedness of firms is measured by actor-level degree centrality (*KN_DC*). This measure uses undirected dichotomous data. The value has been normalized by its theoretical maximum (g-1), where g is the number of firms in each cluster:

$$KN\_DC_{(j)} = \sum(x_{(ji)})/g\text{-}1$$

Control variables

I control here for the following firm-level variables that are commonly associated to performance: the size of firms, measured by the log of employees (*LEMP*), the age of the firm (*AGE*), measured as the number of years since the starting of operations until 2002. The ownership (*OWN*) which is a dummy variable indicating whether the firm is foreign- (1) or domestic-owned (0). I also control for the type of organization. As shown by Table 1, firms in the clusters have four different types of organizational structures: *ORG1* corresponds to firms that part of a national group and perform all phases of the production process within the cluster, *ORG2* refers to firms that are as well part of a national group but perform only part of the production process, usually grape-growing, within the cluster. *ORG3* refers to firms that are independently owned and that perform all production phases in the cluster, where the headquarter is also located. Finally, *ORG4* represents a residual category including cooperatives.

5. Empirical results

Table 5 reports the results of the Probit estimation and Table 4 the descriptive statistics and the correlation matrix. Model 1 in Table 5 only includes the control variables, showing that only size is positively related with the likelihood of a firm being rated by *Wine Spectator* and therefore with its performance.

Model 2 shows that the value of firm knowledge base is strongly and positively related with performance, a result that is in line with several other recent contributions (for example, Camison, 2004; Zaheer and Bell, 2005). This is explained by the fact that firms that have better educated or experienced knowledge workers (Drucker, 1993), and that carry higher internal experimentation intensity, are more likely to exploit knowledge for the generation of successful innovations (March, 1991). This in turn drives a firm to achieve higher performances (Wernerfelt 1984).

Model 3 provides support to the view that firms that interact for business matters are more likely to be good performers. This result is consistent with the fact that being co-located in the same industrial cluster, and being embedded in the local network, may facilitate the access to relevant information or may ease inter-firm transactions. In this case, firms may benefit from several types of externalities and enhance their performance accordingly. This evidence seems to support the view that both intra-firm resources and relational proximity matter for firm performance (Capello and Faggian, 2005). However, no evidence is found that the latter matters more than the former.

Model 4 finds a strong and positive relationship between the degree of firms' embeddedness in the knowledge network and their performance. This is in line with most of organizational sociology's literature (e.g. Powell et al., 1996, Smith-Doerr and Powell, 2003), since the access to external sources of knowledge for the solution of internal problems favours innovation and enhances firm performance. The interesting result here is that the coefficient of *KN_DC* is higher in Model 4 than the coefficient of *BI_DC* in Model 3. Furthermore, when both *BI_DC* and *KN_DC* are considered in the estimation (Model 5), *BI_DC* ceases to be significant, while both *KB* and *KN_DC* persist to be positive and strongly significant.[v]

Table 4. Descriptive statistics and correlation matrix

	Mean	*St. Dev.*	*RATING*	*LEMP*	*AGE*	*OWNER*	*ORG1*	*ORG2*	*ORG3*	*ORG4*	*KB*	*BI_DC*	*KN_DC*
RATING	0.30	0.46	1.00										
LEMP	1.99	1.39	0.47***	1.00									
AGE	32.61	66.95	0.14	0.01	1.00								
OWNER	0.07	0.25	0.08	0.18*	-0.09	1.00							
ORG1	0.10	0.31	0.19*	0.34***	-0.05	0.41***	1.00						
ORG2	0.04	0.19	0.31***	0.23***	-0.04	-0.05	-0.07	1.00					
ORG3	0.83	0.38	-0.26***	-0.42***	0.06	-0.28***	-0.75***	-0.44***	1.00				
ORG4	0.03	0.17	-0.11	0.07	-0.01	-0.05	-0.06	-0.03	-0.38***	1.00			
KB	0.00	1.00	0.50***	0.66***	-0.09	0.21***	0.51***	0.09	-0.43***	-0.08	1.00		
BI_DC	26.69	17.05	0.37***	0.22***	0.14	0.04	0.03	0.12	-0.09	0.00	0.22***	1.00	
KN_DC	8.11	8.30	0.64***	0.43***	0.05	0.22***	0.17*	0.35***	-0.26	-0.12	0.52***	0.55***	1.00

Note: * Significant at 10%; ** Significant at 5% and *** Significant at 1%. Based on Pearson coefficients.

Table 5: Probit estimations with marginal effects

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
	Control variables only	Knowledge base only	Knowledge base *cum BI_DC*	Knowledge base *cum KN_DC*	Knowledge base *cum BI_DC* and *KN_DC*
Dependent Variables	dF/dx (s.e.)	dF/dx (s.e.)	dF/dx (s.e.)	dF/dx (s.e.)	dF/dx (s.e.)
LEMP	0.140 (0.052)**	0.063 (0.070)	0.058 (0.052)	0.064 (0.071)	0.063 (0.770)
AGE	0.000 (0.000)*	0.000 (0.000)***	0.001 (0.000)**	0.000 (0.000)***	0.000 (0.000)***
OWNER	0.019 (0.099)	-0.146 (0.082)	-0.015 (0.138)	-0.146 (0.084)	-0.146 (0.082)
ORG3[(℘)]	-0.067 (0.225)	-0.024 (0.335)	0.067 (0.231)	-0.022 (0.334)	-0.024 (0.335)
KB		0.085 (0.018)***	0.181 (9.296)***	0.083 (0.017)***	0.085 (0.018)***
BI_DC			0.006 (0.003)**		0.000 (0.001)
KN_DC				0.027 (0.005)***	0.026 (0.006)***
N	96	96	96	96	96
Log pseudo-likelihood	-46.003222	-41.330488	-38.942215	-33.722975	-33.698371
Pseudo R2	0.1934	0.2745	0.3170	0.4087	0.4092

Note: * Significant at 10%; ** Significant at 5% and *** Significant at 1%.
[(℘)] ORG1, ORG2 and ORG4 have been dropped due to collinearity.

The results of this study indicate that both firm internal capabilities, and the degree to which firms are embedded in local networks, matter for their performance. However, it is relevant to note that it is a specific type of network that affects performance most: the knowledge network. It is reasonable to argue that this is connected to the structural properties of this network. As illustrated by Giuliani (2005), the knowledge network is formed on a selective rather than pervasive, collective basis. This is due to two types of factors: first, firms with stronger knowledge bases have more to transfer and are understandably more likely to be targeted by other firms for technical advice. Second, firms with stronger knowledge bases will seek technical advice from equally advanced firms, thus targeting firms with strong knowledge bases in their search for external knowledge (Giuliani and Bell, 2005). On the basis of this, communities of knowledge are formed in clusters by a restricted group of equally advanced firms. An implication of selectivity is that the knowledge that is circulated within the community is likely to be of valuable content, which in turn enriches the knowledge base of the member firms and, consequently, their performance. It is therefore reasonable to argue that this evidence casts doubts on the importance of *meso*-level conditions, such as geographical, sectoral and relational proximity, for performance. More convincingly, it seems that knowledge endowments affect performance both directly and indirectly through the generation of a local knowledge network, which serves to enhance individual firms' capabilities.

6. Conclusion

This chapter has made an attempt to understand the factors that influence firm performance in industrial clusters. Taking an evolutionary approach to this domain of studies, it has shown that the heterogeneous distribution of firm knowledge bases is related with their performance, both directly and indirectly through the participation to the local knowledge community. Following up on a previous study (Giuliani, 2005), this novel empirical evidence shows that, in spite of pervasive business interactions, the performance of firms is unevenly distributed in the clusters. The econometric estimations provide support to this and show that firm performance in clusters depends on their internal capabilities (i.e. knowledge bases) and their capability of being connected to the local knowledge network. More importantly, this empirical evidence seems consistent with the fact that similar *meso*-characteristics -i.e. the geographic and relational proximity of firms - do neither constitute the substratum for collectively-shared knowledge flows (Giuliani, 2005), nor for processes of *even* growth.

On the basis of this, two considerations can be raised. First, one should be extremely careful in associating the concept of industrial clusters to enhanced performance and competitiveness, even when firms are geographically and relationally proximate. Instead, more rigorous studies should be carried out in the future that analyze the interplay between firms, the cluster knowledge network, and performance. Second, as recently suggested by Markusen (2003), more rigorous analysis in regional studies will provide better indications for policy makers. Indeed, this study supports the view that clusters' performance is more likely to be enhanced by strengthening firms' knowledge bases rather than by pooling firms together in the same geographical area (as is the case of 'technopoles' (OECD, 2000)) or by the promoting inter-firm networking *per se* (UNCTAD, 2001; UNIDO, 2001).

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[i] The lists of firms are drawn from official sources: the S.A.G. (Servicio Agricola y Ganadero) for Chile and the provinces of Pisa and Livorno for Italy.

[ii] The choice of the journal was done on the basis of two criteria: free availability on the web and coverage (countries, vintages, wine areas).

iii The rating is based on the following criteria: 95-100 Classic: a great wine; 90-94 Outstanding: superior character and style; 85-89 Very good: wine with special qualities; 80-84 Good: a solid, well-made wine; 70-79 Average; drinkable wine that may have minor flaws; 60-69 Below average; drinkable but not recommended; 50-59 Poor; undrinkable, not recommended.

[iv] The questionnaire included a question asking the respondents to name the firms in their cluster that they perceived as having achieved high performance in terms of quality of wines and commercial success.

[v] Given the existence of a positive relationship between two of the independent variables, *KB* and *KN_nDC* (Giuliani, 2005), simultaneous equation modelling would have given more robust or insightful econometric estimations. This model is applied in other forthcoming works by the author.