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Multirelational Embeddeness, Information Transfer and Opportunity Discovery

A Longitudinal Study of a Small Firm Cluster

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CHAPTER 1

INTRODUCTION

1.1 RESEARCH PROBLEM

Explaining differential firm performance and behavior has always been one of the main concerns of scholars in the strategy field.

In the fourth century before Christ Sun Tzu summarized the essence of strategy as follow: "Know your enemy, know yourself, and your victory will not be threatened. Know the weather, know the terrain, and your victory will be complete". As these words suggest, the contraposition between the actor and the context has characterized the strategic thinking ever since. In modern times, as management scholars have searched for determinants of organizational performance, this distinction has translated into two fundamental views. One, the industry structure view associated with Bain (1959) and Porter (1980), suggests that the sources of competitive success and the determinants of firm performance depend on the firm's membership in an industry with favorable structural characteristics. This assumption has led many researchers to focus on the industry as the relevant unity of analysis.

The second, the resource-based view of the firm (RBV) – has shifted the unity of analysis on the firm, based on the argument that differences in firm performances are mainly due to firm heterogeneity rather than industry structure (Barney, 1991; Rumelt, 1984).

When developing these approaches, researchers were choosing either to observe firms as autonomous entities, trying to exploit exogenous conditions of profitability or as actors engaged in an endogenous rent generating process, based on the valorization of unique internal resources. Although both these two perspectives have contributed greatly to our understanding of firm behavior and performance differences, they fail to see that advantages and disadvantages of a firm are often linked to the

characteristics of the relational network in which the firm is embedded (Dyer and Singh, 1998). As Gulati and colleagues (2000) recently observed, the image of atomistic actors competing against each other in an impersonal market is inadequate in a world in which firms are embedded in multiple professional, social and exchange networks that link them to their environment and to the other actors populating it.

The basis towards a reconciliation of the two approaches is set forth between the seventies and the eighties by economic sociologists such as Granovetter (1973, 1985), Burt (1982), and Baker (1984), who convincingly demonstrate how the social structure of ties within which economic actors are embedded may shape their opportunities and decisions. The argument is that distinct social structural patterns in exchange market relations may influence the flow and nature of information that actors can accrue (Burt, 1982; Baker, 1984), which in turn, affect the likelihood of perceiving new opportunities, with performance as well as behavioral implications.

Building on this approach - usually known as embeddedness perspective – starting from the nineties a growing number of scholars in the strategic as well as organizational field have highlighted the salience of firms' social, economic, and professional networks to explain economic actions. Part of these studies have analyzed the role of inter-organizational networks on alliance formation (Kogut et al., 1992; Gulati, 1995), their impact on the likelihood of firm survival (Baum and Oliver, 1992; Mitchell and Singh, 1996), on competitive dynamics and organizational performance (Uzzi, 1997; Lorenzoni and Lipparini, 1999; Baum et al., 2000), on the development of new competencies and the process of organizational learning (McEvily and Zaheer, 1999; Dyer and Nobeoka, 2000; Yli-Renko et al, 2001). Similarly, the role of relational activities has widely emerged in the context of innovation (Freeman, 1991; Shan et al., 1994; Sobrero, 2001), while a lot of entrepreneurial research has also ascertained the importance of social networks during the start-up phase (Birley, 1985; Dubini e Aldrich, 1991; Ostgaard e Birley, 1996), and their function for the entrepreneurial process more in general (Jarillo, 1989; Larson, 1992; Lipparini e Sobrero, 1994).

Building on this tradition of studies, in what follows the embeddedness perspective is applied to analyze the organizational performance of a sample of small firms located in a *geographical cluster*.

Following Porter (1998, 2000), geographical clusters can be defined as spatially concentrated groups of small entrepreneurial firms competing in the same or related industries that are linked through vertical (buyer-supplier) or horizontal (alliance, resource sharing, etc.) relationships. Well known examples of this phenomenon are, among the others, cases like Silicon Valley (Saxenian, 1994; Castilla et al., 2000), Motor Sport Valley in southeast England (Pinch and Henry, 1999), the industrial districts of Northern Italy (Lazerson and Lorenzoni, 1999), the California Wine Cluster illustrated by Porter (1998) or the Northern America biotech clusters widely investigated by Powell and colleagues (2002).

After a period of irregular interest during the 1970s and 1980s, over the last fifteen years geographic clusters (and locally concentrated industries more in general) have been the object of a growing and renewed attention across a broad range of academic disciplines (Malmberg and Maskell, 2002). The initial theoretical treatment of this phenomenon, however, is generally attributed to Alfred Marshall (1920). Marshall's theorization of geographic clustering built on three key tenets: the benefit of labor pooling, specialized suppliers and rapid formal and informal communication due to a common base of knowledge across firms, employees, and the community. In particular, Marshall initiated the concept of shared knowledge as a characteristic of localized economies with his idea of an "industrial atmosphere" with "knowledge in the air." Despite Marshall's pioneering intuitions, for several decades research in this field has been focusing almost exclusively on efficiencies in supply chains, labor markets, and subcontracts, purported as the key drivers of the agglomerative advantage. As the theory developed and ideas from economic sociology propagated, though, economists also recognized the need to introduce wider institutional inputs within their frames of reference, one reason being the fact that cost based models alone fell short in addressing the condition of many smaller firms rather than a single large firm (Maskell, 2001; Tallman et al., 2004). Consequently, towards the recent turn of the century, a far more socially and relational oriented account has come to occupy centre stage in the discourse on local agglomerations. The general argument is that a local industrial structure with many small firms competing in the same industry, or collaborating across related industries, tends to trigger a higher degree of situation-specific knowledge transfer as well as exchange and circulation of new ideas and information (Nohria, 1992; Saxenian, 1994; De Carolis

and Deeds, 1999). This process is indeed bolstered by the sharing of norms, values and institutions that shape the local culture and allow for the access to otherwise less valuable (as well as transferable) pieces of information (Storper, 1995; Porter, 1998). As Tallman et al. (2004) note: "Knowledge creation and circulation of ideas under conditions of high social embeddedness allowing individual firms to tap the body of local knowledge are now seen as essential to explaining regional clusters" Along this vein, more and more scholars have advocated the adoption of relational or network lenses to unfold and analyze the dense and overlapping social, professional and exchange interfirm relationships that shape geographical clusters.

Despite this increasingly popular trend however, only very few attempts have been made to move beyond an empirically vague appreciation of the role and magnitude of the 'network effect' within geographical clusters (Sobrero, 2001). In particular, if we exclude few isolated cases (McEvily and Zaheer, 1999; Castilla et al., 2000), virtually no work has endeavored to introduce a network analytic approach within the boundaries of a locally concentrated industry and use such lenses to explain the performance of the firms located within the cluster (henceforth CLFs). This is all the more surprising given the characteristic of tight spatial and socio relational boundedness that distinguishes these organizational realities, a unique feature that facilitates the often troublesome problem of specifying the boundaries on the set of units to be included in the network (Marsden, 1990).

This shortcoming, I believe, is at least partially related to the prevailing tendency in the literature to consider geographical clusters as a whole, without focusing on what is happening at the micro level of the single firm. The main goal usually being the elucidation of the mechanisms superseding the genesis of a local agglomeration of firms – either economic (Marshall, 1920; Krugman, 1991), sociological (Becattini, 1979; Lazerson, 1988), historical (Putnam, 1993) or geographic (Storper and Scott, 1995) – or the illustration of the factors leading to the competitive advantages of certain localized production systems (Saxenian, 1994; Pouder and St. John, 1996; Porter, 1998). This 'macro perspectivÈ has undoubtedly favored our understanding of the overall phenomena and its implications, but it has also contributed to nurturing a somewhat latent assumption that all CLFs tend to be homogenous and thus do not merit special attention in their

own right (Lazerson and Lorenzoni, 1999). Some evidence, however, also suggests that whereas clusters are often populated by extremely dynamic and fast growing firms, some of these firms struggle to survive, grow a little or die during their first years of operation, while only relatively few of them maintain the capability to successfully compete and grow (Saxenian, 1994). What is the source of such heterogeneity in the performance of CLFs?

In order to address this question I take a rather different angle from the more established 'aggregate way' of looking at the phenomenon of localized industries. Instead of centering my perspective on the system and its aggregate properties, I focus on the actors and their performance, as a function of the actors' participation to the system.

In adopting this perspective I build on McEvily and Zaheer's (1999) finding that competitive capabilities of CLFs may radically differ depending on their heterogeneous embeddedness within the dense system of interorganizational relations that characterizes the cluster. But whilst the two scholars elaborate on the embeddedness notion to account for differences in CLFs *capacity to compete*, I concentrate on the link between *networks and growth*, as a tangible measure of CLF performance. In line with previous research I see these networks as devices for information gathering and knowledge transfer. As a result, depending on their network properties and attributes, CLFs are more or less likely to accrue valuable information flows and incur into attractive business opportunities.

This process is examined in the light of the possible moderating effect of an important theoretical construct at the firm level: *absorptive capacity*.

1.2 Organization of the dissertation

The structure of the dissertation is as follow.

In chapter two I provide a short illustration of the phenomenon of small firm clusters, the reasons why interfirm networks represent a particularly apposite concept to understand the functioning of these organizational entities, together with the gaps that appear to affect this research domain. I proceed by elaborating on the strong tight-knit, embedded nature of networks within geographical clusters to outline the basics for a multirelational influence model of network ties on CLFs

performance. I do so by moving away from a purely structural conception of firm networking and focusing instead on the underlying informational and knowledge benefits that CLF firms derive from their participation in such multiple networks of relations.

In CHAPTER THREE, after describing the research setting and the structure of the data, I go on by adopting a multi-indicator approach for measuring the network constructs of interest. This approach allows me to distinguish among different informational dimensions of firm networks and come up with measures that summarize the rich relational spectrum of the CLF. These measures are then incorporated as covariates into a longitudinal hybrid model where the effect of network variables on CLF performance is estimated together with a variety of control variables.

In CHAPTER FOUR I conclude the work by discussing the results and their theoretical and practical implications. The last part of the chapter highlights the major limitations of the study and addresses some topics for future research.

In understanding the relevance of networks for these small firms I made use of extensive interviews with firm owners. This field information provided grounding for claims about the role of networks in conveying valuable information and supporting the performance of the firm. I resort to these interviews wherever relevant in the study.

CHAPTER 2

THEORETICAL FRAMEWORK

This chapter is divided in two parts. In the first part I establish three elements that serve as conceptual scaffolding for the model. Concepts are presented and linked within a scheme of causal reasoning. In the second part these ideas are translated into a set of testable hypotheses with measurable independent and dependent constructs, to specify how structural properties of CLFs may impact on their growth performance.

In short, the framework rests on the following interlinked concepts:

1. Relational ties within geographical clusters are imbued with value in the form of information and knowledge that flows across the multiple ties in which firms are embedded.

2. The heterogeneous position of CLFs within this web of ties translates into diverse exposure to valuable opportunities and hence, into heterogeneous potentials for economic performance.

3. CLFs that are better armed to appreciate/understand the value of these opportunities are in an advantageous position to translate this potential into economic vale.

Paragraphs 2.1-2.3 illustrate each of the above points, paragraphs 2.4-2.6 introduce the hypotheses.

2.1 INTERORGANIZATIONAL NETWORKS AND INFORMATION ACCESS WITHIN GEOGRAPHICAL CLUSTERS

While several mechanisms may be identified through which interorganizational networks may affect firm behavior, the key argument behind a vast majority of influence models is that relational ties provide *access* to information and knowledge. The informational value of network ties is a prominent and well-established idea among network theorists

(Stephenson and Zelen, 1989; Burt, 1992; Wassermann and Faust, 1994), and represents a core assumption in a variety of studies that have investigated the relational foundations of organizational level outcomes (Gulati, 1995, 1999; Hansen, 1999; Koka and Prescott, 2002). For instance, Gulati (1995, p. 624) summarizes this point in stating "That social networks are conduits of valuable information has been observed in a variety of contexts, ranging from interpersonal ties…to interlocking directorates…The common theme throughout this body of research is that the social networks of ties in which actors are embedded shapes the flow of information between them. Differential access to information, in turn, moderates the behavior of actors". This 'network-access' idea is particularly relevant in the context of tightly spatially and socially bounded geographical areas such are geographical clusters. As Powell et al. (2002) observe: "The advantages of location… are very much based on access and information" (p. 293). In fact, as economic actors co-localize within spatially and socially bounded contexts, knowledge spillovers, buzz, and exchange of ideas are triggered while the local environment is gradually turned into a vibrant repository of information and opportunities". This point is reaffirmed by DeCarolis and Deeds, who note: "The proximity of firms to competitors, suppliers, and a qualified labor pool increases the flow of knowledge across a firm's boundary. Social interactions, both formally and informally, stimulate information exchange about such topics as competitor's plans, developments in production technology, and recent developments within the local university's labs" (1999, p. 956). Because CLFs share a common institutional environment, are spatially proximate and consequently interact more frequently, they are more prone to circulate ideas, knowledge and fined-grained information that can be channeled and secured through the thick web of overlapping personal and professional ties that typically emerge within these contexts (Lazerson and Lorenzoni, 1999; Porter, 2000; Maskell, 2001)[1] . In such a tight-knit community, customers, suppliers, competitors, allies as well as institutions and informal relations are all potential vehicles

[1] Any infringement of trust by firms in such closely knitted business networks is so severely penalized that in effect malfeasance becomes a non-option. Cheaters are selected to make a convincing reparative gesture for any first-time misdeed however small. The collective awareness of this mechanism makes it possible to exchange knowledge even between competitors within a network, to an extent that no outsider can aspire to achieve (Maskell, 2001).

through which CLFs may tap valuable information flows. As a result of this *multirelational embeddedness* phenomena: "Increasing returns are present in the form of overlapping networks, recombinant projects, personal and professional relationships, and interpersonal trust and reputation, all of which are thickened over time. In such a milieu, access to reliable information… occurs through personal as well as professional networks, and these ties are critical in reducing uncertainty about projects that are not well understood by non-experts, exceedingly risky in terms of their payoff and unclear in terms of their eventual market impact." (Powell et al., 1996) By tapping the multiple flows that circulate throughout the cluster CLFs broaden their exposure to new opportunities and enhance their performance aspirations.

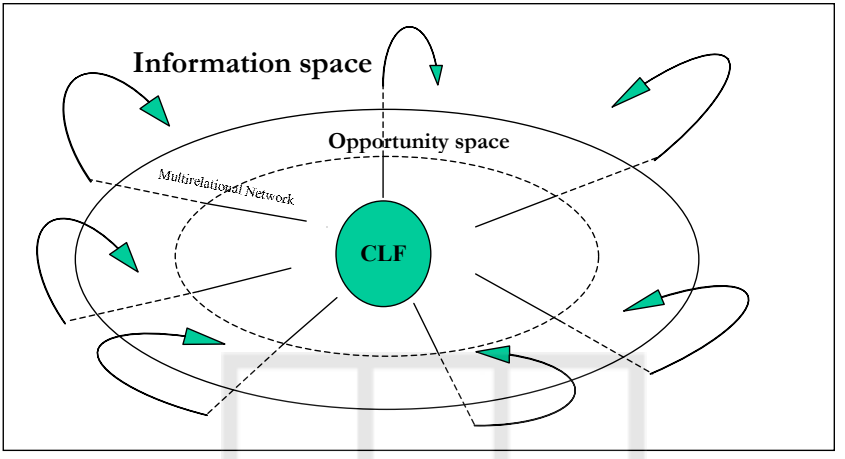
Tenets from the Austrian Economics help providing a theoretical grounding for this idea.

2.2 Information access and opportunity discovery as antecedents of growth

According to the Austrian Economics accessing information is a crucial premise for discovering new opportunities that is, finding potential economic profits that have not yet been grasped (Hayek, 1954; Kirzner, 1974). Opportunities exist because different people access and control different information. The discovery of these opportunities is rarely the result of an aimed search (because, as Kirzner (1997) posits, the searcher will be unaware of it until discovery); rather it depends on the recognition of the value of information that actors happen to receive through other means (Shane, 2000). Thus, while proactive search may be an important enabling condition, results are often unintended and opportunities not necessarily consequential. These concepts suggest two simple ideas: First, because interfirm networks may affect the firm's exposure to the 'information spacÈ that permeates the cluster environment, they may impact the likelihood for the CLFs to discover valuable opportunities. A stylized representation of this idea is provided in figure 1.

Second, because the pattern of network linkages maintained by each of these firms is highly idiosyncratic, the probability of discovering new opportunities via network ties may be unevenly distributed. Simply speaking,

Figure 1. CLFs multirelational embedded ties as bridges between information space and opportunity space.



CLFs with a better network-access will be more likely to come upon opportunities and enhance their performance. In particular, because both from a theoretical (Penrose, 1959; Venkataraman, 1997) and empirical (Timmons et al, 1987; Corbett and Koberg, 2001) standpoint the discovery of opportunities has been shown to be a crucial antecedent of growth, I expect variations in network positions of CLF to translate into heterogeneous growth expectations.

The wide variety of measures, indicators and operationalization criteria that have been proposed to gauge firm's growth (Evans, 1987; Weinzimmer et al., 1998) provide a pretty clear image of the difficulties in establishing whether and how an organization is growing. All the same, while there are certainly many several ways in which the outcome of this process may unfold and reify, the antecedents of firm growth are typically to be found in the discovery and recognition of one or more economic opportunities. Opportunities to expand the business, to enhance current activities, to enter new product domains, to learn new practices, improve the current skills or capitalize on existing resources. Many scholars support this idea by viewing the process of opportunity discovery and recognition as a crucial antecedent of firm growth (Timmons et al, 1987; Venkataraman 1997). In fact, not only the relationship between opportunity recognition and firm growth has been empirically proved (Corbett and Koberg, 2001), but it is also at

the core of the Penrosian idea of growth as *discovery of productive opportunities* (Penrose, 1959). As Penrose stated: "A theory of the growth of the firm is essentially an examination of the changing productive opportunity of firms...It is clear that this opportunity will be restricted to the extent to which a firm does not *see opportunities* for expansion…" (1959, p.31)

One might then wonder what does it take to turn such potential into real value, or, stated differently, whether different firms are equally armed to recognize and exploit the potential for value creation inherent in their network-enabled opportunity space.

2.3 The moderating role of absorptive capacity

There may be a great chasm between possessing growth potentiality and realizing it. In fact, an opportunity rich position is likely to remain confined in the realm of perceptions and possibilities until active understanding and appreciation of the opportunity value is reached.

One way to discriminate among firms that may take this further step and firms that, in this regard, are in a more disadvantageous stance is to focus on their knowledge base. This idea has been convincingly formalized by Cohen and Levinthal's (1990) *absorptive capacity* construct, that is: "the ability to recognize the value of new information, assimilate it, and apply it to commercial use" (p. 128).

Regardless of the steps that one will eventually take to gauge this multifaceted knowledge construct, the key insight here is that in order to assess the CLFs' network-enabled process of growth it may be meaningful to account for the moderating effect of absorptive capacity. This expectation is consistent with Tsai's (2001) recent findings that business unit with high levels of absorptive capacity are more likely to benefit from their interorganizational network centrality in terms of innovation and performance.

In abstract, the absorptive capacity construct may be imagined as the point of junction between the information space and the opportunity space: the higher the exposition and accessibility of the firm to external knowledge and information, the higher the need for absorptive capacity in order to benefit from such knowledge.

2.4 Hypotheses

Building on the above and drawing on existing research in the field of social networks I suggest two primary ways in which an actor's network position may impact his information access conditions: First, the structure of the network may affect the *volume of information* accessed, which can be expressed as a function of the actor's *centrality* within the system; Second it can affect the *variety of information* accessed, which is interpretable as a function of the *range* (or diversity) of actor's ties (Koka and Prescott, 2002). Further, in order to account for the multirelational nature of CLFs embeddedness, I introduce the notion of '*overall network position'*, that is, the focal CLF's network position as resulting from the observation of its overall set of network ties with the key constituents of its multirelational cluster environment. This idea is consistent with Fonti's (2002, p.8) remark that: "While it is interesting to examine the influence on organizational outcomes of the position held by an organization in a network (i.e., its level of embeddedness) for a given relationship (such as communication, for example), this only partially captures the fact that any organization belonging to a given network is embedded in a number of different relationships that are *all simultaneously affecting* its economic decisions… the degree of embeddedness of a given organization needs to be interpreted not only in terms of its position within a network for one specific relationship, but also as the cumulative effect that all the relevant relationships in which it participates have simultaneously on its actions".

2.4.1 Network centrality

Network centrality refers to the extent to which the focal actor occupies a strategic position in the network by virtue of being involved in many ties simultaneously (Wasserman and Faust, 1994). High centrality leads to higher *volume of information*[2] (Koka and Prescott, 2002) and, as Gulati notes: "The greater the information the higher the opportunity set" (1999, p. 399). Accordingly, I expect high centrality within the cluster's relational network to have a positive impact on the growth of the CLFs. In fact, by being at

[2] i.e. The quantity of information that an actor may access via its relational ties (Koka and Prescott, 2002, p.798)

the point of convergence of multiple relationships, central CLFs may maximize their exposure to the developments, ideas and initiatives that resonate throughout the system and thereof, increase their likelihood of discovering valuable opportunities. This is vividly illustrated by the comments of one of the entrepreneurs I interviewed.

> Clients, suppliers firms with which we collaborate, they all may be sources of valuable information, they all may open up valuable opportunities. One of the most important projects in the last few years sprang up almost by chance … thanks to an information we got from a client" (SonicRocket)

Furthermore, because centrality implies visibility and status, firms more centrally located enjoy power benefits such us a greater ability to undertake promising initiatives and/or attract further opportunities (Brass and Buckhardt, 1992; Powell et al., 1996). A comment by an entrepreneur I interviewed exemplifies this point:

> Our growth has proceeded hand in hand with our network …the more we grew the more they knew us and the more they knew us the easier it was to establish business relations[3] (MediaMutant)

Consolidating the above reasoning I propose the following:

(H1): *Other things being equal, an increase in the overall network centrality of a CLF will positively affect its growth probability.*

2.4.2 Network range

Because CLFs embedded in the network may operate in different segments, utilize different technologies and belong to different (but related) industries, they are also likely to be source of heterogeneous information. Burt (1983) defines the concept of network range as the extent to which an actor's network links it to diverse other units. Thus, while centrality emphasizes

[3] These and the following statements were all translated by the author. The original versions are available upon request.

the volume dimension of information access, range has mainly to do with the variety of the information. There are several ways in which network range may enhance information benefits: First, diversity of contacts across parties reduces access redundancy that is, tapping information that is superfluous and/or obsolete. On the contrary, the likelihood of entering novel niches of information is enhanced, and the overall flow of information enjoyed by the focal actor tends to be more effective. As McEvily and Zaheer point out: "When actors seek out contacts that are tapping fundamentally different informational domains, they are likely to discover unique opportunities and information not available from a network of redundant ties" (1999, 1138). Another entrepreneur I interviewed said:

> When you stick to the same circles for too long you loose the pioneer instinct, you have fewer incentives to explore new things and end up being unable to stay tuned with your times… when your network parties know each other it is unlikely that you get involved in challenging and stimulating undertakings …in a business reality like this one things change too quickly, and unless there is bum like in the '99, if you cannot find new stimuli you wind up getting bogged. (Officine Digitali)

Second, whereas networks with a narrow range of contacts are likely to confirm ones beliefs and mental models, network with higher range allow a finer and more mindful understanding of the system, which may then convert into a higher awareness of original developments, innovations and potential opportunities as they emerge in the surrounding environment (Powell et al., 1996). Further, when actors tap heterogeneous domains of knowledge and information they are more likely to enjoy advantages in the form of information asymmetries and control since the probability that the other parties of the relation know each other, on average, tends to be low. Having disconnected parties may have some important benefits, as confirmed by one of the interviewees' words:

> In general we prefer our clients not to know each other, specially when they are new ones…we can handle them in an easier way, we have more power during the price definition… sometimes, when two clients know each other they will eventually tend to imitate each other because they don't want to adventure into original solutions…this limits our experimentation, the motivation to try alternative paths. (Echodesign)

Based on the above I suggest the following:

(H2): *Other things being equal, an increase in the overall network range of a CLF will positively affect its growth probability.*

2.4.3 PREEXISTING KNOWLEDGE STRUCTURE

According to Cohen and Levinthal the absorptive capacity of an organization heavily depends on the "richness of its preexisting knowledge structure" (p.131). Whether developed from work experience, education, or other means, the preexisting knowledge structure influences the firm's ability to comprehend, extrapolate, interpret, and apply new information in ways that those lacking that prior information cannot replicate (Roberts, 1991). For instance, consistent with this idea, Shane (2000) relates the level of prior knowledge to the entrepreneur's ability to recognize new opportunities. As he notes: "Each person's idiosyncratic prior knowledge creates a "knowledge corridor" that allows him/her to recognize *certain* opportunities, but not others" (p. 452). This concept is well reflected in the following sample quote, by one of the owner/managers I interviewed:

> ... that project turned into nothing because we had no ideas about the opportunities it could pave the way to…probably it would have jumped us into the advertising segment and we would have been much farther by now… if we had recognized the importance of that contact we wouldn't have let it go. *(Achtoons)*

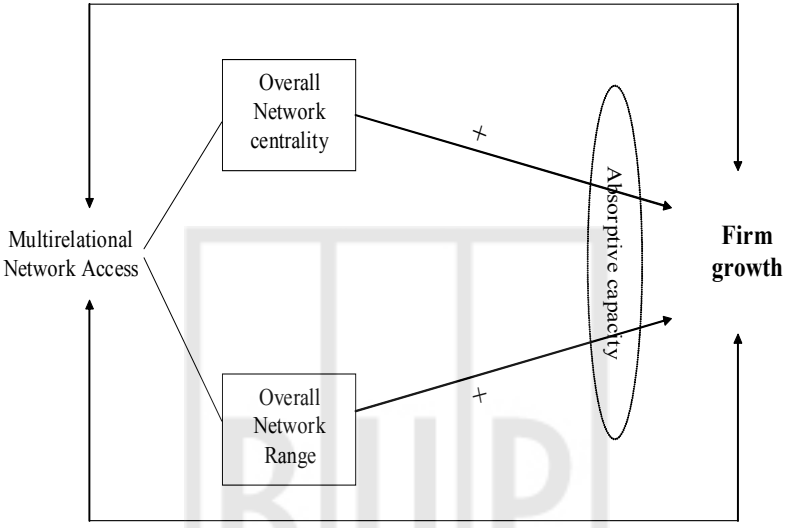
Following this line of reasoning I contend that the effect of network position on growth will be moderated by the CLFs' level of prior related knowledge. Hence, I posit:

(H3): *Other things being equal, an increase in the overall network centrality of a CLF is more likely to be positively related to the firm's growth when the firm has a rich preexisting knowledge structure rather then when the firm has a poor preexisting knowledge structure.*

(H3b): *Other things being equal, an increase in the overall network range of a CLF is more likely to be positively related to the firm's growth when the firm has a rich preexisting knowledge structure rather then when the firm has a poor preexisting knowledge structure.*

Figure 2 provides a stylized graphic representation of the causal relations postulated by the hypotheses.

Figure 2. Multirelational access and CLF's growth: An influence model



CHAPTER 3

DATA AND METHODS

This chapter is divided in three sections. First I illustrate the empirical setting and the reason why I regard it as an appropriate field for addressing the research questions introduced earlier.

In paragraph 3.2 I discuss the data collection process, I describe the characteristics of the sample, the nature of the data, the questionnaire tools as well as the measure that I took in order to strengthen the interviewees' commitment to the study.

The next section is centered on the operationalization of the constructs. Dependent and independent variables are introduced together with a multi-indicator measurement model, which I developed in order to operationalize the variables of theoretical interest (main effects).

I conclude by illustrating estimation techniques, and the related econometric issues.

3.1 Research setting

The field setting of this research consists on a geographical cluster of micro and small multimedia enterprises located in the area of Bologna, a city of Northern Italy. Starting from late eighties and beginning of nineties the metropolitan area of Bologna was invested by an entrepreneurial wave that has led to a fertile and dense agglomeration of multimedia enterprises. Sustained by the growing interest of local economic authorities, starting from the second half of the nineties several public and private institutions started to provide evidence as to the rapid emergence of what is sometimes referred to as the Bologna Multimedia Cluster (Lorenzoni and Ferriani, 2004). The word 'multimedia', in line with previous studies, is referred to as the combination and integration in a digital format of different kinds of information - such as text, video, images, sounds, voice - within a common

delivery channel (Brackzyck et al., 1999). This definition takes account of two fundamental aspects of multimedia activities: the plurality of different communication media, and their integration into a digital format.

There are several reasons for considering this setting worth studying: First, in the last decade, a number of governments, regional development associations, and trade organizations have sought to promote the development of multimedia clusters. These initiatives can be partly attributed to a global interest in the potential for multimedia to drive economic growth in urban centers. According to Fuchs and Wolf, multimedia is "a paradigmatic example of industries of increasing importance to regional economic prosperity" (1999, p. 301). This is not only because multimedia is a high-technology industry, but also because it is simultaneously a form of cultural production that is increasingly critical to strategies of economic growth (Scott 1998, p. 323).

Second, despite the relatively young age of the industry, entrepreneurial processes in the multimedia field have consistently translated into small and micro firms agglomerations all over the world (Braczyck et al., 1999), a circumstance that implies at least some prospect for theoretical inference beyond the local boundaries of the phenomena presented here. Well-documented cases of small firms clusters in the multimedia industry are for example the San Francisco Multimedia Gulch (Egan e Saxenian, 1999), New York's Silicon Alley (NYNMA, 2000), the New Media Cluster in Toronto (Brail and Gertler, 1999; Mills and Brail, 2002) or Montréal's 'Cité du Multimédia' (Tremblay and Rousseau, 2003). Further, analogous phenomena have been investigated in the metropolitan area of Cardiff (Cooke and Hughes, 1999), in Stockholm (Sandberg, 2001) as well as in Netherland (Hertog et al., 2000).

Third, because multimedia is an emerging and relatively young industry the importance of networks and external ties is likely maximized. In fact, findings in institutional economics suggest that emerging economic settings are characterized as having significant voids in informational markets and social networks often substitute for such failures (Peng and Luo, 2000). According to this literature the informational benefits of external ties are then likely to be grater in such a setting, thus maximizing the chances of observing their performance consequences.

Fourth, the importance of establishing interorganizational ties appears here even greater given the inherent 'hybrid' nature of the multimedia

industry. In fact, as Van Den Bosch et al. (1999, p.560) observe: "the multimedia complex lies at the heart of an evolutionary process of convergence… in which technologies stemming from a variety of industries are converging in hybrid forms". Because digital convergence erodes the boundaries between these industries, multimedia firms are faced with a unique dilemma: on one side they need to be "coherent" in their incremental accumulation of intangible assets (Teece et al., 1994), on the other they are induced by convergence forces across technologies (that is, by the need to access new knowledge domains) to 'break with the past' in order to escape the 'competency trap' that comes with a strict adherence to coherence. At the core of this tension is a vital need to access relevant knowledge: knowledge of a sort that is widely dispersed and not easily captured inside the boundaries of a firm. As Pennings and Puranam's (2002) recent findings in the field of digital imaging suggest, building a "substantial stock of relational competencies" by linking up with other firms and their competencies helps strike a balance between these tensions and successfully shape the convergence process. These ideas are echoed in the words of one of the owner/managers I contacted:

> In this industry there's a strong necessity to share and exchange information and knowledge. In our company, just a closed door represents a problem as it creates isolation…In order to realize a multimedia product you need specific competences from firms operating synergistically. (Vegas Multimedia).

More in general, dynamic industry contexts are appropriate for examining firm networks and their relationship to firm performance as rapid changes in markets and technological developments make knowledge access and acquisition in exchange relations particularly salient (Yli-Renko et al., 2001; De Carolis and Deeds, 1999; Powell et al., 1996).

Finally, I believe there is an intrinsic value in taking small and micro organizations as units of analysis in a study on growth. In recent years, many western economies have faced high unemployment and slow economic growth rates. These events have raised the attention of public economic

[1] According to the well known definition applied by the European Community micro and small firms can be identified based on the number of employees, 0-9 and 10-49 respectively.

institutions and policy makers on small firms[1] while research from different industrialized countries have shown that small firms are of great and increasing importance to the development of the economies (Acs and Audretsch , 1993; Audretsch, 2002). In fact, according to the latest estimates by the European Union 99.5% of a total of about 20.455.000 firms operating in Europe is represented by small and micro enterprises that employ 55% of the overall population employed in firms (The European Observatory for SMEs Report 2002/No. 4). Whereas, on the aggregate level, small firms appear to be a fundamental propulsive component of the economy, the prospect for any individual firm is uncertain. Many small firm die during their first years of operation, or struggle to survive, some grow a little while only very few firms exhibit substantial growth (Davidsson, 1989; Gundry and Welsch, 2001). This situation makes of great interest the problem of predicting small firms' growth, especially when considering that empirical analysis in the field is still scarcely developed or fairly deficient, as in the case of micro enterprises (Heshmati, 2001). "In some areas – Storey notes (1994, p.5) – theorists have already made a major contribution to our understanding of small firm issues, but in others their contribution is much weaker...In other areas – most notably small firm death and growth, it is much weaker" (1994, p.4).

3.2 Data collection

Data collection started at the beginning of 2002 and extended over one year, until the beginning of 2003. As a first step I had to come up with a reliable list of all the multimedia firms located within the Bologna cluster. This list was built by using *InfoImprese*, which is a comprehensive database operated by the Italian Chambers of Commerce to provide basic demographic information on all of the companies operating on the Italian territory. It is important, however, to recognize the inherent complexity of defining the boundaries of an industry profoundly shaped by the blurring forces of digital convergence; as such is the case with the multimedia arena. The following quotes may help appreciate the non trivial nature of the problem:

> The first problem that one encounter in any attempt to study the multimedia industry is to identify its essential features in terms of its

> sectoral structure and representative products. This is a particularly difficult task because the boundaries of the industry are extremely fluid and its outputs changing constantly in form and substance" (Scott, 1995 p.2)
>
> Multimedia is a widely used catchword. It is difficult to assign it a precise definition or a concept on which there is agreement across disciplinary boundaries […] The lack of clear-cut sector boundaries make it difficult to analyze the emerging multimedia industry (Barczyk et al., 1999 p. 7-8)
>
> Although many different prognoses on market volumes and job exist, there is no official definition of what multimedia means in sectoral sense (Hilbert et al., 1999 p.134)

At the heart of the problem is the fact that stable boundaries are definable only in an equilibrium situation, whereas convergence is by nature a disequilibriating process (Pennings and Puranam, 2002). Hence, some extent of arbitrariness was inevitable in setting the criteria for population inclusion. The difficultness of the task is well reflected by the non-trivial discrepancies in the number of firms' estimates that occur across the many research reports that have endeavored to map the explosion of multimedia entrepreneurship in Bologna over the last few years (Lorenzoni and Ferriani, 2004). I tried to lessen this problem by conforming as much as possible to selection criteria already adopted in previous research. Six industry segments tend to be consistently identified, with at least some degree of uniformity across the literature, as the key constituents of the emerging multimedia complex (Barczyk et al., 1999): publishing, audiovisual, computer graphics, communication&advertising, film, music. Using these selection criteria, the database returned a population of 205 firms concentrated within the area of Bologna. Most of these companies (85%) are currently members of one or the other of three multimedia consortia established by local public and private authorities to sustain the development of the multimedia business (namely: Bologna Multimediale, Digicitta' and Visioner). While it is hard to find clear-cut agreement on the kind of firms to be accounted, I am confident that this population constitutes a "critical mass" (Porter, 1998, p.76) that thoroughly represents the local multimedia reality as defined by the above criteria. The distribution of these firms by industry segment is provided in table 1.

All these companies were initially contacted by telephone when the purpose of the study was explained and they were asked for cooperation.

Table 1. Frequency distribution of CLFs by industry segment

Industry segment	Nr of films	%
Publishing	31	0.15
Music	24	0.12
Film	11	0.05
Audiovisual	56	0.27
Computer Graphics & Multimedia	57	0.28
Software	26	0.13
Advertising and Communication	**205**	**100%**

As a result 102 personal interviews with the company owners were secured[2]. Seven of these companies were randomly picked to conduct a pilot study. During this phase interview questions were initially open-ended and grew in detail over time, seeking to understand how firms scanned the environment for information, and the role of their networks in decision-making processes.

I also stimulated the informants to provide any kind of anecdotic evidences that might help flesh out their perception on the role and importance of the cluster environment for their business. These interviews reaffirmed the relevance of examining the link between external networks and performance outcomes in this setting. The final questionnaire was defined using the feedback from the pilot study.

Based on this protocol I then started gathering data on each of the remaining 95 firms who had expressed their willingness in being part of the research. However, because 6 of them turned out to be ineligible to participate in the study, my final sample reduced to 89 firms[3]. The complete list of these companies is provided in appendix.

[2] Companies that refused to be involved in the study seemed randomly mixed between those not interested in the research and those without time to devote to the interview.

On average, firms in the sample were 8 years old, with annual turnover lower than Euro 300.000 and less than 10 employees (key statistics provided in figures 3-5). These demographics, which show the predominance of small and micro enterprises, are consistent with other surveys that were carried out in the area.

Based on GIS geo-referencing, the topographic localization of these firms within the Bologna cluster is provided in figure 6.

An outline of questions, statement of research purpose, and assurance of confidentiality together with a copy of a research report on the local

Figure 3. Frequency distribution of sampled firms by industry segment

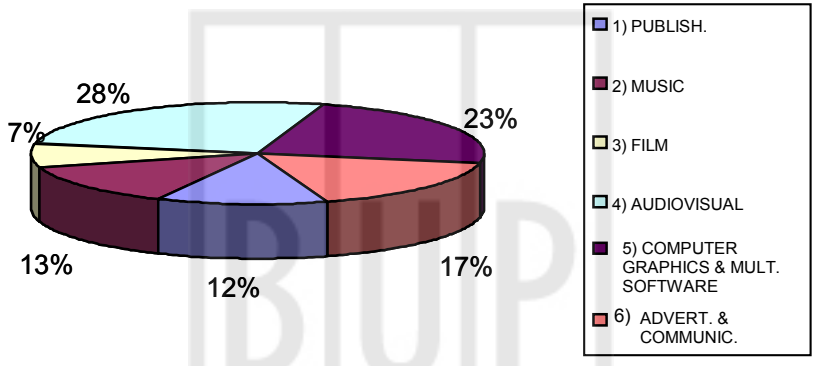
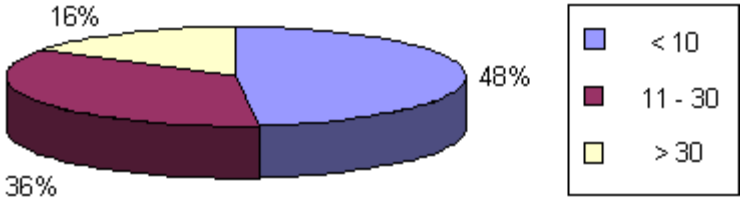


Figure 4. Frequency distribution of firms by nr of employees



[3] The six excluded firms had been founded later than 1999. They were considered ineligible since they couldn't provide retrospective network data for 1999, the starting data point of the study.

Figure 5. Frequency distribution of firms by market sales (brackets)

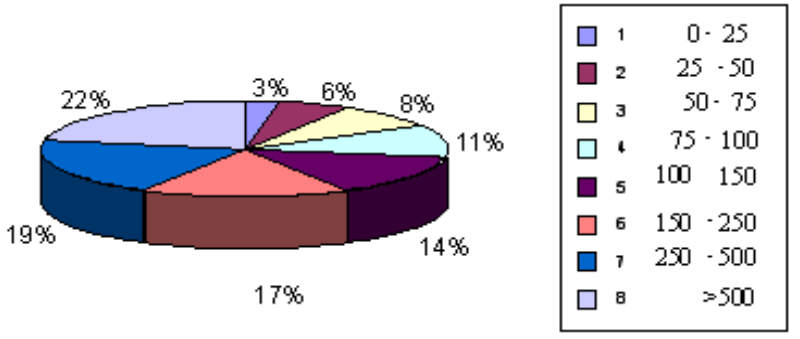
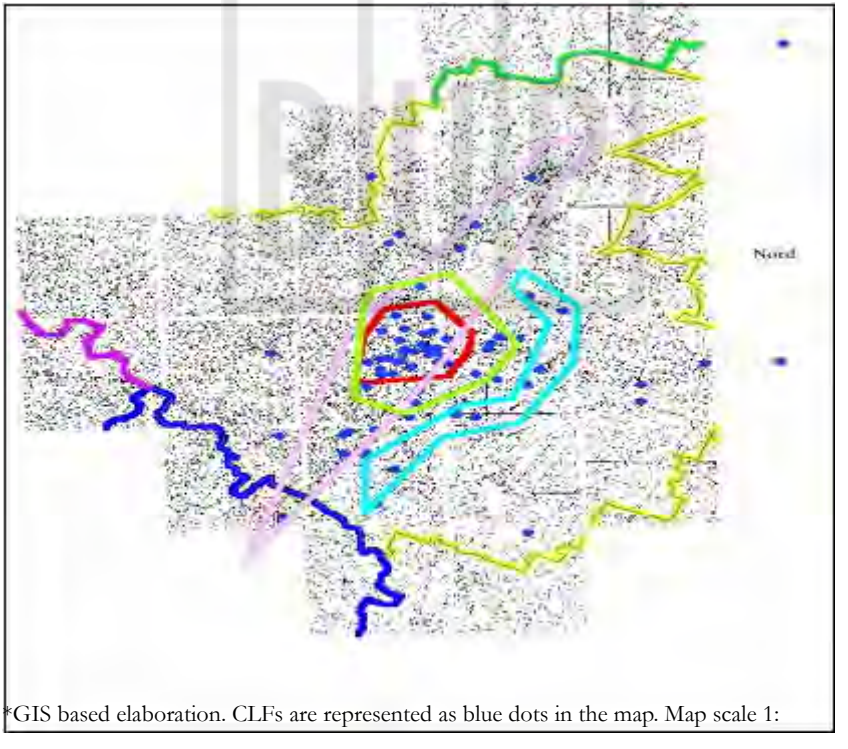


*Figure 6. The Bologna Multimedia Cluster: a topographic illustration**



*GIS based elaboration. CLFs are represented as blue dots in the map. Map scale 1:

industry formerly written by one of the authors were mailed prior to every personal interview.These measures helped guarantee the entrepreneurs' long-term commitment to the study.

Structured face to face interviews were conducted for each company over the first 4 months of 2002. A second round of shorter, follow-up telephone interviews was conducted at the beginning of 2003, for an overall total of 174 interviews[4], with an average duration of about 2 hours per (face to face) interview (full questionnaire provided in appendix). In all of the cases the respondent was the founder (or one of the co-founders) of the firm. In this regard, it is important to stress the fact that my theoretical and empirical framing focuses on small and micro organizations that are by and large owner-managed. In such contexts, as it has already been pointed out elsewhere (Cooper et al., 1993; Ostgaard and Birley, 1996; McEvily e Zaheer, 1999), the founder is usually the key repository of the strategic, organizational and relational memory of the company; while its social network represent a resource the entrepreneur heavily draws upon to influence the firm development (Starr e MacMillan, 1990; Larson e Starr, 1993). Consequently he represents an ideal source of organizational level information for the researcher. As Cooper and colleagues note (1993): "… the outcome cannot be understood without explicit attention to the role of the founder. He or she is most often solely responsible for identifying ranges of alternatives, determining actions, carrying out these activities".

Each interview was divided into five sections. Sections *a-d* included structured and semi-structured questions about the firm history, products, and performance as well as the background of the entrepreneurs in term of education and previous professional experience. In section *e* the informant was required to provide the relational data to be used for creating network measures and matrixes. I had two objectives in mind when I designed this section: first I wanted the informants to provide an extensive map of the multirelational web of interorganizational ties contributing to the CLFs inflow of information; second I wanted to track the evolution of

[4] Four companies contributed only one interview having ceased their activity after the second half of 2002.

these networks over time. Tracking the network evolution was a critical condition if any conclusion as to the causal link between the CLFs' network structure and their performance, was to be drawn.

A wide array of economic actors may contribute to the CLFs' inflow of information, actors as diverse as customers, suppliers, allies, and so on, all represent potential sources from which CLFs may tap the flow of information and knowledge that circulates throughout the cluster environment (Porter, 1998, 2000). In order to approximate this vibrant relational space without loosing in analytical focus I decided to concentrate on four kinds of actors: Customers, suppliers, partners and social contacts. Correspondingly, I identified three network types, which I labeled as follow: Transaction network, Collaboration network, and Advice network. The first network captures the CLFs' buyer-supplier relationships; the second represents the interfirm collaboration linkages, while the advice network encompasses the informal ties established by the informant with members of other CLFs. I focused on these networks for two reasons:

First, their importance in enabling information and knowledge access is well established in the literature. Yili-Renko et al. (2001), for instance, based on the analysis of a sample of tech-based small firms illustrate the critical role of network ties in enabling the acquisition of knowledge from key customers. The transfer of strategic information was a salient feature of the relation between the Japanese automobile producers studied by Cusumano (1985) and their US suppliers. Likewise, the exchange of valuable information between Toyota and its Japanese suppliers has proved critical in fostering Toyota's competitive growth (Dyer and Nobeoka, 2000). The transmission of information is portrayed as a driving force of the collaborative patterns widely investigated by Gulati (1995, 1999) and Gulati and Gargiulo (1999). In a similar vein, McEvily and Zaheer's (1999) research highlights the role of small firms' advice networks in providing access to heterogeneous niches of information, which in turn may help sustain the development of competitive capabilities.

Second, while there is obviously a plethora of formal and informal ties that contribute to the structuration of the CLFs' interorganizational field, focusing on a critical subset of these ties may help maintain clarity and provide momentum in the empirical development of the conceptual arguments.

Each informant was thus presented with four relational questionnaires, matching the network types described above. For each relational question respondents were provided with a list of all the other 204 CLFs included in my cluster population list. In response to the list (with the same list reported four times, one for each relational question), I asked them to put a check by all the alters whom they recognized as their contacts in the specified kind of relation. In essence, the respondents had to indicate those companies that they identified either as their transaction partners (buyers – suppliers), or as their collaborators, or, finally, companies whose members they recognized as individuals on whom they usually relied for valuable advice and information[5].

The interviewees were required to indicate the relational activity of their company as of 1999, 2000 and 2001 (see appendix 1 for an overview of sociometric questions). The process resulted in a 3-year multirelational dataset for the 89 sampled firms. These data were then converted into 3 sociomatrices (3 adjacency matrices - representing the three types of relationships between the firms - for each of the 3 years, totaling 9 sociomatrices over the full period), which were used for the computation of network and non-network measures (see the operationalization section for details on the creation and manipulation of sociomatrices). The 3 matrices can be viewed as layers in a three dimensional space matrix of size 89x204x3, or, in Wasserman and Faust's terminology, as constituents of a super-sociomatrix.

[5] The questionnaires were also integrated by a *free recall area* (Wasserman and Faust, 1994), in which respondents had the possibility to add other company names that had not been included in the list. These data, which I did not include in the analysis, allowed me to assess the degree of CLFs' internal vs external relationality. External relationality accounted for about 30% of the total relationality of the sampled firms, suggesting that most of the CLFs' network activity was taking place within the boundaries defined by our population list.

3.3 Operationalization and Measures

3.3.1 Dependent Variables

Growth: Many different variables have been proposed to capture small firm's growth. Delmar (1997) and Ardishvili et al. (1998), based on an extensive review of the literature, provided a nearly identical list of suitable measures of firm growth: assets, employment, market share, physical output, profit and sales. For a series of reason I chose to focus on two of the above variables: sales growth and employment growth. First of all, these variables represent the most widely used measures in empirical research on growth (Delmar, 1997). Second, these indicators are the only ones available in the present study for all of the firms of interest. Third other indicators have limits that constraint their suitability beyond certain specific contexts (Delmar et al., 2003). For example, such measures as market share and physical output can only be compared within industries for firms with a similar product range. An indicator such as total asset value is markedly related to the capital intensity of the industry and sensitive to changes over time. Furthermore, while profits are an important indicator of success, the relationship of profits to size is only evident in aggregates of firms or over long periods for individual firms, and it is especially ambiguous in the case of small firms (Van de Ven et al., 1984).

The adoption of sales as a measure of growth provides several advantages (Ardishvili et al., 1998), as pointed out by Delmar et al. (2002) sales is a relatively easily accessible indicator, it applies to almost all sorts of firms, and it is relatively insensitive to capital intensity and degree of integration. Finally sales are a highly suitable indicator across different conceptualizations of the firm (Davidsson and Wiklund, 2000), and are also the indicator favored by entrepreneurs themselves (Barkham et al., 1996). On the other hand employment growth has also proved to be an extremely reliable indicator of firm growth both in theoretical and empirical terms. For example, the value of employment based measures of growth is particularly well suited to the current popular conceptualization of firms as bundles of knowledge-based resources (Kogut and Zander, 1992; Grant, 1996). In addition, employment and occupational concerns make this variable especially attractive and relevant in relation to socio-economical issues, that is partly the reason why it is so common to come across research focusing solely on this indicator (Delmar, 1997).

Based on the above arguments I indexed growth in two ways:

I used the reported number of employees at time t +1 ($EMPLO_{t+1}$) to compute a measure of year by year absolute growth.

I used the reported market sales at time t +1 ($SALES_{t+1}$) to compute an ordered class dependent variable ranging from 1 to 8, based on a eight point scale of increasing market sales brackets, which I had defined during the pilot study.

Such codification strategy was necessary due to the fact that most of the companies in this study were privately held, and did not disclose financial information to the public; thus only self-reported data were available. The respondents were requested to provide their growth indicators with respect to each of the two items for each of the years of observation. Brackets were used because of a possible reluctance to reveal precise financial data. The convenience of categorical options may also have increased the questionnaire completion rate.

3.3.2 Independent Variables

Network variables: My approach to operationalize the network variables was driven by two basic concerns: First, being information the key element of my relational conceptualization of CLFs performance, I was interested in developing network measures capable to capture the extent of information accrued by firms via their position in the cluster network.

Second, I wanted these measures to reflect the multirelational nature of CLFs embeddedness, that is to account for the fact that CLFs are embedded in a number of different relationships, that may all simultaneously contribute to the informational inflow and knowledge exposure of these organizations. Operationally speaking this required identifying two adequate measures for the two original constructs introduced together with the hypotheses: overall network centrality and overall network range. In a way akin to Koka and Prescott's (2002) strategy for operationalizing social capital, I addressed these issues by developing and testing a multi-measure model for the two relational variables. Besides reducing the overall effect of measurement error of any individual observed variable on the accuracy of results, this method allowed me to approach the two network variables of theoretical interest as latent constructs with simultaneous manifestations on multiple networks.

We developed this operationalization strategy in two steps: As a first step I identified a series of indicators to operationalize CLFs' centrality and range as first order latent constructs in each of the three networks of interest; As a second step, I postulated the resulting six constructs (one centrality factor and one range factor for each of the three networks) to be indicators of two higher order factors, representing the overall centrality and range of the CLFs[6].

We tested the empirical saliency of the resulting measurement models, which are graphically illustrated in figure 4, as a hierarchical confirmatory factor analysis (CFA) using structural equation modeling[7].

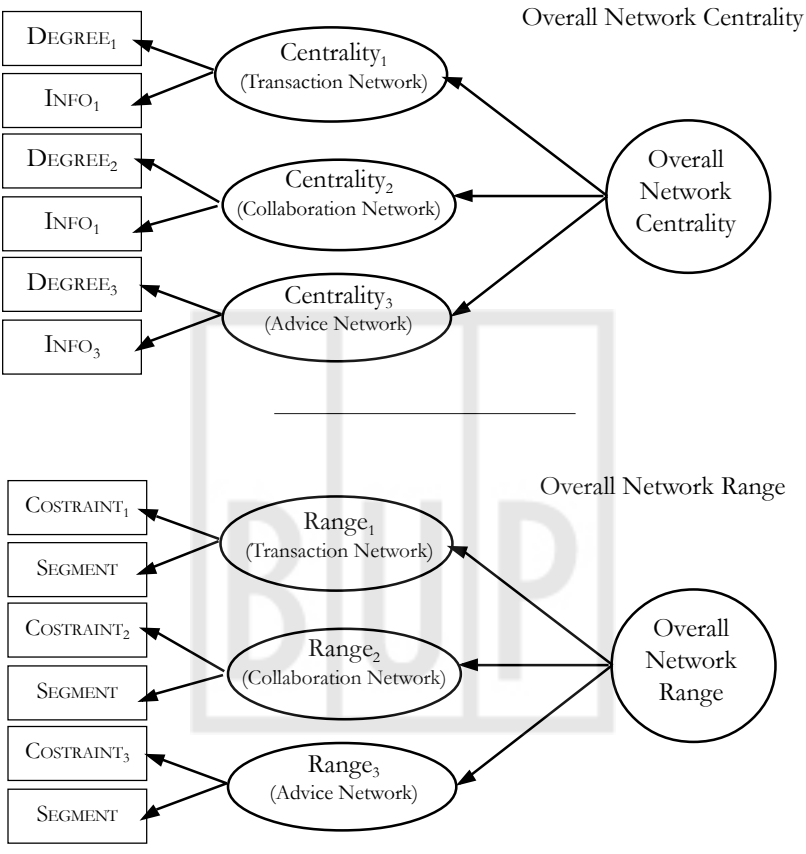
As figure 7 shows, there are 6 first order latent constructs encapsulated within two different measurement models, representing the two distinct network based informational features associated to CLFs multirelational networks. The upper measurement model includes as first order factors: *Transaction Network Centrality*, *Cooperation Network Centrality*, *and Advice Network Centrality*. The intercorrelations among these factors are accounted for by the second order construct: *Overall Network Centrality*. *Transaction Network Range, Cooperation Network Range and Advice Network Range* are part of the lower model; where *Overall Network Range* is the common, higher level cause.

Multiple indicators, calculated across each of the three network types, were used in order to operationalize the model:

[6] The choice of this approach rested on the conjecture that network properties of small and micro companies like the ones that are the object of this research, may be conceived as manifestations of an inherent 'relational propensity' of the organization. Thus, whilst firms establish and discard linkages across different network types, they make choices that are not perfectly independent. Instead they tend to be driven by an underlying relational behavior that is organization-specific and that generates commonalities across network fields. I believe that this specificity stems from the high degree of overlap that exists in small organizations between firm and owner behavior, where the art of interweaving ties and linkages is profoundly shaped by the owner-manager's relational skills and attitude.

[7] Through its flexible interplay between theory and data structural equation modeling approach bridges theoretic and empirical knowledge for a better understanding of the phenomenon at work. Such analysis allows for modeling based on both latent and manifest variables. Furthermore structural equation modeling takes into account errors in measurement and variables with multiple indicators.

Figure 7. Centrality and Range as second order latent factors in a multirelational space



Centrality: there are several approaches to scrutinizing the centrality of firms in networks that are used to examine the extent of information available to actors (Freeman, 1979). The most intuitive and popular measure is probably the Freeman's '*degree centrality'* ($DEGREE_{1\text{-}3}$): The actor with the most ties is the most central. As Freeman (1979) argued, degree centrality is the most suitable centrality measure for capturing an individual actor's information or knowledge access.

Freeman's degree centrality is given by:

$$CD(p_k) = \sum_{i=1}^{n} \alpha\,(p_i, p_k)$$

Where n = number of points; $a(p_i,p_k)=1$ if and only if p_i and p_k are connected by a line, 0 otherwise.

Degree centrality alone, however, may be deceiving. It is quite likely that information can flow through paths other than the geodesic. Stephenson and Zelen's (1989) '*information centrality*' score ($INFO_{1-3}$) uses all paths in the network, and weights them based on their length. Actor information centrality is a hybrid measure which relates to both path-length indices (e.g., closeness, graph centrality) and to walk-based eigenmeasures (e.g., eigenvector centrality, Bonacich power). In particular, the information centrality of a given actor can be understood to be the harmonic average of the ``bandwidth" for all paths originating with said individual (where the bandwidth is taken to be inversely related to path length).

Formally, the index is constructed as follows. First, we take *G* to be an undirected graph – symmetrizing if necessary – with adjacency matrix *A*. From this, we remove all isolates (whose information centralities are zero in any event) and proceed to create the weighted connection matrix

$$C = B\text{^-}1$$

where *B* is a pseudo-adjacency matrix formed by replacing the diagonal of *1-A* with one plus each actor's degree. Given the above, let *T* be the trace of *C* with sum *S_T*, and let *S_R* be an arbitrary row sum (all rows of *C* have the same sum). The information centrality scores are then equal to

$$C\_I = (T + (S\_T\text{-}2S\_R)/ |V(G)|)\text{^-}1$$

(recalling that the scores for any omitted vertices are 0).

We computed these two indices using the sociomatrices originated from the four relational questionnaires, following the convention that if firm *i* reported *j* as a contact (customer, supplier, collaborator or social contact) then element in *row i* and *column j* was set to 1 (and to 0 otherwise). If the answers of all firms had been consistent the supply matrix would equal the transpose of the purchase matrix, and both the collaborative and the advice

ties matrices should be symmetrical. In the first case, if firm *i* reports *j* as a customer, then *j* should report *i* as a supplier (both the elements *ij* of the supply matrix and *ji* of the purchase matrix should equal 1). In the second case, if collaboration between *i* and *j* is reported by *i* then also *j* should report it (both elements *ij* and *ji* of the collaboration matrix should equal 1); the same holds for the adjacency matrix of social ties. This however was not always the case, likely a consequence of the fact that firms did not recall and report all their ties[8].

For all networks, I considered a tie to be present if it was reported by at least one of the connected firms. I also joined supply and purchase ties in one non-directed transaction network, which disregards the distinction between buyer and seller and records only the existence of a generic transaction tie between two firms. This resulted in the three (non-directed) networks introduced above: *Transaction* network, *Collaboration* network and *Advice* network. The adjacency matrix for the *Transaction* network was built by setting both elements *ij* and *ji*, to 1 if either *i* or *j* reported the other as a customer or supplier. The adjacency matrices for the *Collaboration* and *Advice* networks were obtained by symmetrizing the corresponding raw matrices; both elements *ij* and *ji* were set to 1 if one of them equaled 1 in the raw non symmetrized matrix, that is if the collaboration or advice tie was reported by at least one of the two firms involved.

For each of the three matrices the two indices were assessed using UCINET 6 (Borgatti, Everett and Freeman, 2002).

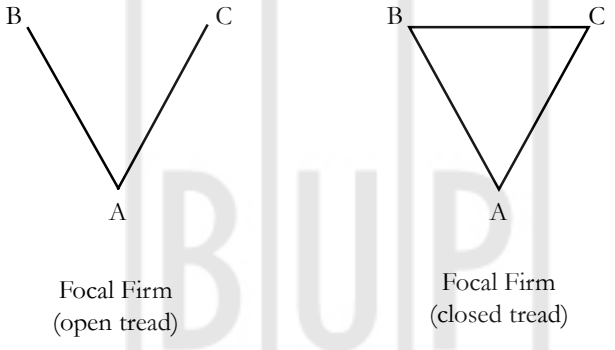
Range: As Marsden suggests, there are essentially two approaches for measuring network range: One focuses on network density - with less dense networks having higher range, by Granovetter's argument (1973); the other looks at characteristics of alter units. Consistent with this argument I computed two indices. The first is the *Burt's constraint index* (1992), which

[8] This could be a consequence of distance in time; ties that were in place only in the first observed year can be expected to be more difficult to recall for all firms. Besides this, the same tie can be more important for one firm than for the other, and by consequence the first firm is more likely to recall and report about the tie. Also, recalling any single tie is more difficult in a firm that is tied to many others than for a less connected firm. Whatever the case, it is however notable that the reciprocation rate was quite high, being close to 76%.

measures the degree to which a CLF's contacts are themselves connected to one another ($CONSTRAINT_{1-3}$).

The constraint index is based upon an evaluation of the focal actor's proportional investment of time and energy (expressed as the proportion of ties) in each contact and the degree to which that contact can be reached through other contacts of the focal actor. Thus, in the closed triad of Figure 8 (p. 53), the focal firm A can reach B directly, and indirectly through firm C. A is highly constrained; there is no structural hole for A to exploit. However, in the open triad, A's investment in the tie to B is not made redundant by a tie between B and C. A has low constraint and can use the structural hole to her advantage.

Figure 8. Open vs Closed Triads



Essentially, the constraint index is calculated by summing the dyadic constraints for the focal actor with each person in the network and squaring the total.

Constraint varies from 0 (no constraint) to 1 (complete constraint). In other words, low values of this index indicate that focal firm's contacts are not connected to each other, whereas high values reflect higher redundancy, and thus lower range.

I calculated Burt's index using UCINET 6.

My second measure of network range is based on *Blau's index of heterogeneity (1977)*, where diversity was considered in terms of the industry segments of CLFs' contacts ($SEGMENT_{1-3}$). Because companies operating

in different multimedia segments have seemingly access to different market niches and technologies, they are sources of diverse information. To compute the index firms were classified according to the six segments already indicated on table 1. The measure was then computed for each CLF in each year, as follows.

For firm i in year t, denote the number of ties with alters in segment j as $n_{it,j}$ and the total number of ties aggregated over all segment types (j = 1…J, J = 6) as n_{it}. The proportion of firm i's ties of type j, out of the total number of ties, is denoted $p_{it,j}$ and given by $p_{it,j} = n_{it,j} / n_{it}$. Each $p_{it,j}$ is squared and then the sum is taken over all j and subtracted from 1, resulting in the Burt's index of heterogeneity y_{it}, so that:

$$y_{it} = 1 - \sum p^2_{it,j}$$

Heterogeneity can then be treated as a continuous random variable, though bounded in the interval [0, 5/6].

This kind of approach for assessing network diversity is not uncommon among organizational networks theorists (see for example Powell et al., 1996, Gulati, 1999; Ahuja, 2000; Koka and Prescott, 2002). The two measures were computed over the three networks.

Using these indicators[9] I estimated the measurement model year-wise, for the three-year period 1999-2001. The analysis was conducted using Proc Calis in SAS.

I started the model assessment by checking the validity of the first order structural model. *Convergent validity* - whether a set of indicators is representative of the domain they're supposed to measure - was assessed by examining whether each indicator's estimated loading on its posited underlying factor was large. Kline (1998) suggests that factor loading should be statistically significant and shared variance should be not trivial. Values reported on tables 2-3 indicate that these criteria were met.

Discriminant validity - whether a construct differs from others - was assessed by constraining the correlation parameter between the factors at 1.0 and employing a chi-square difference test on chi-square values from the constrained and unconstrained models. Because the constrained version

[9] All the variables were log transformed in the analysis to alleviate skewness.

Table 2. Factor loadings and composite reliability of first order centrality factors

First Order Factor	Measurem. Item	Factor loadings (t statistics in parenthesi)			Average CRI†
		1999	2000	2001	
$Centrality_3$ (Advice Network)	$Degree_3$	1.00	1.00	1.00	0.87
	$Info_3$	0.897*** (10.75)	1041*** (12.59)	0.906*** (10.51)	
$Centrality_1$ (Transaction Network)	$Degree_1$	1.00	1.00	1.00	0.91
	$Info_1$	1.026*** (8.50)	1.230*** (9.34)	1.123*** (8.443)	
$Centrality_2$ (Collaboration Network)	$Degree_2$	1.00	1.00	1.00	0.95
	$Info_2$	0.986*** (16.91)	1.068*** (14.6079)	0.958*** (14.02)	

***p<0.001, **p<0.01, *p<0.05

† Composite reliability index calculated over the three-year period. This index is analogous to coefficient alpha and reflects the internal consistency of the indicators measuring a given factor

of the model is nested within the unconstrained one, the discriminant validity is achieved when the χ^2 difference statistic is significant (i.e. the unconstrained model has a significantly lower chi-square value), indicating that the multiple first order factors are not redundant (Kline, 1998). As reported on tables 4-5, discriminant validity was consistently achieved over the three-year period across each of the three models.

After assessing the validity of the first order measurement model I moved to the hierarchical specification. Results are reported in tables 6-7.

Parameter estimates and goodness of fit statistics were computed for each of the three years. Consistency of results over this time span provides strong evidence for reliability. The fit of the model was assessed with multiple indicators: the χ^2 statistic test provides a test of the null hypothesis that the

Table 3. Factor loadings and composite reliability of first order range factors

First Order Factor	Measurem. Item	Factor loadings (t statistics in			Average CRI†
		1999	2000	2001	
$Range_3$ (Advice Network)	$SEGMENTDIV_3$	1.00	1.00	1.00	0.55
	$COSTRAINT_3$	0.891*** (4.61)	1.294*** (3.63)	1.257*** (3.44)	
$Ranger_1$ (Transaction Network)	$SEGMENTDIV_1$	1.00	1.00	1.00	0.55
	$COSTRAINT_1$	0.758*** (3.99)	0.823*** (3.03)	0.866*** (2.80)	
$Range_2$ (Collaboration Network)	$SEGMENTDIV_2$	1.00	1.00	1.00	0.80
	$COSTRAINT_2$	0.635*** (3.63)	0.974** (3.66)	0.834*** (3.66)	

***p<0.001, **p<0.01, *p<0.05

model fits the data. If the model provides a good fit, the χ^2 will be relatively small and the corresponding p value non significant (p>.05), indicating that the model does not differ significantly from the data. The Goodness of Fit Index (GFI) is more standardized and less sensitive to sample size (Joreskog and Sorbom, 1996). Its value ranges from o (poor fit) to 1 (perfect fit) and indicates the relative amount of variance and covariance jointly explained by the model. A GFI greater than 0.9 is usually considered an indication of acceptable fit. Bentler and Bonnet's (1980) Normed Fit Index (NFI) has been proposed as an alternative to the χ^2 test. This index indicates the proportion in the improvement of the overall fit of the postulated model relative to a null model (that is one in which the observed variables are assumed to be uncorrelated.

The values on this index may range from 0 to 1, with values over 0.9 indicating an adequate fit of the model to the data. The Comparative Fit Index (CFI) is interpreted in the same way as the NFI (i.e., it is an incremental

Table 4. Discriminant validity tests of first order centrality factors

Year	First order latent variables	Degrees of freedom	χ^2	$\Delta\chi^2$
1999	All ϕs left free	6	*9.298*	0
	ϕ12 fixed to 1 (Centrality3 and Centrality1)	7	18.15	8.852**
	ϕ13 fixed to 1 (Centrality3 and Centrality2)	7	14.46	5.162*
	ϕ23 fixed to 1 (Centrality1 and Centrality2)	7	16.8	7.502
	All ϕs fixed to 1	9	18.53	9.232**
2000	All ϕs left free	6	11.92	0
	ϕ12 fixed to 1 (Centrality3 and Centrality1)	7	22.38	10.46**
	ϕ13 fixed to 1 (Centrality3 and Centrality2)	7	19.69	7.77*
	ϕ23 fixed to 1 (Centrality1 and Centrality2)	7	24.06	12.14**
	All ϕs fixed to 1	9	24.39	12.47**
2001	All ϕs left free	6	9.37	0
	ϕ12 fixed to 1 (Centrality3 and Centrality1)	7	18.41	9.04**
	ϕ13 fixed to 1 (Centrality3 and Centrality2)	7	15.33	5.96*
	ϕ23 fixed to 1 (Centrality1 and Centrality2)	7	17.95	8.58**
	All ϕs fixed to 1	9	19.09	9.72**

***p<0.001, **p<0.01, *p<0.05

fit index) but it provides an assessment of fit regardless of sample size (Bentler's Comparative Fit Index, 1990).

The Standardized Root Mean Squared Residual is a standardized summary of the average covariance residuals. A favorable value of the SRMR is less than 0.1 (Kline, 1998).

Table 5. Discriminant validity tests of first order range factors

Year	First order latent variables	Degrees of freedom	χ^2	$\Delta\chi^2$
1999	All ϕs left free	6	*5.78*	0
	ϕ12 fixed to 1 (Range3 and Range1)	7	15.70	9.92**
	ϕ13 fixed to 1 (Range3 and Range2)	7	18.03	12.25***
	ϕ23 fixed to 1 (Range1 and Range2)	7	20.28	14.5***
	All ϕs fixed to 1	9	21.25	15.47***
2000	All ϕs left free	6	*3.27*	0
	ϕ12 fixed to 1 (Range3 and Range1)	7	18.17	14.9***
	ϕ13 fixed to 1 (Range3 and Range2)	7	27.4	24.13***
	ϕ23 fixed to 1 (Range1 and Range2)	7	24.7	21.43***
	All ϕs fixed to 1	9	29.96	26.69***
2001	All ϕs left free	6	2.9	0
	ϕ12 fixed to 1 (Range3 and Range1)	7	19.5	19***
	ϕ13 fixed to 1 (Range3 and Range2)	7	21.9	5.96*
	ϕ23 fixed to 1 (Range1 and Range2)	7	24.2	21.3***
	All ϕs fixed to 1	9	27.49	24.59***

***p<0.001, **p<0.01, *p<0.05

As showed in the last column of the tables, all the relevant statistics are in an acceptable range, indicating that the overall fit of the hierarchical CFA model is satisfactory (Kline, 1998).

Table 6. Hierarchical model 1: Overall Network Centrality

Year	Path (2nd order factor --> 1st order factor)	Parameter Estimate	t Value	Composite Reliability	Fit Indices
1999	Overall Network Centrality –> $Centrality_3$	0.77***	7.71	0.85	χ^2=9.29 *(p=0.157)* GFI=0.97 CFI=0.99 NFI=0.98 RMR=0.013
	Overall Network Centrality –> $Centrality_1$	0.68***	6.56		
	Overall Network Centrality –> $Centrality_2$	0.83***	8.36		
2000	Overall Network Centrality –> $Centrality_3$	0.82***	8.69	0.88	χ^2=11.92 *(p=0.063)* GFI=0.95 CFI=0.98 NFI=0.97 RMR=0.02
	Overall Network Centrality –> $Centrality_1$	0.65***	6.40		
	Overall Network Centrality –> $Centrality_2$	0.75***	7.7		
2001	Overall Network Centrality –> $Centrality_3$	0.77***	7.73	0.85	χ^2=9.37 *(p=0.153)* GFI=0.96 CFI=0.99 NFI=0.97 RMR=0.01
	Overall Network Centrality –> $Centrality_1$	0.67***	6.4		
	Overall Network Centrality –> $Centrality_2$	0.79***	7.93		

***p<0.001, **p<0.01, *p<0.05

Turning to the path coefficients, it is notable that the vast majority of second order paths are statistically significant at $p < 0.001$, an indication of convergent validity (Bollen, 1989).

Finally, the proportion of variance in the first order factors, which is accounted for by the higher order construct can be used to assess the reliability of the latent factors. As illustrated in the penultimate column of each table, the composite reliability ranges consistently from 0.66 to 0.88 over the three-year period, suggesting adequate reliability.

Table 7. Hierarchical model 2: Overall Network Range

Year	Path (2nd order factor --> 1st order factor)	Parameter Estimate	t Value	Composite Reliability	Fit Indices
1999	Overall Network Range –> $Range_3$	0.74***	6.15	0.87	χ^2=5.78 *(p=0.12)* GFI=0.98 CFI=0.98 NFI=0.96 RMR=0.04
	Overall Network Range –> $Range_1$	0.66***	5.82		
	Overall Network Range –> $Range_2$	0.59***	5.26		
2000	Overall Network Range –> $Range_3$	0.58***	3.97	0.86	χ^2=3.27 *(p=0.35)* GFI=0.99 CFI=0.99 NFI=0.98 RMR=0.03
	Overall Network Range –> $Range_1$	0.62***	4.64		
	Overall Network Range –> $Range_2$	0.40***	3.33		
2001	Overall Network Range –> $Range_3$	0.61***	3.99	0.84	χ^2=2.09 *(p=0.55)* GFI=0.99 CFI=1 NFI=0.99 RMR=0.03
	Overall Network Range –> $Range_1$	0.53***	4.18		
	Overall Network Range –> $Range_2$	0.47***	3.79		

***p<0.001, **p<0.01, *p<0.05

The satisfactory indications offered by factor loadings and fit indices, and the robustness of results over time increased my confidence that the model provided a suitable assessment of the two network constructs of theoretical interest: *Overall Network Centrality and Overall Network Range*. Using factor scores, I then obtained a single composite measure for each of these two constructs: $OVERCEN_t$ and $OVERRAN_t$. These two measures represent the variables of theoretical interest.

Absorptive capacity: A common approach in the literature for measuring absorptive capacity is to use the firm's intensity in R&D. Such a strategy,

however, was not pursuable in this context of study. In fact, only a minor proportion of companies had reported investments in research and development, and even in these cases the quote was typically trivial. This was not surprising, though. Previous research in the field (Grimaldi and Munari, 2001) indicates that the innovation activity of these companies is based more on the identification and exploitation of new market opportunities (demand pull) rather than on the development of new technology by means of investment in R&D (technology push). Research on small multimedia firms in the San Francisco Gulch also suggest that the drivers of competitive advantage of these type of companies are typically to be found in their ability to create and assemble content in innovative ways rather than developing technology (Egan and Saxenian, 1999)[10].

Given these specificities I had to choose a different route to operationalize the construct. I decided to focus on the characteristics of the owner-managers, following Cohen and Levinthal's idea that the absorptive capacity of an organization will depend on the absorptive capacity of its members. In fact, I believe that the plausibility of this assumption is enhanced in a context of micro and small organizations, where the behavior of the firm is widely reflected in the choices and decisions of the owner-manager.

Cohen and Levinthal suggest two ideas to assess the richness of the pre-existing knowledge structure of the organization: One is the idea of having prior related knowledge, in fact because learning is cumulative, absorption performance is greatest when the object of learning is related to what is already known. The second is the idea of knowledge diversity, in fact because in uncertain environments new useful information my stem from various different sources, an heterogeneous knowledge base provides a more robust basis for absorption: "because it increase the prospects that incoming information will relate to what is already known" (p. 131). Further, interaction of people having different background will augment the organizational capacity for making associations and novel link (enhanced problem solving).

[10] "In a production system increasingly composed of standard hardware and software elements, the distinguishing characteristic of multimedia products becomes their content: the degree to which they harness the power of interactive multimedia in creative and appealing ways" (Egan e Saxenian, 1999 p.18).

In order to capture these two complementary sources of absorptive capacity I introduced two measures: PRIOR is a dummy variable indicating whether or not at least one of the owner-managers (in case of multiple founding members) had already developed prior professional experience in the current field of specialization of the company. In order to extrapolate this information I used the respondents' answers to the following question: "Would you consider the field of specialization of your company consistent with the professional experience you have been acquiring during your career?" KNOWHET is a measure of internal knowledge diversity based on both the educational background of the founding members and their professional experience. I created this variable by computing two Blau's indices of heterogeneity for each of the two knowledge domains and by taking their arithmetic average[11].

3.3.3 Control variables

A wide variety of industry, organizational, as well as individual level variables have been illustrated to affect the likelihood of firm growth. The aim of this research, however, was not to corroborate the validity of predictors that had already been amply tested and established by previous studies. Instead, what I was really interested in was to explore the effects of network characteristics and absorptive capacity on CLFs' growth, controlling for plausible sources of spuriousness. One powerful class of multivariate analysis techniques for longitudinal data, that help reconciling the complexity of accounting for a large number of controls with the necessity to minimize the possibility of confounding effects, are the so called fixed-effects estimation methods. Indeed, the major attraction of fixed-effects methods in nonexperimental research is the ability to control *for all unobserved and unknown stable characteristics in the study*, thereby eliminating large sources of bias.

Although fixed-effects methods cannot provide coefficient estimates of time-invariant factors, they do consent to control for them, in fact the

[11] Founders' educational background was classified within three types, based on the orientation of their formal training: art, business, science/technology or humanities. In a similar way, founders were differently grouped according to their previous field of specialization. I used Blau's formula (see page 47 for details on the construction of this measure) with these two sets of categories for computing KNOWHET.

control is likely to be much more effective than in conventional regression (Allison, 1999). Furthermore, while stable covariates cannot be estimated their interaction with variables that do change over time can (see 'Model Estimation' section for a broader discussion of these topics).

Based on these considerations, only a limited set of time-variant controls were included in the analysis[12]:

Lagged growth 1 ($EMPLO_t$) - Inclusion of the previous year measure of growth helps account for the possibility of any specification bias due to unobserved heterogeneity. In particular, controlling for lagged growth should mitigate spurious effects due to endogeneity.

Lagged growth 2 ($SALES_t$) – Current growth rate on one of the two dependent constructs may also depend on lagged value of the other dimension. Consequently, in addition to the lagged value of the dependent variable I introduced a lagged control for the other dependent variable in each of the equations.

Time (YEAR) – I included a dummy variable for each year in order to capture any effects of temporal trends related to contemporaneous economic and environmental conditions that may have influenced the availability of growth opportunities within the cluster.

Age (AGE) – I also controlled for firms age (measured as the number of years since founding) in order to avoid the possibility that any significant effects of the theorized variables were simply a spurious outcome of aging related differences.

3.4 Model Estimation

The data set consists of three year of cross sectional records. Given the different nature of the dependent variables, in order to test the proposed hypotheses I estimated two different longitudinal models: a cumulative longitudinal model, to estimate variations in the ordered categorical dependent variable, and a fixed effect negative binomial to treat the discrete, count nature of the employees-based dependent variable.

[12] Drawing on past research, I also run separate random-effects analyses with a wider set of individual and firm specific time-invariant variables. Findings were generally consistent with this literature. These results are available from the authors upon request.

The selection of these techniques reflects two prominent statistical issues, namely unobserved heterogeneity and autocorrelation. Unobserved heterogeneity arises from the possibility that observationally equivalent firms may differ due to unmeasured characteristics that may affect both independent and dependent variables.

To eliminate any spurious effect due to unobserved differences among firms I included in the model a fixed effect term; estimated coefficients are then interpretable as the amount by which the within-firm deviation on the dependent variable shifts in response to a preceding change in the deviations of the covariates. Furthermore, by introducing firm specific effect I correct for autocorrelation by permitting observations of the same firm to be correlated across periods and thus by building serial correlation directly into the model.

As anticipated above, the different nature of the dependent variables required different model specifications. A fixed effect negative binomial was used to estimate the probability of firm growth when using the employees-based dependent variable. The negative binomial is a generalization of the Poisson model that is specially suited to cope with the overdispersion problem. The danger with overdispersion is that the standard errors may be underestimated, leading to *chi-squares* that are too large and *p-values* that are too low (Allison, 1999). While the estimation of a Poisson model requires an ad hoc correction of the standard errors and chi-squares based on the goodness-of-fit ratios, the negative binomial directly builds in the overdispersion term, allowing a more appropriate treatment of the problem (Allison, 1999).

Negative binomial regression models can be formulated in different ways, the model used here is what Cameron and Trivedi (1998) call an NB2 model, where the probability function for y_{it} is given by

$$\Pr(y_{it} = r) = \frac{\Gamma(\theta + r)}{\Gamma(\theta)\Gamma(r+1)} \left(\frac{\lambda_{it}}{\lambda_{it} + \theta} \right)^{r} \left(\frac{\theta}{\lambda_{it} + \theta} \right)^{\theta}$$

In this equation λ_{it} is the expected value of y_{it}, θ is the overdispersion parameter, and $\Gamma(.)$ is the gamma function. As $\theta \to \infty$, this distribution converges to the Poisson distribution.

We then specify how the parameter depends on the explanatory variable by assuming a loglinear regression decomposition of the expected value,

$$\log \lambda_{it} = \alpha y_{it-1} + \mu_{t-1} + \beta x_{it-1} + \gamma z_i + \alpha_i$$

where α is a parameter that indicates how current growth depend on prior growth, x_{it-1} represents the time-varying vector of predictor variables at time t-1, z_i denotes the time-invariant predictors, and α_i denotes the un observed "fixed effects". Inclusion of the lagged dependent variable among the predictors helps account for the endogeneity problem already discussed.

The model was estimated on the pooled dataset with each firm contributing a time series panel. An observation for every firm was entered for every year for which data is available. For example if a firm has three years of data, then it would contribute 3 observations to the analysis. The estimation procedure was based on unconditional maximum likelihood. In fact, while Hausman, Hall and Griliches (1984) proposed a different fixed-effects negative binomial regression model deriving a conditional maximum likelihood estimator for that model, Allison and Waterman (2002) have shown that this is not a true fixed-effects regression model, and the method does not control for all stable covariates. The fixed effect unconditional negative binomial was computed using the GENMOD procedure available in SAS.

Because the second growth measure is an ordered categorical variable I estimated a fixed effect cumulative logit in order to predict the market sales growth to be expected in an interval of time. Cumulative logit models are a generalization of logit models specifically suited to handle ordered categories (Allison, 1999). The growth can then be modeled as follow:

$$\log\left(\frac{F_{ijt}}{1-F_{ijt}}\right) = \alpha y_{it-1} + \mu_{t-1j} + \beta x_{it-1} + \gamma z_i + \alpha_i \qquad j = 1,\ldots,J-1$$

where $F_{ijt} = \sum_{m=j}^{J} p_{imt}$

is the "cumulative" probability of being in category *j* or higher; μ_{t-1} is an intercept which is allowed to vary with time, z_i is a column vector of variables that describe the persons but do not vary over time; x_{it-1} is a column vector of lagged variables that vary both over individuals and over time for each individual and α_i represents all differences between persons that are

stable over time and not otherwise accounted for by γz_i. Finally, α is the parameter for the lagged dependent variable.

The model was estimated by using the GEE estimation available in SAS and robust standard errors to adjust for lack of independence in the repeated observations for each individual.

CHAPTER 4

RESULTS

The chapter is divided in two parts: in the first part I present basic descriptive statistics and a test for multicollinearity. I then turn to the assessment of the hypotheses by providing a series of panel model estimates. The interpretation of regression coefficients concludes the chapter.

4.1 COLLINEARITY

Table 8 presents descriptive statistics and multicollinearty check for the variables included in the analysis.

The problem with multicollinearity – which occurs when there are strong linear dependencies among explanatory variables – is that, if two or more variables are highly correlated with one another, it is hard to get good estimate of their distinct effects on some dependent variable. Although multicollinearity does not violate any assumptions and does not affect predictions, it does make the estimates of the regressions coefficients unreliable. Standard errors may get large and variables that appear to have weak effects, individually, may actually have quite strong effects as a group. A quite common way to proceed in order to asses the presence of this problem is to examine the bivariate correlation. While this is certainly a helpful means, it is not always sufficient. In fact, as explained by Allison (1999, p.48), "It's quite possible to have data in which no pair of variables has a high correlation, but several variables together may be highly interdependent". Much better diagnostics are produced by regressing each of the variables against all other explanatory variables and then by calculating a tolerance factor (together with the corresponding value of Variance Inflation, which is just the reciprocal of the tolearance), measured as the difference between R^2 and one. This can be easily accomplished in SAS, by means of the TOL option with PROC REG.

Table 8. Basic descriptive statistics and multicollinearity check

Variable	Mean	Std Dev	Minimum	Maximum	Variance Inflation	Tolerance
Overcen	0	0.97	- 3.08	1.86	2.90033	0.34479
Overange	0	0.94	-2.34	2..27	2.59706	0.38505
Prior	0.47	0.5	0	1	1.22668	0.81521
Knowhet	0.6	0.16	0	0.83	1.10212	0.90734
Year	2	0.82	1	3	1.05862	0.94462
Age	7.7	5.78	1	14	1.21055	0.82607
Sales	5.62	2.15	0	8	1.4814	0.67504
Emplo	8.41	11.55	0	70	1.18884	0.84116

While there is no formal cutoff value for determining presence of multicollinearity, statisticians sometimes suggest 0.4 as a threshold level below which starting to be concerned. As I had expected, I found OVERCEN and OVERRANG to be inflated, their tolerance levels being 0.34 and 0.38 respectively. Accordingly, the effects of these two variables were estimated separately in the models.

4.2 Estimate and interpretation of the coefficients

In table 9 and 10 I reported the results of regression analysis. Hypotheses were assessed sequentially, for each of the two models.

Model 1 (table 9) was estimated by using the number of employees as the dependent variable ($EMPLO_{t+1}$). There are three versions of this model: version I (model 1a) is the baseline model, version II (model 1b) and version III (model 1c) are variations of the full model, which were obtained by dropping the two variables of theoretical interest, one at time and by including the corresponding interaction terms.

Table 9. Model 1: Fixed-effect negative binomial estimate of (employees-based) CLFs growth

	1a		1b		1c	
	Coef.	**Std. Er.**	**Coef.**	**Std. Er.**	**Coef.**	**Std. Er.**
Intercept	1.295*	0.521	1.481*	0.608	0.865**	0.167
$YEAR_1$	0.080	0.051	0.080	0.057	-0.064	0.049
$YEAR_2$	-0.027	0.067	-0.026	0.060	0.025	0.060
$YEAR_3$ (reference cat)	0	0	0	0	0	0
AGE	0.428*	0.183	0.269	0.172	0.258	0.163
$SALES_t$	0.144**	0.044	0.122**	0.040	0.123**	0.038
$EMPLO_t$	0.261**	0.086	0.250**	0.088	0.245**	0.079
$OVERCEN_t$			-0.336*	0.170		
$OVERANGE_t$					-0.157	0.131
$OVERCEN_t$*PRIOR			0.410*	0.201		
$OVERCEN_t$*KNOWHET			0.195*	0.091		
$OVERANGE_t$*PRIOR					0.182*	0.088
$OVERANGE_t$*KNOWHET					0.101*	0.050
Likel Ratio Vs. Baseline (4 d.f.)			15.18**		12.67**	

***p<0.001, **p<0.01, *p<0.05

The second model (table 10) provides the cumulative logit estimates. The same set of hypothesis was tested based on the alternative measure of growth ($SLAES_{t+1}$). Again I provided three subsets of explanatory variables, so as to separate the collinear covariates and display the incremental contribution of the variables of theoretical interest.

Positive coefficients of variables indicate a positive influence of those variables on growth likelihood. Negative coefficients, conversely, show a lower probability of firm's growth when those independent variables increase.

The results provide mixed support to my predictions. Starting from model 1b, which presents tests of hypotheses 1 and 3a, we note that the coefficient estimate of OVERCEN is negative and significative, suggesting an effect opposite to what I had expected. Both the direction and the

significance of this effect, however, change dramatically when the level of prior related knowledge and knowledge heterogeneity are taken into account. In fact, the OVERCEN*PRIOR and OVERCEN*KNOWHET coefficients are positive and significant, supporting hypothesis 3a. For those firms with prior related experience the effect of centrality is positive, and it grows bigger as the level of knowledge heterogeneity increases. Results are somewhat similar when focusing on the effect of overall network range on growth (as measured by the nr of employees).

Turning to model 1c, while, contrary to my predictions, the coefficient of OVERANGE is not significant, the positive and significant coefficient of this variable's interaction with the two measures of absorptive capacity provides corroboration to hypothesis 3b. The positive effect of network range on CLF's growth is dependent on the richness of its pre-existing

Table 10. Model 2: Fixed-effect cumulative logit estimate of (sales-based) CLFs growth

	2a		2b		2c	
	Coef.	**Std. Er.**	**Coef.**	**Std. Er.**	**Coef.**	**Std. Er.**
$YEAR_1$	0.533	0.396	0.534	0.436	0.520	0.0442
$YEAR_2$	-0.337	0.387	-0.329	0.370	-0.310	0.370
$YEAR_3$	0	0	0	0	0	0
AGE	0.025	0.021	0.023	0.028	0.025	0.023
$SALES_t$	0.945*	0.243	0.89***	0.247	0.850***	0.240
$EMPLO_t$	0.090	0.045	0.083*	0.046	0.080	0.040
$OVERCEN_t$			-0.420*	0.1494		
$OVERANGE_t$					-0.106	0.170
$OVERCEN_t$*PRIOR			0.510*	0.195		
$OVERCEN_t$*KNOWHET			0.280*	0.085		
$OVERANGE_t$*PRIOR					0.250	0.164
$OVERANGE_t$*KNOWHET					0.051*	0.025
Likel Ratio Vs. Baseline (4 d.f.)			9.01*		8.4†	

***p<0.001, **p<0.01, *p<0.05, † p<0.1

knowledge structure and it increases with the level of KNOWHET. This is reflected in the two positive and statistically significant coefficients for OVERANGE*PRIOR, and OVERANGE*KNOWHET.

Consistency of results across the two models provides further support to the robustness of the analysis.

Model 2b reaffirms the negative impact of OVERCEN, being the corresponding coefficient negative and statistically significant. Likewise, the effect of this variable on sales growth appears highly contingent on the level of prior related knowledge and knowledge heterogeneity, an indication of the mutual reinforcing nature of the two constructs. Model 2c also, does not provide support for hypothesis 2. In fact, the coefficient for OVERANGE is negative, though quite far from approaching the level of statistical significance. Like in the previous case, however, the possession of a heterogeneous knowledge base enables the RANGE effect to be leveraged. When the heterogeneity-based measure of absorptive capacity increases, the effect of OVERANGE is enhanced significantly. In this model, however, although the effect of prior related knowledge seems to operate in the expected positive direction, it does not seem to play a significant role. In fact, while the PRIOR coefficient is positive its p value is greater than .05.

For purposes of illustration it may prove helpful to provide some quantitative interpretation of the coefficients. Let us dismiss for a moment the interaction term and focus just on the overall centrality effect in model 1b (table 9). Because the OVERCEN coefficient is negative (-0.33) we can say that a one unit increase in the centrality factor score would cause the expected number of employees to decrease by 28%, that is (exp -0.33-1) * 100. Since interpreting a factor score variation may be somewhat problematic, the same effect can be expressed in terms of change in standard deviation. Thus, if we multiply the OVERCEN coefficient by its standard deviation and we divide by the standard deviation of the dependent variable (listed in table 8) we obtain -0.33*0.97/11.5= - 0.03. We can than say that a one standard deviation increase in the overall centrality score dampens the expected number of employees by 0.03 standard deviations, or (exp -0.03 – 1)*100. We have to keep in mind, however, that the above interpretation only holds when the two interaction terms (OVERCEN*PRIOR and OVERCEN*KNOWHET) are equal to zero, that is, only for those firms

who have no prior experience in the field (PRIOR=0)[1] and exhibit no heterogeneity in their knowledge background (KNOWHET = 0). In fact, because both the interaction terms are significant, the effect of the OVERCEN variable changes in direction as well as in magnitude when interaction terms are considered. Because the full effect of the overall centrality variable is given by -0.33+0.41*PRIOR +0.19*KNOWHET, we can say that for those firms with prior related experience (PRIOR = 1) the effect of OVERCEN is positive (-33+0.41=0.8) and it tends to augment as the level of knowledge heterogeneity increases. For instance, for those firms with prior related experience and a 0.2 value in KNOWHET the effect of the overall centrality variable will be equal to –0.33+0.41+ 0.19*0.2 = 0.118. Under these circumstances, an increase in the centrality measure would positively affect the measure of growth.

The same logic holds when interpreting the effect of the network range variable (OVERANGE).

The interpretation is slightly different for the second model. In this case, because we are dealing with an ordered category (the firm's market sales as an ordered class), the coefficients' estimate represent the impact of a change in the corresponding variables on the probability of being in a higher rather than a lower category. Thus, if we look at model 2b in table 10 and we disregard for a moment the interaction components, we can for instance affirm that a one point increase in the OVERCEN score, will cause the odds of being in a higher category of market sales to diminish by 34% or (exp –0.42 –1)*100. As in the previous model, however, this effect holds true only when the interaction terms equal 0. For those firms with previous experience and heterogeneous knowledge base, the effect is indeed positive and it goes up as the knowledge heterogeneity measure increases. Let us assume that the KNOWHET level is 70%, and that the firm has developed previous knowledge in the field, the effect of OVERCEN would then be equal to 0.22, or (-0.42 + 0.51*1 + 0.19*0.7). Under these conditions a one point increase in OVERCEN factor would cause the odd of being in higher, rather than lower category to go up by 0.24%, or (exp 0.22 – 1).

[1] Note that the variable PRIOR is a dummy variable assuming value 1 for firms who do have prior experience and 0 for those who do not have it.

CHAPTER 5

Conclusions

In this final chapter the implications of the research are discussed, limitations highlighted and promising directions for future inquiry suggested.

I start by fleshing out the key findings of the research and their contribution to the debate on geographical clusters and interorganizational networks.

I proceed by emphasizing the major limitations of the study, and the boundaries within which to appreciate and understand the findings. This section is integrated with a descriptive overview on cases of local agglomerations of industries that closely resemble the empirical setting object of this dissertation.

After summarizing the dissertation purpose and structure, I conclude by addressing some avenues for further research along the vein herein pursued.

5.1 Discussion

Results are somewhat surprising, although not completely unexpected. The idea that CLFs may grow by being richly and diversely connected requires cautious thoughtfulness. My findings suggest that CLFs enriching their relational spectrum without the appropriate knowledge endowment may incur into unwanted negative effects. Why is that? What does that mean? I submit two potential explanations.

First, it is possible that CLFs may suffer an information overload due to overconnectedness. As pointed out by Gulati (1999), beyond a certain threshold the effect of grater information may taper off. In fact, because extending the relational horizon poses further information-processing requirements, CLFs without enough processing power might experience a

saturation problem (Kogut *et al.*, 1992; Koka and Prescott, 2002), resulting in lack of strategic focus, decisional impasse or inertia before emerging opportunities.

Another possibility is that in the absence of a robust preexisting knowledge structure, an increase in connectedness would lack drive and direction. As a result, CLFs might be more prone to misjudgment errors and costly dead end searches, leading to resource dissipation (time, money, energy) and/or decline.

Building ties is an effortful task whose benefits are not automatic. One thing is being exposed to multiple avenues for information and opportunities, another is being capable to evaluate, assess and reflectively appreciate the value that is embodied in these flows. Consistent with this argument, my results indicate that the characteristics of the CLFs' internal knowledge structure may impose radical limitations on the degree of connectedness that each CLF should strive for. Accordingly, I suggest the notion of *mindful embeddedness* that is, the importance of defining a coherent strategy of embeddedness, whereby the relational search for information and opportunities is consistently appraised against the cognitive limitations of the organization. Thus, organizations that do not possess at least some degree of prior experience and knowledge breadth should be particularly prudent in undertaking linkages whose benefits they may not fully be able to appreciate or understand.

All in all, this evidence emphasizes the need to be strategic in the design and development of the CLF's relational profile.

It is my conviction that this research contributes a variety of reflection cues to the understanding of firm performance and interorganizational networks within geographical clusters, both on a conceptual and empirical ground. I discuss them separately.

5.1.1 Conceptual contributions

First of all, building on the notion of embedded networks as carriers of information and knowledge, this research contributed a theoretically grounded conceptualization of relational ties as enablers of CLF growth. In fact, despite the great emphasis on networks that distinguish research on localized industries by and large, the driving forces of this process of relational influence appear often vague or loosely specified; either because

the 'networking metaphor' is endorsed with a taken-for-granted facilitator role, or because it is credited with a multiplicity of overlapping benefits (resource, power, status, information, legitimacy, etc.), with no clear explanation as to the basic underlying mechanism linking these elements to the process of firm growth. I took two steps in order to address this issue:

1. Drawing on well established ideas among network and organizational theorists, I provided an *information-based* conceptualization of network ties. I did so by moving away from a purely structural conception of firm networking and focusing instead on the underlying informational and knowledge benefits that CLF firms derive from their participation in such multiple web of relations. In this regard, two structural properties – centrality ad range – were introduced to assess the network-based access conditions of each CLF.
2. Building on some key ideas dating back to the work of Penrose but mainly established within the Austrian Economics framework, I elaborated on the concept of *firm growth* as a process of entrepreneurial discovery and recognition of economic *opportunities*. Opportunities exist because different firms have access to and control different information, they are not an intended outcome of a deliberate search process, but serendipitously discovered through the recognition of the value of information that firms happen to receive through other means. By way of this heterogeneous exposition to information, firms wind up occupying diverse positions within the space of economic opportunities. As recently suggested by Dernell, Fang and Winter (2003, p. 18): "firms can be expected to differ considerably in the information they possess… Such differences in information… typically imply differences in positioning relative to new opportunities".

These two arguments allowed me to stretch out a more transparent line of causal reasoning between firm network and firm growth. Because the discovery of economic opportunities is profoundly shaped by the availability and distribution of information in society, and since "information can be acquired by use of social relations maintained for various purposes" (Coleman, 1988, p. 104), CLFs networks represent a crucial interface between the information space and the opportunity space, and thus they may play a critical role in the process of CLF growth.

Second, although the idea that network ties represent conduits through which information and knowledge may circulate throughout the cluster

has led some scholars to emphasize the informational benefits associated to certain structural properties, less concern has been shown with regard to the actual capability of the firm to recognize and absorb the value of such information. Building on this gap, I highlighted the benefits of integrating the analysis of network properties with the concept of absorptive capacity (Cohen and Levinthal, 1990), as a filter between the firm and its network environment.

Absorptive capacity represents a powerful conceptual tool to improve our understanding of network based influences on firm behavior, yet there have been only sporadic attempts to incorporate this construct into inter-organizational research designs (Tsai, 2001). In this regard, in line with recent theorizations on the contingent value of interfirm networks, I believe my findings contribute new perspectives from which we might start looking at firm performance implications of network embeddedness. In fact, not only organizational networks ought to be assessed in the light of the characteristics of the environment in which organizations operate (Rowley et al., 2000; Koka and Prescott, 2002), the existing socio-organizational structure of work (Burt, 1997), or the type of network under investigation (Ahuja, 2000), but also with an eye on the knowledge environment that characterizes the organization. Incorporating internal knowledge considerations into our account of the performance implications of CLFs' interfirm ties not only provides us with a more accurate representation of the key causal mechanisms at work but is consistent with the general observation that an actor's network position and attributes offer complementary insights that taken together offer a fuller explanation of the actor's action (Blau, 1982).

In a broader sense, I think this finding also addresses another limitation of current research that has predominantly emphasized the liabilities of 'unconnectdedness'. In fact, it can be argued that rich and diversified networks may actually have adverse effects on performance if they do not fit specific contingencies.

Third, while research on locally concentrated industries has contributed crucial insights to the understanding of interorganizational networks and embedded ties as determinants of local growth and systemic strength, much weaker focus has been placed on the role and performance of the single firms herein located, as active constituents of this dense multirelational

system. Further, the analysis of knowledge flows in clusters does often go beyond the capacities of the single firms and tends to conceive clustered firms as homogeneous. Instead, by adopting the CLF as the unit of analysis, I was able to draw attention to CLFs heterogeneity and performance differences, as arising from idiosyncratic patterns of linkages with other actors in the cluster. In this regard, I believe my research represents a significant step towards a finer understanding of the role of network embeddedness within geographical clusters.

5.1.2 Methodological contributions

From an empirical standpoint, I think the study makes three major contributions that are worth stressing out:

First, this research represents an original attempt to introduce network analytic tools within thee boundaries of a geographical cluster. In fact, while networks are consistently portrayed as one of the most distinctive traits of localized industries (Nohria, 1992), only few scholars, and mostly in recent years (McEvily and Zaheer, 1999; Fonti, 2002), have endeavored to untangle such processes within a framework of formal network measurement and operationalization. In order to pursue this goal I took several measures: As a first step, I gathered network data based on multiple ego-centered relational questionnaires that allowed me to assess the CLFs' degree of collaborative, transactional and advice-based participation to the interorganizational field shaping the cluster environment. Based on these multi-network data, I then elaborated a series of sociomatrices that I used to analyze the structural properties of the sampled firms and compute measures of theoretical interest. Lastly, these measures were integrated, as manifest indicators, into an original confirmatory factor analysis model, which I developed in order to operationalize the multirelational nature of CLFs embeddedness. To the best of my knowledge, this model represents the first attempt ever to operationally account for the fact that CLFs are embedded in a number of different relationships, that may all simultaneously contribute to the informational inflow and knowledge exposure of these organizations.

In pursuing this goal I tried to address the concerns of many scholars who lament too strong a tendency, among organizational network theorists, to concentrate on a single type of network, despite the multiplicity of

relationships in which organizations are typically embedded. Barley et al. (1992), for instance, emphasize the fact that studies of network structure among profit-making firms have often focused on one or few interfirm relationships rather than capturing multiple ties among organizations. Similarly, Hedstron (1994, p. 1177) noted that "much more analytical work is needed on the role of multiplex networks, particularly on how multiple, overlapping networks of varying density and reach are likely to influence the diffusion of information". By simultaneously accounting for the CLFs participation to three kinds of interorganizational networks (transactional, collaborative and advice-based networks), my composite measures represent an initial attempt to move towards the direction auspicated by these and other scholars (see for example Gulati and Gargiulo, 1998 and Gulati, 1999[1]).

Second, due to the challenges of gathering network data over multiple points in time, there are only few studies that employ longitudinal data to analyze networks (McPherson et al., 2001; Hoang and Antoncic, 2002). Burt (2000) has voiced a similar concern that most studies of network structure are cross-sectional. In general, while some progress has been made analyzing thee dynamics of dyads (Gulati and Gargiulo, 1998; Stuart, 1998), little attention has been given to dynamics of networks over time (Powell et al., 2004). One crucial problem is that the use of cross-sectional network data precludes a robust understanding of the causal mechanisms at work. While this is generally the case with static research designs, the problem turns out to be particularly salient in this field of studies, given the inherent endogeneity that characterizes network dynamics (Nohria, 1992; Galaskiewicz and Wasserman, 1994). This study is distinctive in that it tackles some of the above concerns by assessing the performance implication of CLFs' interorganizational ties over a three year period. As far as I know, no prior study on geographical clusters had ever approached this topic within a framework of longitudinal network measurement and estimation.

[1] For instance Gulati (1999, p. 415) notes that: "the notion of network resources can be further extended to incorporate the multiplicity of networks beyond the network of prior alliance in which firms are placed…such an expansion of the domain of interfirm networks that provide network resources can enable a broader understanding of the multiple avenues by which firms can obtain resources from their social context".

Third, I think it is worth pointing out that the study was carried out based on a multimethod approach, so that qualitative insights, measurements techniques and estimation models build on one another in bringing evidence to the conceptual speculations. As suggested by Hoang and Antoncic (2002), when guided by the insights generated from qualitative research, a study based on survey data is more likely to capture network dynamics and be more predictive of entrepreneurial outcomes. Quantitative research, in turn, allows assessing and statistically control for competing theories.

5.2 Limitations and avenues for future research

In order to better appreciate the findings hitherto discussed, it is very important to recognize that the study is subjected to a number of potential restrictions. Noting the limitations may provide ideas for extension and improvement.

First of all, clusters of firms, industrial districts and spatially concentrated industries more in general, are often the expression of a complex mixture of local socio-economic conditions and institutional forces that contribute to create a unique environment for the development and growth of economic activities. This simple consideration should come as a warning against any attempt to draw conclusions beyond the spatial and social boundaries of the phenomena herein investigated. It is nonetheless notable that the empirical setting object of this research is not an isolated occurrence. In fact, I think it is fairly intriguing to observe the maps in figures 9 to 12, and appreciate that the clustering of small firms in the multimedia field is far from being an exceptional or unique phenomenon.

Further, these cases seem to epitomize what appears to be a much broader and pervasive propensity of ICT sectors to give rise to spatially

Figure 9. The Multimedia District of Toronto (source: Brail e Gertler, 1999)

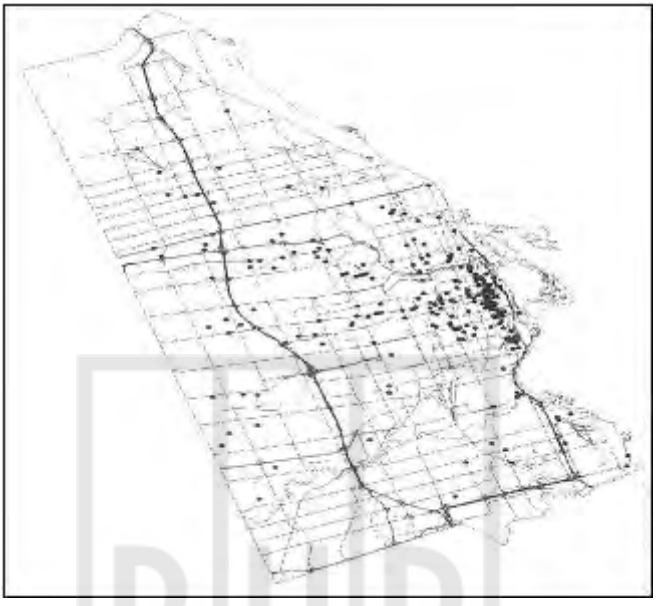


Figure 10. The Baden-Wurttemberg Multimedia Cluster (source: Fuchs e Wolf, 1999)

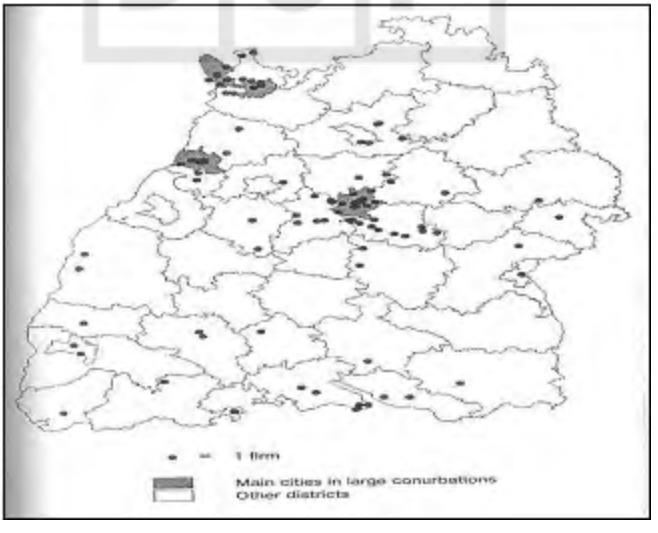
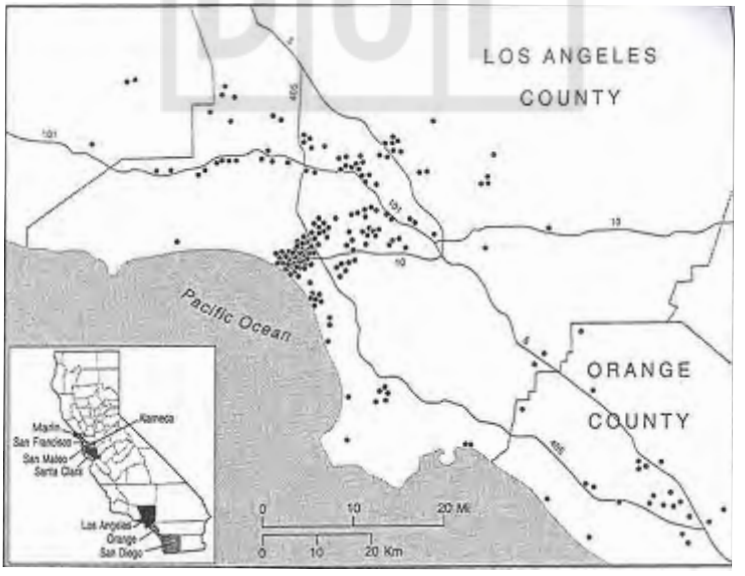


Figure 11. The Multimedia Gulch (source: Scott, 2000)

Figure 12. The Los Angeles Multimedia Cluster (source: Scott, 2000)



concentrated industries, and geographically bounded agglomerations of small firms, as suggested in figures 13 and 14.

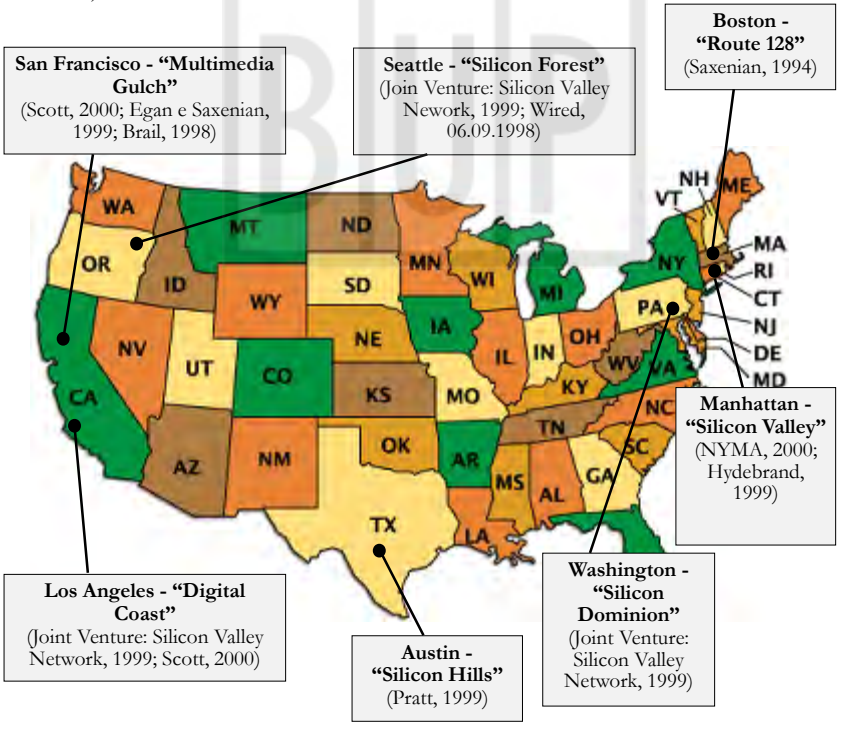
Although the degree of generalizability across institutional environments is not known, all this evidence provides at least some suggestive grounding to the possibility that the mechanisms elucidated in this study be not idiosyncratic and specific of a particular context. In this respect, I believe these cases represent fruitful opportunities for extending the avenues of investigation commenced here.

Figure 13. Firm clustering in the ICT: EUROPE (source: elaboration by the author)

Second, because all the CLFs share the same social, spatial and institutional environment, it might well be the case that the observed effects are the spurious manifestations of common forces operating at the cluster level. The above mentioned examples constitute ideal candidates to undertake comparative research and examine competing explanations.

More broadly, it is important to recognize that all the causal relationships I portrayed in this study belong to the realm of corroborated conjectures. In fact, like it is generally the case with non-experimental analysis, it is never perfectly possible to rule out the chance of the observed effects to be the spurious manifestations of untracked forces. On the other hand, by using fixed-effect estimation I was able to control for all unobserved and unknown time invariant variables that may affect the dependent variable. In that sense, I believe I provided an extremely conservative and rigorous test for my predictions.

Figure 14. Firm clustering in the ICT: USA (source: elaboration by the author)



Third, in building the conceptual framework, I made a strong '*homogeneity assumption*' with regard to the informational value of ties across network types. For example, I did not elaborate on the possibility that different *kinds* of relations may lead to information of different value. The rationale for this choice, consistent with the Austrian approach, is the idea that valuable information emerges more often as the byproduct of relational ties with a different purpose rather than the expected outcome of deliberate ties, accordingly opportunity discovery is more an unpredictable phenomena than a purposeful one. Based on this premise, I implicitly assumed the diffusion of valuable information via cluster networks to be essentially a stochastic process; in other words, relevant information may spring up in every part of the cluster's relational system network. However, while in principle it is impossible to anticipate what network conduits the relevant information would be channeled from; there may be rationales for modeling the informational value of different network ties according to some fine-grained probability distribution. Given the considerable efforts in joint problem solving that an alliance most commonly implies, one might for example consider this kind of relations as 'imbued' with a higher amount of informational value than other sorts of linkages (Koka and Prescott, 2002). Such an approach could then be easily translated into a model that allows for a ties' weighting scheme, based for example on the content/origin of ties. Another fruitful extension of my model might also consist in developing more fine-grained hypotheses, where the CLF's growth likelihood is related not just to the change in its egonetwork properties over time, but also on the supposed informational value of the alters it is connected to. Like in the previous case, one could for example account for heterogeneous probabilities of information transmission across nodes, and weight the likelihood of firm growth accordingly.

Fourth, there are inevitably methodological limitations involved in the measurement of CLFs networking activity. It is important to note, for example, that the research designed called for single respondent per organization. Given the micro and small sized of the organizations I decided to rely exclusively on network-data provided by my key informant that is the CLF's owner manager. Although I believe this to be a reasonable way to proceed for collecting this kind of data (see paragraph 3.2 – page 36 – for details on the motivations of this choice), I am aware that the use of

only one respondent per firm might be a source of measurement error for the network constructs (Marsden, 1990). In fact, a majority of the firms do actually have more than one owner. While this is probably a negligible issue with regard to the collaboration and transaction networks (for which it is quite sensible to expect a high degree of overlapping in the responses provided by different owner-managers from the same CLF), major biases are likely to occur with regard to the advice networks, where ties are less formalized and more personal in nature, and thus more difficult to appreciate from the outside. In an attempt to alleviate the potential for bias, each interviewee was explicitly required not only to check off those firms whose members he identified as constituents of his own advice network, but also those that he was able to recognize as alters in his partner/partners advice network. Obviously, this is only a marginal measure, further investigation is needed.

A similar problem of accuracy arises from the reliance on ego-centric network data, which introduces the potential for bias in the assessment of network structure (Marsden, 1993). Two features of this study served to mitigate the risks of informant accuracy. First, respondents were given a list of all the potential network members and were asked to indicate the presence of a relationship; thus, I did not exclusively relied on respondents to accurately recall the names of those to whom they are tied. Second, because all the roster members were interviewed, it was possible to assess the rate of ties reciprocation, which is equal to 76%. While there may be several reasons contributing to the absence of a perfect match (se footnote 12 for further discussion), the degree of correspondence is still substantial, suggesting that accuracy fallacies, where present, should not subtract too much from the validity of the results.

5.3 Summary and concluding remarks

Building on a rich tradition of studies on interorganizational networks, the embeddedness perspective was here applied to analyze the organizational performance of a sample of small firms located in a *geographical cluster*.

Regional Clusters (1998, 2000), also known as Industrial Districts (Becattini, 1979), Neo-Marshallian Nodes (Amin and Thrift, 1992), or Hot Spots (Pouder and St. John, 1996), are a prominent feature of our modern

economy. Hollywood (Scott, 1998), Silicon Valley (Saxenian, 1994), Mototorsport Valley in South England (Pinch and Henry, 1999), or Sassuolo in Italy (Lorenzoni, 1992) are just a few renowned cases among the many manifestations of the phenomena of firms concentration within clearly definable and relatively small geographic areas.

Scholars in the organizational, sociological and strategic field have long recognized the crucial importance of interfirm networks and embedded ties in supporting the success of geographical clusters and localized industries more in general (Nohria, 1992). Despite this trend, however, only sporadic studies have attempted to untangle such processes within a framework of formal analytic measurement and operationalization, so as to assess the extent to which the participation of CLFs to these networks is related to their organizational performance (Molina-Morales and Martinez-Fernandez, 2003). This shortcoming is consistent with what appears an overwhelmingly dominant tendency to approach firm clusters based on description oriented research strategies, more interested in exploring the extent to which the region or local agglomeration meets the defining characteristics of a business cluster than in the analytic understanding of the underlying mechanism that shape its internal functioning (Malmberg and Maskell, 2002; Morrison and Staber, 2000).

I addressed these issues by departing from a purely descriptive ground in favor of empirically based research that relies on network analysis and data on a panel of small firms situated in a Northern Italy cluster. Drawing and elaborating on previous findings on spatially and socially bounded industries that emphasize the high degree of embeddedness and connectedness that characterizes firms herein located, I advanced a stylized multirelational model of network ties as enablers of opportunity discovery and CLFs growth. In essence, because embedded ties are imbued with value in the form of information and knowledge, they contribute to carve out and mold the space of opportunities to which CLFs may gain exposure. Accordingly, I predicted CLFs' performance asymmetries to stem from their structural differences, which I identified in terms of network centrality, as a proxy for information volume, and network range, as a proxy for information diversity. Further, based on the simple idea that distinct CLFs may vary in their ability to understand and assess the importance of the information they accrue from their networks, I also postulated the existence of a moderating effect depending on the richness of CLFs' preexisting

knowledge structure. I formalized and tested these ideas within a framework of longitudinal measurement and estimation. Results provided mixed support to my predictions indicating that an increase in centrality and range over time is not unconditionally beneficial to the firm performance. In fact, unless CLFs are endowed with a threshold level of absorptive capacity, the effect of centrality and range is either significantly negative or statistically insignificant. In contrast, the presence of a strong preexisting knowledge structure radically inverts these effects, turning rich and varied relational structures into effective enablers of growth.

This study represents a first step toward unlocking and measuring the network effect within the boundaries of a geographical cluster. My findings demonstrate that even in a highly relational environment, such as is usually the case with local agglomerations of knowledge-intensive firms, being unconnected may not necessarily result in a liability. On the contrary, CLFs that expand their networks with no regard to their internal knowledge characteristics may suffer what I suggested to be an overload shock, that is to say failure to process the burdening mass of information flowing from the cluster environment to the firm, via multiple relational conduits. Results indicate that the consequences may be detrimental for the firm route to growth.

While this is probably the most intriguing finding of my study, I believe it is just an initial step towards a horizon fraught with promising research opportunities.

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Appendix 1

Questionnaire

Section a – Background information

1) When was your company founded? Please indicate year and month of founding.

2) What is the legal status of the company (s.n.c., s.a.c., etc….)?

3) How many founders did you start the company with?

4) Please, indicate the place of birth of each of them.

5) Please, indicate place and type of education of each of the founding members of the company (specify the highest degree completed).

6) What was each member professional position before launching this company?

7) Would you consider the field of specialization of your company consistent with the professional experience you have been developing during your career?

Section b – Company business and performance

1) In what circumstanced did you come up with the idea to start up the company? Can you elaborate a bit on that?

2) In brief, how would you describe your company core business?

3) Were you to indicate what industry segment/segments your company operates in, which one/ones would you pick?

- Computer graphics
- Publishing
- Software development
- Advertising
- Audiovisual
- Music
- Audiovisual
- Film/TV
- Communication
- Other (please, specify)

4) Consider the five items below. What do you think are the most crucial factors for the competitive success of your company? Please, list them in order of priority (1st = most crucial, 5th = the least crucial).
   - Creativity
   - Time
   - Price
   - Technology
   - Customer care

5) How are key functions and responsibilities distributed within the company? Feel free to sketch out a graphic illustration of the organizational structure of the company.

6) Please, provide the company's personnel composition over the indicated years

Foundation time			**1999**			**2000**			**2001**		
Nr. Founding Members	Nr. Employees	Nr. Temporary Collabor.	Nr. Founding Members	Nr. Employees	Nr. Temporary Collabor.	Nr. Founding Members	Nr. Employees	Nr. Temporary Collabor.	Nr. Founding Members	Nr. Employees	Nr. Temporary Collabor.

7) Please indicate the company markets sales (brackets) over the last three year (check off the corresponding cell in the table)

Annual Sales			
Euro (X 100)	1999	2000	2001
0-25			
25-50			
50-75			
75-100			
100-150			
150-250			
250-500			
> 500			

8) Indicate the % distribution of your yearly turnover by customer localization (refer to the latest fiscal year).

Local	Regional	National	International

9) What are the company's growth expectations in the next few years?

Section c - Institutional context

1) What financial sources did you tap to found the company? Please, provide a % indication in correspondence of each of the following items.

Personal savings	Bank Loans	Angel investors Venture firms	Goverment grants	Other (Please specify i.e. friends, family, etc...)

2) Why did you decide too establish your activity in Bologna? Do you think this location provides some kind of competitive advantage to the company?

3) What kind of initiatives would you suggest to the local socio-economic authorities for enhancing the development of the local multimedia district?

- Empowerment of digital infrastructures
- Initiatives to ease entrepreneurs' access to financial sources
- Initiatives to encourage the establishment of interorganizational linkages
- Territorial marketing actions
- Creation of a technological incubator
- Other (please specify)

4) Do you think that the local governmental institutions have played a role in fostering the development of the company (for instance by providing financial, managerial, accountancy or general information services?)

5) How would you describe the local competitive context? Is the pressure from your competitors high?

6) Are there institutionalized occasions of informal gathering when you may have the chance to exchange valuable business information, referrals, advice or discuss about potential projects or promising

undertaking with other members of the local multimedia business community?

7) Do you think that the advent of digital technology is diminishing the importance of proximity for your business exchanges? Alternatively, do you think that establishing face-to-face relationships with your stakeholders (customers, allies, suppliers, and institutions, etc…) will always be a key requirement?

Section d – Interorganizational linkages, proximity and information transfer

1) Would you consider your suppliers as potential sources of valuable information? In other words, have they ever contributed information that turned out to be particularly valuable for the development of the company? Would you mind provide some example based on your experience?

2) Do you think that being located close to the suppliers may represent an advantage for the company? Why?

3) Would you consider your customers as potential sources of valuable information? In other words, have they ever contributed information that turned out to be particularly valuable for the development of the company? Would you mind provide some example based on your experience?

4) Like in the previous case, do you think that the company may benefit by being located nearby its customers?

5) Overall, how would you describe the importance of the multiple network linkages that connect the company to its local business community (customers, suppliers, companies with which you collaborate, business associates) to the detection and acquisition of valuable information (i.e. information that may help boosting the company's development)? Could you provide some example, if any?

Section e - Sociometric questions

Question 1

Check off the cells in correspondence of the firms with whom, over the indicated years, you have established collaborative linkages. Check off the cell if the linkage was there in the specified year. If there are further companies with which you have collaborated than those herein provided, indicate them at the end of the document.

	1999	2000	2001
Firm 1			
Firm 2			
Firm 3			
.			
.			
.			
.			
.			
Firm 204			
(Others)			
“			

Question 2

Check off the cells in correspondence of the firms that you recognize as parties of your supply-network. Like in the previous case, check off a cell if a supply relationship with the corresponding firm was present in the indicated year. If there are additional companies to those provided here, name them at the end of the document.

	1999	2000	2001
Firm 1			
Firm 2			
Firm 3			
.			
.			
.			
.			
.			
Firm 204			
(Others)			
“			

Question 3

Check off the cells in correspondence of the firms that you recognize as parties of your customer-network. Like in the previous case, check off the cell if the relationship with the corresponding firm was present in the indicated year. If there are additional companies to those provided here, that you would like to include, please name them at the end of the document.

	1999	2000	2001
Firm 1			
Firm 2			
Firm 3			
.			
.			
.			
.			
.			
Firm 204			
(Others)			
“			

Question 4

Thinking of the informal ties that you have established with other members of your business community over the past year, could you indicate what are the firms, among those provided in the list, whose members (one or more) you know personally and turn to for valuable advice, guidance or information relevant to the company? Are there other companies that you would include to the list? Use the same criteria as in the above cases.

	1999	2000	2001
Firm 1			
Firm 2			
Firm 3			
.			
.			
.			
.			
.			
Firm 204			
(Others)			
“			

Question 4b

By the same token, are you knowledgeable of similar connections maintained by any of your partner with companies other than those you have just provided? Could you please check them off?

	1999	2000	2001
Firm 1			
Firm 2			
Firm 3			
.			
.			
.			
.			
.			
Firm 204			
(Others)			
“			

Appendix 2

Companies in the sample

A Lato
Achtoons
Albatros
Alessandro Editore
Angelica Festival
Arancia Film
Area Digitale
Art Servizi Editoriali
Audiomax
Aura Music
Azimut
baule dei suoni
BR&C
By Design
Campanini
Centro Nuova Comunicaz.
Chia Lab
Cicco Corp.
Cidieci Multimedia
CLAST
Cmp
Default
Dire
D-Sign
Dynamic
E Tv
Elea
Ethnos
Euro Video
Euro.Runner
Eventi Progetti Speciali
Florian Cinetv
Fonoprint
Forseco
Giostra
Giove S.A.S.
Grafton 9
Hirin
Homina
Horizons S.R.L.
Hst
Internet Images
Irma Records
Janus
Kamel
La Baracca
Laborat. Cinem. Morsiani
Laboratorio Del Ritmo
Latte Miele
Le Macchine Celibi
Max Information
Mediamore
MediaMutant
Meta S.r.l.
Movie Land
Movie Movie S.r.l.
Nananana
Net.Work.Com S.r.l.
Netmeta
Not Available
Nowhere
Officina Immagine
Officine Digitali
Outsource S.N.C.
Pendragon
Pidgin
Piero Casadei
Pierrot & La Rosa
Pressing
Progetto Video Produzioni
Proposta Video 8
Radio Fashion Time
Radio Fujiko
Radio NettunoOndaLibera
Rigenesi
Ritram
Rosanna & Associati
Softec
SONICROCKET
Stile Libero
Studio XXX Prog. grafici
Stylo
Technos-Video One
Tekne Immagine
Televisual
Terminal
Traffico Grafico
Vegas
Virtual Coop

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