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**KNOWLEDGE FLOWS AND NETWORKS:
THE INTERPLAY BETWEEN LOCAL AND
GLOBAL LINKAGES IN BANGALORE IT CLUSTER**

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A Vittorio e Yvette

*Where the mind is without fear and the head is held high;
Where knowledge is free;
Where the world has not been broken up into fragments by narrow domestic walls;
Where words come out from the depth of truth;
Where tireless striving stretches its arms towards perfection;
Where the clear stream of reason has not lost its way into the dreary desert sand of dead habit;
Where the mind is led forward by thee into ever-widening thought and action
Into that heaven of freedom, my Father, let my country awake.*

Rabindranath Tagore – Gitanjali (1910)

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CHAPTER 1

Introduction

1.1 The theoretical focus

The *fil-rouge* underpinning this work focuses on the study of knowledge flows within and across clusters, considering their features, directions and strategic implications. The three papers composing this thesis are the primary outcome of an effort of speculative experimentation, at the cross-point between research methods and units of analysis. The interplay between the various channels fostering knowledge flows – and thus the different possible measures of the phenomenon – and the richness of available research methods has allowed for the elaboration of three different empirical papers. The works aim at gaining deeper insight into the dynamics of knowledge flows within and across clusters, by generating three different original perspectives and thus, a detailed portray.

Knowledge flows have been at the core of an intense scholarly speculative effort, over the last few decades. Resource-based view considers the firm as a bundle of resources, which need to be rare and difficult-to-imitate to entail competitive advantage. The subsequent knowledge-based view then emphasizes the special role of knowledge within the stock of a firm's resources. Ever since the acknowledgement by the academic community of the

strategic importance of knowledge, many contributions have analyzed the key issues related to the nature of the knowledge (e.g. Polanyi, 1966; Kogut, Zander, 1993), and the possibility to transfer the knowledge (e.g. Gupta, Govindarajan, 2000; Fey, Birkinshaw, 2005).

The debate acquires particular flavor when knowledge-related issues are applied to the geographical co-localization of companies within clusters. Clusters are acknowledged to foster knowledge sharing, re-elaboration and refining; on the other side, they can build up important barriers to knowledge renewal, thus entailing negative implications for firms' competitive advantage. The heterogeneity of companies within clusters is a key element suggesting an uneven distribution of knowledge flows (Singh, 2007). In particular, the presence of both MNCs and domestic firms and their interaction within clusters has triggered the academic debate. Many studies, at different levels of analysis and with different analytical methods, have tried to unravel the phenomenon of knowledge spillovers from MNCs to local domain. Within this research stream, two main groups of studies can be distinguished: the ones adopting a macro-perspective and considering the impact of the presence of MNCs on the host countries (Arora, Gambardella, Torrisi, 2001; Fosfuri et al., 2001; Patibandla, Petersen 2002), the ones using patent data to highlight the transfer of knowledge between host countries and parent companies (e.g. Singh, 2007). Both kinds of studies reach different degrees of understanding of the dynamics of knowledge flows within and across the clusters. The indirect measures they offer, however, fail to unravel the nature of knowledge flows, their directions and paths, the firm-level and tie-level characteristics which can channel knowledge flows and influence their distribution.

The thread underpinning this work revolves around two key-words: knowledge flows and clusters. Literature highlights three major channels for knowledge flows within clusters: inter-firm alliances, networks and personnel mobility (Fosfuri et al. 2001). Focusing on each knowledge channel separately, this thesis aims at filling some basic empirical and theoretical

gaps emerging from the previous literature. The line of reasoning leading to the formulation of the basic research questions supporting this work has followed a destruction-construction pattern: from the acknowledgment of important limitations of extant literature, to the identification of possible contributions.

Extant literature so far has been considering the knowledge as one-dimensional, running from being extremely tacit, embedded into people's experience and ways of executing, to being extremely explicit, codifiable and easily explicable through words and schemes (Polanyi, 1966; Kogut, Zander, 1993; Von Hippel, 1994; Fey, Birkinshaw, 2005). I argue that a one-dimensional framework fails to capture the multi-faceted nature of knowledge and that a more in-depth analysis is needed. Paper 1, through in-depth qualitative evidence, highlights new nuances in the knowledge constructs and proposes new categories of knowledge emerging directly from the field. The proposed distinction is between technical and business-domain knowledge; this underpins the whole speculation of the first paper and directs further elaboration.

Directions of knowledge flows have undergone the same minimization process as the nature of knowledge: one specific route has drawn the general attention, which is the one leading from MNCs to domestic companies and entailing – often unwanted – spillovers. I suggest that a much more complex intertwined reality of knowledge flows has to be discovered, which encompasses not only the traditional path but also the routes back from MNCs to domestic firms, between domestic firms and between MNCs. The notion of 'knowledge spillovers', as associated to the path leading from MNCs to domestic firms, underlines the MNC-centered perspective of extant literature. A cluster-based perspective is thus needed, to complete the picture and further elaborate on knowledge flows and their direction. Giving a cluster as formed by both MNCs and domestic companies, how does the

presence of these two different entities influence the distribution of knowledge flows across the cluster and the companies?

The concept of cluster boundary is another element of cluster affiliation that has been lately boosting research effort; the speculation has particularly focused on the duality between external and internal flows of knowledge. External linkages, as pipelines able to convey knowledge from outside, are considered as increasingly important to prevent local firms from becoming overembedded in the local domain (Albu, Bell, 1999; Nachum, Keeble, 2003; Owen-Smith and Powell 2004; Giuliani, Bell, 2005). The situation of overembeddedness particularly requires local firms to develop linkages outside the clusters to refresh their local stock of knowledge. As described by Uzzi (1997), overembeddedness is a condition which sees cluster companies devoting most relational effort towards the inner dimension of the cluster, by engaging into strong linkages towards local entities, by building relational networks which only reaches within the internal domain, by sourcing most preferably from the local pool of human capital. In this scenario, companies with a well-balanced share of external and internal linkages better off their competitors (Zaheer, George, 2005).

Considering the literature speculating on the duality internal/external, two are the knots remain unsolved. One refers to the need for a clear understanding of which knowledge path are available and more likely to channel which kind of knowledge. The same kind of knowledge can be flowing along both external and internal linkages, thus guaranteeing the refreshment of cluster's knowledge stock. Or, different kinds of knowledge can be observed along the external and the internal paths, thus suggesting a complementarity of the two channels.

Paper 1 and paper 3, with very different methods and measures, consider knowledge paths and the nature of knowledge flowing with respect to the cluster boundary, and with a

focus on the differences between MNCs and domestic firms. Paper 1 proposes alliance-level quali-quantitative evidence, in order to highlight differences in the type of knowledge shared across different types of linkages. Special attention is given to the *external* dimension: both firm-level and dyad-level factors are influencing the type of knowledge transferred across the cluster boundaries along firm linkages. Paper 3 proposes a quantitative analysis based on personnel movements, and mainly focuses on the *internal* dimension of the cluster. Personnel movements establish linkages between companies, according to a social capital perspective which considers the strategic benefits of both employees acquisition and employees' loss. Social capital through personnel mobility appears to distribute unevenly across companies within the cluster, under the influence of firm-level characteristics. This empirical analysis allows for the observation of the direction of knowledge flows at micro-level.

The second point of speculation stemming from the focus on cluster boundary reads the duality internal/external from an evolutionary and dynamic perspective. The causal relationship unfolding over time between the formation and development of external linkages and the formation and development of internal linkages in clusters contexts remains uninvestigated. Literature considering network evolution, in particular, has assumed the network to be a monolithic entity, thus studying the impact of network-related factors on firm-related factors and viceversa (Ahuja, 2000), or considering the evolution over time of network characteristics (Lechner, Dowling, 1999; Hite and Hesterly, 2001; Schutjens, Stam, 2003). Any potential causal pattern between sub-networks, namely between the network and the network itself has been missed out. Another degree of complexity comes with the recalling of the different behavior of MNCs and domestic firms. Can external network influence the formation and evolution of internal networks of knowledge flows? And, if so, which differences or common patterns can be highlighted between MNCs and domestic companies? Paper 2 addresses these questions; it considers simultaneously the *internal* and

external dimension by leveraging on the concept of inter-firm networks. The detailed qualitative evidence allows for the observation of the evolution of internal and external networks of selected companies, both MNCs and domestic firms, over time. The intent is not only to draw patterns of evolution of internal and external networks separately, but also to unravel the possible causal relationships between the rise and growth of internal and the external sub-networks. The perspective thus deployed is ultimately disrupting the idea of the network as a unique, monolithic entity and focuses on the causal patterns between the network and the network itself.

Giving the research problems thus highlighted, the appropriate choice of the empirical setting is of utmost importance. A description of first Indian IT industry and then of the formation and characteristics of Bangalore IT cluster will follow, emphasizing the reasons underpinning this choice. Each paper will then be introduced and discussed separately. In particular, an in-depth discussion will follow to justify the choice of different research methods as matching different research problems and the use of specific measures of knowledge flows.

1.2 The Indian IT industry

Irrespective of US recession and the recent scam affecting one the India IT pillars, Satyam Computer Services, India software industry does slow down, but steadily preserves its two-digit yearly growth rate. According to the last reports by NASSCOM, the National Association of Software and Service Companies, industry clocked a combined growth rate of 28.2% in 2007-08, which is expected to slow down to between 21-24% in the present financial year. However, according to NASSCOM President Som Mittal, even the projected growth rate of 21-24% is ‘robust’ and in sync with the industry target of achieving 60 billion USD of exports by 2010. On the industry’s decreasing growth rate, Mittal observes that:

'[...]In the last eight years the average growth rate has been 33.7%. We have had as much as 50% growth in a single year initially. But it is natural for the growth to stabilize as the industry grows' (Som Mittal, NASSCOM – President).

Indeed, the gross revenue from both domestic as well as export markets altogether increased to 52 billion USD in 2007-08 as compared to 39.6 billion USD during 2006-2007. Exports of information technology (IT) services alone grew by 28.2%, reaching gross 23.1 billion USD, while the BPO (Business Process Outsourcing) sector showed an increase of 30%, fetching 10.9 billion USD as compared to 8.4 billion USD of the previous year.

Commenting the recent crisis, Mittal has highlighted the capability of the Indian industry to handle the subprime mortgage crisis in the US well by venturing into industries that were not affected, such as transport, telecom and healthcare. However, 2007-08 was acknowledged to be a 'difficult' year because of the US economy slowdown, the oil and food crises, and the currency fluctuations. Apparently, the full impact of the situation in the US is yet to be felt by Indian companies, which are now trying to mitigate its consequences by finding new ways to cut costs and enhance productivity.

Considering the current labor situation, IT services and the BPO sector has a two million-strong workforce that is increasing by 26% annually. During the run-up phase to the presidential elections in the US, concerns have arisen about the future of offshore outsourcing, with particular emphasis on India. The widespread worry of job loss in Western countries as a direct consequence of offshore outsourcing is still very strong in the collective opinion and occupies increasingly central roles in political campaigns, as highlighted by the last US presidential election. Mittal brushed up this issue by claiming that

'[...] in 2003-04 elections also, offshoring had become a major issue, but the industry has only grown ever since. It is more of an emotive issue. Barack Obama, who once voiced his concerns about outsourcing recently acknowledged its importance and referred to it as 'inevitable' (Som Mittal – NASSCOM President).

The origin and development of Indian software industry has received important scholarly attention and a very sharp and exhaustive systematization by Suma Athreye (2005). The author portrays the growth of the industry over the past decades: even though the noticeable boost dates back to 1995, IT outsourcing activities were present since late 80s. Athreye clearly identifies the key elements triggering the rise and success of the industry: skilled workforce and the creation of a new business model. Using her words,

'The particular strength of Indian firms was their ability to assemble teams of talented engineers and deliver a technical, outsourced service to different customers anywhere in the world. They also leveraged their capabilities for maximum economic value through the adaptation and perfection of a new business model. This model was based around an outsourced service offering, and different variants of it were developed by Indian firms as new economic opportunities arose. Over time, one variant of this outsourcing model commonly known as offshoring, has come to be applied to other domains and areas: call centres, financial services and other forms of content management services of large firms that can be done remotely. As a result, India now enjoys a 'created' comparative advantage in outsourced services and offshoring' (Suma Athreye, 2005: pag. 1).

The business model of outsourced services can encompass both onsite and offshore work and different pricing policies (Ethiraj, Kale, Krishnan, Singh, 2005). One form sees the IT service provider sending personnel to the client company onsite, to develop software according to their needs. Termed as 'body shopping' or onsite work, such services are paid on the basis of quantum of labor required/used. Else, projects can be on a turnkey basis, wherein firms are responsible for delivering an entire software package and are paid on a project basis (Vijayabaskar, Krishnaswamy, 2002). The peculiarity of the business model is strictly related to the export-oriented nature of the industry: exports hit the 80% of the total revenue of the industry in 2001 and this percentage keeps stable over time (Arora, Gambardella, Torrisi, 2001; Ethiraj et al., 2005). The industry started by offering services to

customers spread all over the world and grew up around this strategic profile. Interestingly, from being an element of strength, the strong export-orientation is currently becoming a constraint, preventing companies from developing the necessary capabilities to address the growing local market. In the numerous interviews I held with Bangalore IT service providers, a common pattern emerges, highlighting the high internal costs needed to undergo a strategic shift towards local market. Capabilities, internal processes, costing policies, along with a wide spectrum of organizational mechanisms and incentives have been tailored over the years on the peculiarities of EU and US customers. The need to modify such deeply rooted framework entails enormous switching costs, which prevent the local companies from serving the Indian market for IT services.

Another element featuring Indian IT industry is the focus on customized software service, unlike products in the Israeli case (Athreya, 2005). The first focus of Indian software industry was low-end, labor-intensive work such as low-level design, coding, testing support and maintenance, which US-based companies outsourced to Indian service providers (Ethiraj et al., 2005; NASSCOM, 2001). Over time, however, a change has occurred, fostering an evolution from low-level, cost-driven outsourcing to the delocalization of more value-added and knowledge-intensive tasks (Maskell et al., 2006; Ethiraj et al. 2005). Indian companies have upgraded their capabilities and strengthened their relationships towards US and EU counterparts with trust; this created a fertile basis to channel more tacit knowledge and to boost the joint development of high added-value projects.

The third important element which is worthy emphasizing refers to the importance of MNCs in the growth of the industry. Unlike the case of Ireland, the development of Indian IT industry largely relied on the potential of domestic firms, which in the early 2000s were still overcoming MNCs subsidiaries in the top twenty IT exporters in India (Athreya, 2005). This favored the entrance of different types of actors, like MNCs' subsidiaries, subsidiaries of

foreign firms set up by expatriate Indians (NRI) seeking for relocation, subsidiaries of Indian business houses, and entrepreneurial firms often set up by IT professionals. Another point of view enriching the debate comes from Patibandla and Petersen (2002). After presenting some of the most important MNCs which set up their operations in India (Texas Instrument, HP, Oracle, Microsoft, Motorola, Nortell, Cisco), the authors highlight the advantages for local firms, which benefited from a new international exposure by leveraging on their relationships to MNCs. The labor market side also plays an important role: the initial stock of human capital leads to the entry of MNCs, which triggers a cumulative process of further human capital accumulation through a process of externalities (spillovers) governed by firm-level and market structure dynamics.

1.3 The IT cluster in Bangalore

Technology-intensive work tends to concentrate in spatially agglomerated clusters of firms, well-networked with each other and with other support institutions like universities and research institutes and financial intermediaries (Vijayabaskar, Krishnaswamy, 2002). The Indian software industry as well has concentrated over time around few spatial agglomerations in the metropolitan cities, Bangalore being the most important of them. Bangalore's dynamism has even drawn comparisons with the Silicon Valley high-technology district in the US (Balasubramanyam and Balasubramanyam 2000: pg. 350).

Vijayabaskar and Krishnaswamy (2002) underline how Bangalore's urbanization and industrialization patterns, ever since the early 20th century, has been strongly state-led. Being a part of the erstwhile princely state of Mysore, it benefited immensely from the industrialization efforts undertaken by the state, which included establishing a polytechnic and a few state-owned factories. The first research centre present in Bangalore, the Indian Institute of Science, was set up during that period (Holmstrom 1998). In the years 1950s-

1970s, the city's dust-free environment fostered the set up of large public sector companies specializing in industries like electronics, aerospace, machine tools and telephone equipment, apart from a few national defense research laboratories. This spawned the growth of upstream and downstream activities, in the form of small and medium firms that supported these companies in their activities. Though the Indian software industry has its origins in Bombay in the 1970s, shortage of skilled labor and the rising costs of built-in space led to a search for alternative locations. Bangalore, for lower land prices, the pleasant environment and the presence of a knowledge infrastructure with a remarkable growth potential, turned out to be a favorable destination. Clustering of electronics-related industries also brought people from all over India to Bangalore, starting to build up the cosmopolitan culture of the city, which began to stand out among most other cities in India.

Such factors, and especially the low cost pool of skilled labor educated in the local high-level institutions, drew multinational IT firms to Bangalore, Texas Instruments (TI), being the first (Vijayabaskar and Krishnaswamy, 2002). TI's primary aim in coming to India was to establish a base in the Asia/Pacific region. India was selected because of its strong educational system in theoretical sciences and engineering and for its very large English-speaking, highly skilled labor force. Bangalore was also considered an ideal location for its cosmopolitan character, which could best suit the lifestyles of TI's international staff. The software development centre of TI had a direct satellite link with its headquarters in Dallas, USA; excess capacity on that satellite link was to be shared in the local domain. This paved way for entry of smaller domestic software companies to undertake data entry and basic software programming jobs for distant clients. In 1989, Hewlett-Packard (HP) also set up a fully-owned subsidiary in Bangalore that was 100% export-oriented. This influx of foreign investment has steadily increased since then at two-digit rate; at present, Bangalore is a vibrant and crucial site for many MNCs (Balasubramanyam and Balasubramanyam 2000),

apart from a large number of Indian software firms undertaking software development work for EU and US client firms. Quite a few entrepreneurs, in the initial years, were employees of overstuffed public sector firms, forced to reduce employment due to policy measures seeking to decrease state support for such ventures. Engineer-entrepreneurs also came from Indian Institute of Science (IISc), Central Machine Tools Institute (CMTI) and National Aeronautical Laboratory (Holmstrom 1998; Heitzman 1999). The new liberal policy environment also drew entrepreneurs from among the non-resident Indian (NRI) community wanting to relocate, reversing the brain drain to a limited extent.

1.3.1 Why Bangalore? The need for an evolutionary perspective

Inheriting all the characteristics and historical features of the broader IT industry in India, Bangalore boosts interesting speculation about the benefits and drawbacks of geographical co-location of IT companies. A first major point needs to be discussed: is Bangalore to be considered a cluster? Literature suggests that an agglomeration of companies is not necessarily a cluster, which configures as such in the presence of two key elements: 1. a networking behavior of local companies towards other local companies, education institutions and government (Porter, 2000), 2. the presence of a strong local labor market (Basant, 2002).

The few studies that have been gathering empirical evidence in Bangalore converge in showing the weakness of inter-firm relationships in the local domain. The work by Lema and Hesbjerg (2003) highlights that local companies are competitors, struggling to serve a broad customer base spread worldwide. According to their analysis, IT firms in Bangalore constitute essentially a 'virtual extension' of the foreign customers located elsewhere; the ties connecting local companies to foreign customers are long-term, trust-based strong relationships. Little organizational resources are thus left to undergo a relational effort

towards the local domain, which sees very poor networking and cooperative behavior. In the same line comes the contribution of Vijayabaskar and Krishnaswamy (2002). The authors highlight the lack of specialization and inter-firm networking of Bangalore companies. They emphasize how the industry has diversified its output market profile horizontally, to cater to a wide range of software services. Firms are thus expected to specialize on specific domains and then to network with each other to leverage scope economies. Yet, this does not seem to be the case: such diversification has been accomplished primarily through vertical integration of various segments within a firm, rather than the expected networking between domain-specialized firms. In addition to that, the authors explain their results by considering that the nature of work does not require high-level domain expertise, leaving firms with little incentive to develop any domain-specific specialization.

Given these premises and this empirical evidence, Bangalore does not qualify as a cluster. I argue that some more elements are to be taken into account in order to achieve a complete picture of the local domain and to reach a final point about the cluster nature of Bangalore. Bangalore IT industry is very young, dating no more than 10 years. The abovementioned studies thus capture the first stage of development of the agglomeration of firms. By assuming their picture to keep stable over time, these authors are missing out the essential evolutionary perspective needed to correctly interpret the clustering phenomenon. Considering the market dynamicity and the fervent growth of Indian IT industry in the last decades, waves of evolution are likely to have radically changed the face of Bangalore over time. Nowadays, Bangalore IT companies show a strong and tangible tension to evolution and differentiation. First, a change has been acknowledged so far concerning the nature of the tasks being outsourced to IT service providers, from low-end, labor-intensive activities to high-end, knowledge-intensive projects (Maskell et al., 2006; Manning, Massini, Lewin, 2008; Angeli, Grimaldi, 2008). The upgrading of local companies to more added-value tasks

has further strengthened their relationships to foreign customers, which would delocalize increasingly large – and strategic – portion of internal operations; this has entailed a growing need in local companies for business-domain knowledge and for domain – or vertical – specialization. As soon as the type of service moved from a commodity lacking any industry focus to a highly core, customized and thus industry-specific service, the specialization need has become crucial to competitive advantage (Angeli, Grimaldi, Lipparini, 2008a). Many companies are following this direction: Subex is specializing on telecommunication domain, IGate on financial services, Symphony on retail and storage.

Another direction of differentiation relates to the business model or to the technology focus of the companies. The increasing competitive pressure boosts the need for differentiation and for entrepreneurial effort in finding new directions of competitive advantage (Angeli, Bhagavatula, Kumar, 2008). On the business model side, new business-models other than the service-based are coming to the fore. Interesting example is the ITOP (Information Technology and Operations) originally created by IGate: a technological platform is set up *una tantum* for the client, which then allows IGate to manage remotely all the critical operations of the client firm. Another example is more representative of a set of models rather than an *ad hoc*, firm-specific solution: the IP-based model. This model consists in the production of intellectual property which is then sold and commercialized by other companies. IP-based model is successfully implemented by a few successful companies such as Ittiam, which generated as a spin-off of TI. On the technology side, an increasingly high number of examples can be retrieved of the growing technological focus of small and medium companies in Bangalore. BangaloreSoftSell and S7 Software Solution are sharply focusing on migration technology and refining their technological specialization over time.

At the basis of the differentiation process undertaken by Bangalore companies lies a reaction to leading companies' behavior. Huge companies dominate the cluster, undertaking

production of all orders secured in-house (Vijayabaskar, Krishnaswamy, 2002). This entails an increasingly uneven absorption of the demand, which further triggers the leading companies' growth and crowds out the small and medium companies. The latter are thus pushed to undertake entrepreneurial efforts aimed at differentiation, specifically considering the local leading companies as benchmark to differentiate from. Differentiation due to cluster rivalry, namely to the firms' perceived competitiveness within the cluster and towards cluster companies, offers a relevant piece of evidence of the cluster nature of Bangalore (Angeli, Bhagavatula, Kumar 2008). Further evidence supporting the presence of rivalry in Bangalore is offered by the study by Basant and Chandra (2007). Their analysis highlights that cluster firms in Bangalore benefit from the possibility to access information from competitors and about competitors significantly more than non-cluster firms.

The evolution of the strategic and knowledge content of the delocalized tasks, the increasing vertical specialization, the pressure for differentiation on technological and business-model dimension due to cluster rivalry are the consistent, fast-paced evolution dynamics in Bangalore IT industry described so far. Given this premises, it is reasonable to expect some changes to occur also in the inter-firm networking scenario, and in the intensity of the local labor market. Empirical evidence and theoretical speculation are needed today, after approximately 5 years since the last contributions in this sense, to figure out how Bangalore IT industry has been evolving, if either towards a cluster configuration or else. A major point of interest relates to the understanding of how the strong, long-term oriented relationships towards foreign customers trigger (or hinder) the evolution of local alliances. This doctoral thesis aims at increasing the empirical understanding of the phenomenon of cluster formation and evolution.

Evidence so far has highlighted the absence of cluster features in Bangalore; however, the high-tech nature of local industry can be misleading in channeling the cluster-related

speculation. New patterns and schemes to analyze how the particular industry configures in a cluster are needed, different from those used to portray traditional manufacturing districts (Lorenzoni, Lipparini, 1999). As an example, being a service-based industry, no products are exchanged within and across Bangalore, and all the knowledge is embedded into intangible flows. In addition to that, the service-based business model has fostered the concentration of the local companies around a specific technology, the IT, rather than around specific industries (Manning, Massini, Lewin, 2008). This has led to a horizontal agglomeration of companies, which stands out as very different from the manufacturing clusters, traditionally spanning the supply chain. Furthermore, and most importantly, previous studies have placed their observation point in a very initial stage of the formation of a high-tech cluster in an emerging economy. The historical evolution of cluster domains needs to be taken into account; Bangalore offers the unmatched opportunity to observe a rapidly-evolving environment and so to track the evolution of alliances and labor mobility. The interview with a key informant in the cluster suggested a completely different scenario than the one portrayed by scholars so far, revealing the importance of the longitudinal perspective to analyze the cluster and thus offering the conceptual starting point to this work:

'[...]Knowledge sharing? It has been happening, but in a very informal way. See, very few people can be considered as the founders of the cluster in Bangalore, people who know each other very well, since they have always been there. To share knowledge, or to solve a problem in company A, they just needed to pick up the phone and call the CEO of company B. No need for formal agreements. Now, a second of entrepreneurs is setting up companies in Bangalore. They do not know the members of the first wave, they are much less informally networked than the previous ones with the local domain. So, they need formal alliances to source and share knowledge. That is why networking is increasing. But knowledge sharing, it has always been there' (Yahoo!, CEO).

These words suggest that the lack of inter-firm alliances does not necessarily entail the absence of knowledge sharing and knowledge flows, which is what actually defines a

cluster. Reading this piece of evidence from a broader point of view, this can translate in a further occasion of learning, for a researcher trainee: the gap between the construct and the measure of the construct, namely the internal validity of the measures, is never to be neglected.

The three papers that follow will try to bridge the abovementioned theoretical and empirical gaps. Bangalore is an ideal empirical setting to give an answer the theoretical issues: the presence of both MNCs and domestic companies can serve the purpose to highlight difference in firms' behavior due to foreign affiliation; the strong, long-term oriented relationships to external partners offers the opportunity to study the differences between external and internal alliances, and to highlight causal patterns between them; the service-based nature of the industry allows maximizing the importance of knowledge flows, given the lack of physical products embedding parts of the knowledge; the presence of local strong educational institution is likely to foster a strong local labor market and thus informal knowledge flows among companies through personnel mobility.

To achieve sound empirical evidence and to guarantee exhaustive answer to both theoretical and empirical issues, the three works composing this doctoral thesis leverage on differences in research methods and knowledge flows measures. Considering the latter, the use of alliances, networks and personnel mobility are aimed at portraying from different angles the phenomenon of knowledge flows within and across clusters. Given the common theoretical thread of knowledge flows, different measures recall different – though partially overlapping – bodies of literature, analyzing alliances, networks and personnel mobility. The three papers jointly contribute to deepen the understanding of knowledge flows within and across clusters at the first, broader level. On a second level, they independently provide novel contribution to the specific streams of literature they refer to through the specific measure, alliance or networks or personnel mobility. The presentation of the papers follows.

1.4 Research output

1.4.1 Paper 1 – The Local Leveraging of Globally Generated Knowledge: A Cluster-Based Perspective (*with Rosa Grimaldi and Andrea Lipparini*)

This first paper literally opens up the ‘black box’ of knowledge spillovers between multinational corporations and domestic companies. A cluster-based perspective, which underpins the whole doctoral thesis, is framed: MNCs are considered as a part of the cluster, along with domestic firms. This entails the need for a new and more complete framework of knowledge paths *within* the cluster: 1. from MNCs to domestic companies 2. from domestic companies to MNCs 3. between domestic companies 4. between MNCs. In addition to that, two types of knowledge flows *across* the cluster are considered: 1. from the MNC to the parent company 2. from the domestic firm to the external partner. Leveraging on the new perspective, which takes into account the bidirectional nature of knowledge flows and develops a complete typology, differences in the knowledge flowing along the different paths can be highlighted.

The paper leverages on a powerful quali-quantitative approach to analyze inter-firm linkages as a channel of knowledge flows; inter-firm linkages within the cluster (intra-cluster ties) and the inter-firm linkages across the cluster (extra-cluster ties) are considered. The evidence is gathered from six companies in the cluster: Bangalore SoftSell and S7 Software Solution, to account for small, technology-focused companies; IGate and Symphony representing large IT service providers; Yahoo! and Hewlett-Packard to represent MNCs’ subsidiaries. The study of these six companies, along with their inter-firm alliances, provide the basis for the quali-quantitative approach.

Through the qualitative evidence, the distinction between technical and business-domain knowledge emerges. Moreover, empirical evidence and previous literature suggest

two major factors able to affect the type of knowledge flowing: the governance mode of the alliance (outsourcing vs proprietary) at tie-level; the vertical specialization degree at firm-level. The quantitative evidence further builds on that and tests the differences between the distinct scenarios, as stemming from the interplay of nature of knowledge (business-domain vs technical) and the different knowledge paths.

Along the extra-cluster dimension, proprietary mode seems to foster technical knowledge inflows, as compared to outsourcing mode. Considering the outsourcing mode, however, multiple interactions to the external partners foster the inflows of business-domain knowledge and increase the degree of domain specialization. This turns into increased technical knowledge inflows, since specialized domestic companies seem to attract more technical knowledge from their partner than non-specialized counterparts. Within the cluster, domestic companies show significant differences from MNCs along all dimension of business-domain knowledge; they thus prove to source and share business-domain knowledge in the local domain significantly more than MNCs.

Serving a theory-building intent, propositions are offered. This paper offers original contribution to current literature debate, by: 1. developing a cluster-based perspective, thus a new framework of analysis 2. distinguishing between different kinds of knowledge, thus disrupting the dominant one-dimensional perspective on knowledge 3. highlighting difference between MNCs and domestic firms in both technical and business-domain knowledge sharing, along both extra-cluster and intra-cluster linkages. 4. discovering two major elements able to affect knowledge sharing: governance mode at tie-level, domain specialization at firm-level. In this sense, a major counter-intuitive finding emerges: outsourcing mode can also be conducive to the transfer of highly strategic tacit technical knowledge.

This paper has been presented to Strategic Management Society Conference, Cologne (Germany), October 12-15, 2008.

1.4.2 Paper 2 – Global Demand Triggering Local Cooperation: The Evolution of Internal and External Networks within Bangalore IT Cluster (*with Rosa Grimaldi and Andrea Lipparini*)

This paper zooms out, from the tie-level perspective to the network perspective. Considering the importance of the boundary in the cluster, and thus the duality internal/external, a broader point of view is needed, which considers the bundle of alliances rather than observing every linkage separately. We analyze the impact of the external network of alliances on the formation and evolution of firm's internal network. A self-feeding co-evolutionary relationship between the internal, cluster-based network and the external, globally dispersed network is unfolded, ultimately disrupting the mainstream perspective which conceives the network as a whole and draws causal linkages only between the network and firm-level characteristics. The empirical setting, Bangalore IT cluster, allowed for a sharp differentiation between the two kinds of relational sets while underlining the inter-ties causal relationship which feeds the evolution of both networks over time.

Given the evolutionary, longitudinal character of the research questions of this paper, a pure qualitative approach has been considered as most suitable. Empirical evidence has been gathered considering the same six companies as the previous work, thus building on further interviews carried on with a precise focus on network evolution.

The exploration/exploitation theoretical paradigm as applied to inter-firm alliances has offered the theoretical framework to interpret our empirical evidence, and has allowed highlighting a major counter-intuitive result: the evolution of internal alliance from a exploitation to an exploration strategic intent. This is disruptive towards extant theory, which predicts exploration alliances to be evolving into more in-depth, specialized and mutually committing alliances aimed at exploiting the results of the initial exploration.

Building on that, this work gives evidence of how the characteristics of external networks turn out to influence the evolution and the characteristics of internal networks: long-term orientation and capability span, along with size, entail different degree of exploration through internal networks, which clearly arise to respond to specific needs stemming from the external domain. On the other side, the degree of exploration through local networks entail different degrees of long-term orientation, capability span and size of external networks, which are either triggered or jeopardized by the successful exploration of local domain, in a co-evolutionary pattern.

Following to a theory-building goal, propositions are formulated. The novelty of the study spans from the theoretical to the empirical level. Along the theoretical dimension, the causal pattern between sub-networks is first suggested and theorized, thus disrupting the traditional idea of the network as a monolithic entity. This is of utmost importance within the debate concerning network evolution and inter-firm alliances formation. Moreover, always on the theoretical dimension, the exploration/exploitation paradigm as applied to inter-firm alliances receives consistent advancement. Specifically, the possible evolution from exploitation-based to exploration-based alliances is crucial in developing a new perspective and fostering further research. On the empirical side, longitudinal evidence of a steady increase of local inter-firm alliances is provided; this further adds to our thesis of Bangalore IT industry being a cluster in rapid evolution. Moreover, in line with extant literature, we highlight the increasing strategic importance of the cluster to both domestic companies and MNCs, which have moved from a cost-driven exploitation intent of the local domain to a more knowledge-intensive, strategic exploration of the cluster-related resources.

This paper has been presented at the Strategic Management Society India Special Conference, Hyderabad (Andhra Pradesh, India), December 12-15. On this occasion, the paper has been awarded with the 'Best Paper Proposal Award'.

1.4.3 Paper 3 – Directions and Paths of Knowledge Flows through Personnel Mobility: A Social Capital Perspective (*with Rosa Grimaldi and Alessandro Grandi*)

This paper, as the closing work of this doctoral thesis, tries to catch the softer and more informal dimension of knowledge flows: personnel mobility. Inheriting the framework developed in the previous works, personnel mobility is studied as channelling knowledge flows among companies, both within and across the cluster, with a special emphasis to the inner dimension. The directions and paths of personnel mobility emerge, originally unravelling the uneven distribution of knowledge flows across companies, due to the effect of cluster affiliation (cluster vs non-cluster firms), industry affiliation (IT vs non-IT firms) and foreign affiliation (MNCs vs domestic firms). In formulating the hypotheses and in interpreting the results, a social capital perspective is deployed, through which we take into account the capability of employees to build ties across companies and to extend the overall company's social capital.

This last work is considered as an appropriate closure to the doctoral work, since it contributes to the overall picture through a robust and wide statistical analysis, undertaken by means of a purely quantitative research method. Personnel movements draw thousands of ties among companies: the data are thus very conducive to a quantitative approach. The hypotheses are tested through an original database encompassing 3895 employees' movements across and within the IT cluster in Bangalore, which produce 1331 cross-sectional directed dyads between 397 companies. Negative binomial regressions at dyad-level highlight three major findings. First, in line with previous literature, both outflows and inflows of valuable employees are more likely to occur between local firms: this provides one more piece of evidence further denoting Bangalore as a cluster. Second, and counter intuitively, flows of valuable employees highly concentrate along the path leading from

MNCs to domestic firms, thus apparently favouring knowledge transfer from MNCs to local domain. Third, inflows of valuable employees mainly occur from rivals, while outflows distribute equally to rivals and to non-rivals. Another major finding lies in the role of performance, which is present in the model as a control variable, in conducting knowledge flows through personnel mobility. Interestingly, valuable employees are more likely to flow from more profitable to less profitable companies.

The argumentation of the hypotheses and discussion of the results mainly emphasize the companies' strong strategic effort in both attracting and releasing personnel to other companies; according to a social capital perspective, not only the employees' acquisition but also the employees' loss can establish inter-firm ties and enhance companies' social capital.

The novelty of the study is multi-fold. It opens up the 'black box' of cluster knowledge spillovers, by highlighting different paths of knowledge flows, through a quantitative analysis and a direct measure of personnel mobility. In this sense, it promotes a consistent advancement towards the rich body of literature addressing knowledge spillovers, which mainly relies on patent data and thus provides indirect measures. In addition to that, this work explains the uneven distribution of knowledge flows and thus of social capital within the cluster, by emphasizing the role of three main firm-level factors in channelling personnel mobility: cluster affiliation, industry affiliation and foreign affiliation. The duality between MNCs and domestic firms carried along from the previous works receive further elaboration and a robust empirical support. Strong differences are highlighted in the strategic behaviours of the two types of firms, marking differences in the way these companies try to shape their social capital through the inflows and outflows of their employees.

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CHAPTER 2

*The Local Leveraging of Globally Generated Knowledge: A Cluster-Based Perspective**

Abstract

Much scholarly work has been focusing on knowledge flows within Multinational Corporations (MNCs) and on the impact of MNCs on host countries' growth. Yet, the knowledge sharing between MNCs and domestic firms and between domestic firms has received scant firm-level empirical evidence. This paper advances extant literature by unravelling the nature and direction of knowledge flows. We propose a cluster-based perspective, which considers MNCs and domestic firms as part of the same offshore cluster. Thus highlighting the importance of the cluster boundary, we explore intra-cluster and extra-cluster linkages of six companies located in Bangalore.

The contribution of the paper is two-fold. First, we highlight a fundamental distinction between business-domain knowledge and technical knowledge; second, we show how governance mode at tie-level and business specialization degree at firm-level are both able to determine the type of knowledge shared within the cluster. In this line, a major counter-intuitive finding emerges: outsourcing mode can also be conducive to the transfer of highly strategic tacit technical knowledge, thus approaching the benefits offered by proprietary mode. In addition, we provide evidence that domestic affiliation fuels local business-domain knowledge sharing within the intra-cluster domain.

* This paper has been presented at Strategic Management Society Conference, Cologne (Germany), October 12-15, 2008.

2.1 Introduction

The resource-based view (RBV) has been portraying the firm as a bundle of resources (Nelson and Winter, 1982; Barney, 1991; Nonaka, 1994; Grant, 1996), where knowledge represents one of the most important factors affecting firms' competitive advantage (Dierickx and Cool, 1989). In line with this, scholars have come to theorize the existence of multinational corporations (MNCs), as international organizations able to transfer and exploit knowledge more effectively and efficiently in the intra-corporate context than through external market mechanisms (Kogut, Zander, 1993). Following this stream of speculation, several studies have investigated the deliberate knowledge flows within the MNC (Gupta and Govindarajan, 2000), by focusing on knowledge inflows and outflows, i.e. all knowledge directed to, and stemming from, subsidiaries of MNCs (Mahnke, Pedersen, Verzin, 2003).

Considering knowledge flows across organizational boundaries, a few contributions have specifically explored how knowledge spills out from MNC subsidiaries towards the local contexts, in the form of dangerous leakage depauperating MNCs' core knowledge. A gradual shift in the perspective has recently lead to a stream of studies which, by considering the cluster as a whole, highlight the importance of MNC subsidiaries to local growth (Giarratana, Pagano, Torrisi, 2005). On the one hand, interesting works address how MNCs' subsidiaries absorb and leverage the knowledge embedded into local domain. Within this line of speculation, an important contribution comes from patent data (e.g. Singh, 2007): by considering citations patterns, these studies highlight MNC subsidiaries' degree of leveraging of local knowledge. In the same line, Andersson, Forsgren and Holm (2002) test the link between a subsidiary's business and relational embeddedness within the local domain and its performance. On the other hand, a set of scholars have shown a specific focus on the dynamics occurring within local high-tech clusters, in the attempt to track and describe the

growth and development processes of high-tech clusters in emerging economies (Arora, Gambardella, Torrisi, 2001).

By merging the two viewpoints, we aim at deploying a cluster-based perspective, which considers the MNC subsidiaries and the domestic firms as interacting entities within the local cluster. This perspective allows for the observation of the knowledge flows not only between the MNC subsidiaries and parent companies but also: 1. between domestic firms and external customers 2. between MNC subsidiaries and domestic firms 3. among domestic firms. Hence, in this paper we aim at contributing to extant literature by analyzing the knowledge flowing both through extra-cluster and intra-cluster channels. More specifically, we first intend to explore the kind of knowledge flowing along extra-cluster relationships, according to differences in governance mode. We define governance mode as either *outsourcing mode*, which rules the relationship between domestic firms and any other actor, or *proprietary mode*, which rules the relationship between the MNC subsidiary and the parent company.

Moreover, we want to observe the relation (if any) between *external knowledge* – knowledge that cluster firms source from companies outside the cluster leveraging through extra-cluster linkages - and cluster-based *internal knowledge* – knowledge that cluster firms share internally, within the cluster, through intra-cluster linkages. In this sense, we aim at considering whether the exposure to external knowledge fuels the capacity of cluster firms to accumulate internal knowledge and to share knowledge in the local domain, thus fostering local cluster knowledge accumulation. More specifically, we aim to highlight the role of foreign affiliation, namely the differences between domestic firms and firms affiliated to foreign companies, namely the MNC subsidiaries.

This contribution is considered as relevant to current managerial practice because it unfolds the factors which can eventually lead to differences in the type of knowledge

flowing. This evidence can benefit both external actors – who can be more aware in channeling knowledge back and forth the cluster – and internal actors, who gain new insight into the importance of external presence to refine their knowledge base and ultimately acknowledge the richness in sharing knowledge with the local domain.

The paper is structured as follows. A first section will review the theoretical background, namely the relevant literature addressing knowledge sharing within clusters and the interplay between knowledge flows and governance mode. In order to underline our contribution to the extant literature, our exploratory research questions will be pointed out. Then, a second section will describe the methods, in terms of empirical setting, research methodology, case selection and data gathering. A third section will present the empirical evidence, which is both qualitative and quantitative in nature. Then, a discussion section will advance some propositions, while the concluding section will highlight the theoretical contribution as well as managerial implications of the paper.

2.2 Theoretical background

2.2.1 Industrial clusters and knowledge sharing

Porter (1990) defines a geographical cluster as a spatially concentrated group of firms competing in the same or in related industries, that are linked through vertical or horizontal relationships. The cluster phenomenon is usually characterized by mechanisms that facilitate the interchange and flow of information between firms, while maintaining inter-firm rivalry (Porter, 1990). Firms inside a cluster share engineering solutions and information about new technologies through professional, social and exchange relationships (Nohria, 1992; Saxenian, 1994). Moreover, geographical concentration of firms creates a market for skilled

workers and specialized inputs that lower the cost of inputs for industrially focused firms (Krugman, 1991).

Among the benefits of industrial clusters, literature has broadly underlined the importance of the co-presence of customers and suppliers within the cluster, in order to promote a co-evolution of technology through partnerships in product design. Cluster participation is theorized as fostering the access to certain complementary assets, which are better provided beyond firms' boundaries than within and are accessed more effectively in geographic proximity (Storper, 1997; Porter, 1998). The literature, with specific regard to high-tech industries, has acknowledged the importance of tacit components of knowledge, which require close interaction to be effectively sourced, shared and used (Storper, 1995). Geographical proximity of firms within high-tech clusters is generally considered as a pre-condition to the effective knowledge sharing of tacit knowledge (Saxenian, 1991; Zaheer and George 2004). Indeed, geographical proximity fosters the possibility of interaction between co-located firms, mainly due to social relationships built on inter-personal ties (Sorenson, 2003). Moreover, the limited mobility of actors in their job search triggers the transfer of human capital and knowledge inside a specific context between co-located firms (Breschi and Lissoni, 2001). Lastly, firms find it easier to establish collaborations with other organizations in the same regional context because of the work practices, culture and technical terminology they share (Saxenian, 1994).

Drawbacks of dense industrial clusters are also explored. A consistent stream of studies addresses the need of extra-local linkages by referring to the dangers of local networks that are too close, too exclusive and too rigid (e.g., Zaheer and George, 2004). Strongly embedded social relations could pose an actual threat to the competitiveness of a firm or of a group of firms; Uzzi (1997), in its seminal work, has highlighted the phenomenon of over-embeddedness. He proves that close social relations of suppliers to local customers

turn to be profit-driving until a threshold is reached. Above the threshold, the stronger a large group of suppliers is embedded with the same set of customers, the more likely are firms to fail. Firms that exceed in establishing ties in their geographically localized area may become extremely bounded in the information flowing within the cluster and less open to new and novel concept (Owen-Smith and Powell, 2004; Maskell et al., 2006). Firms that overtake the degree of intra-cluster linkages are less likely to gain new or additional information from their direct contact and as a consequence the potential for creating novel combination decrease (Noteboom, 2004).

Drawing upon these findings, a substantial stream of literature claims the need for channels to access external knowledge (Albu and Bell, 1999; Nachum and Keeble, 2003; Owen-Smith and Powell 2004; Zaheer and George 2004; Giuliani and Bell, 2005). Owen-Smith and Powell (2004) use the term ‘pipeline’ to label the formal channels that enable the source of external knowledge in distant interactions. Extra-cluster ties introduce variance in the overall company’s knowledge stock, enhancing innovative capabilities (Maskell, 2007).

Bridging, on the one hand, the important role that industrial clusters display in fuelling knowledge sharing and innovation, and, on the other hand, the need for external linkages to refresh local knowledge stock, a gap in the literature emerges. A study by Zaheer and George (2004) shows that a mix of extra-cluster and intra-cluster ties benefits the companies’ financial performance. This finding highlights the complex process of acquiring technology-intensive knowledge and underlines the need to further explore the balance between externally-sourced and internally-sourced knowledge. Considering the knowledge sourced through extra-cluster ties by cluster firms, there are elements suggesting that both the contents of knowledge and the governance mode deployed to handle the relationship are crucial factors in unfolding the characteristics of knowledge flows.

2.2.2 Knowledge Flows and Governance Modes

As far as knowledge content is concerned, special emphasis is posed by scholars on the tacitness dimension. According to the distinction first drawn by Polanyi (1966), knowledge can be either tacit or codified. Tacit knowledge is supposed to embed the core elements of the firm's competitive advantage (Kogut and Zander, 1993; Reid et al., 2001; Dhanaraj et al., 2004; Fey, Birkinshaw, 2005;), since it encompasses difficult-to-replicate and difficult-to-imitate capabilities and practices. Due to its procedural nature, tacit knowledge appears to be sticky and difficult to transfer, unless undertaking high costs (Von Hippel, 1994; Szulansky, 1996).

As for governance mode, it refers to the coordination mechanisms used to handle the relationship. Partnering and contracting have been acknowledged as well-established governance modes (Veugelers and Cassiman, 1999; Fey and Birkinshaw, 2005), together with equity alliances, full ownership and joint ventures (Reid et al., 2001). Several studies have investigated the relationship between the governance mode and the nature of the knowledge to be transferred, building upon the seminal empirical work and theoretical speculation by Kogut and Zander (1993). Three main attributes are acknowledged as exhaustive in defining the knowledge construct: *codifiability*, *teachability* and *complexity*. Their findings confirm the significance of the first two dimensions: as the knowledge becomes more codified and more easily taught, the more likely it will be transferred to a third party rather than to a wholly-owned subsidiary. The authors give empirical test to their theoretical argument, according to which 'firms tend to specialize in the transfer of knowledge that is difficult to understand and codify' (1993, p. 523). Furthermore, they argue that, 'due to the joint qualities of novelty and difficult imitation, knowledge that is tacit can be expected to embody the advantage of the firm to grow and expand in the future' (1993, p.

523). Thus, they identify the core competencies of the firm as embedded within the most tacit knowledge within the firm.

Fey and Birkinshaw's study (2005) further develops these issues. They analyze how the choice of governance mode for external R&D, along with openness to new ideas and codifiability of knowledge, impact on R&D performance. The authors distinguish the way through which companies can source external knowledge into two modes: partnering with universities and contracting with firms. Their findings highlight the negative effect of external contracting and the positive effect of partnering with universities. In particular, partnering enhances the transfer of knowledge to the focal firm as compared to contracting mode, thus benefiting the R&D performance, due to the structure of social interaction, relationship quality, and partner network ties. An important moderator effect of codifiability of knowledge emerges: the negative effect of contracting on R&D performance appears to be mitigated in when less codifiable and more tacit knowledge is delocalized through contracting mode. This is 'presumably because the contractee can less easily make use of knowledge it may obtain via leakage from the focal firm without help from the focal firm' (Fey and Birkinshaw, 2005: pag. 615). This finding interestingly breaks the traditional perspective, which tends to associate less tacit and less 'core' knowledge to the outsourcing mode, in order to prevent leakages (e.g. Kogut and Zander, 1993).

Governance mode is thus a major factor able to entail differences in knowledge flows. Bridging the focus on governance mode with cluster-related speculation, deeper investigation is requested, to unfold how local knowledge absorption occurs according to differences in governance modes, and to explore the nature of the knowledge spreading within the local domain. In particular, further research is needed to analyze the process through which extra-cluster knowledge sourced by domestic firms, both via *proprietary* and *outsourcing* modes,

comes to feed local firms and promote knowledge accumulation at cluster level. Aiming at filling the gap thus highlighted, in this paper we address the following research questions:

1. *What kind of knowledge is likely to flow along extra-cluster linkages, according to differences in governance modes?*
2. *Is extra-cluster knowledge likely to affect the capacity of cluster firms to develop further internal knowledge?*
3. *Is extra-cluster knowledge likely to promote local cluster knowledge accumulation?*

2.3 Methods

2.3.1 Empirical setting

The research setting is Bangalore IT cluster. We consider the concentration of IT firms located in Bangalore as a cluster because of the co-presence of competing, and to a certain extent cooperating, firms in the same industry, according to the definition provided by Porter (1990). The IT cluster in Bangalore has recently been paid much speculative attention, as the major example of IT services offshoring/outsourcing phenomenon. It particularly fits the research need of this paper for a number of reasons.

The cluster is portrayed as being mainly horizontal, with a thick network of co-located supplier firms exporting nearly 70% of their IT services to globally dispersed customers. Indian IT suppliers are acknowledged to be highly competitive and scarcely co-operative (Lema and Hesbjerg, 2003; Dossani and Kenney 2003; Giarattana et al., 2004), thus preventing the cluster from evolving up in the value chain. Nevertheless, the domestic firms' relationships to external customers as well as the massive presence of MNCs' subsidiaries undoubtedly give preferential access to highly-qualified knowledge (Basant, 2006). Case-studies referring to other contexts have supported the capability of offshore industrial cluster

to develop local knowledge, turning to be highly competitive from a global point of view (Ernst, 2006). We believe a deep analysis addressing the evolution over time of the knowledge flowing both extra-cluster and intra-cluster is worth it. This can highlight possible patterns, which either support previous evidence with deeper insight or otherwise disconfirm prior findings by highlighting different behaviours.

Last but not least, Bangalore IT cluster is emerging as knowledge-intensive high-tech cluster. Cluster-related literature has traditionally addressed manufacturing clusters (e.g. Lorenzoni and Lipparini, 1999) where knowledge is likely to be embedded in both tangible physical goods and into intangible flows. Unlikely, the service-based focus of Bangalore IT cluster entails the knowledge to be shared through intangible channels only. With respect to this, it is of utmost importance particularly in this empirical context to map the knowledge flows and to highlight factors which can impact on their strength and content. On the other hand, this empirical setting offers a 'pure' case where to observe the process of knowledge transfer, which is entirely flowing 'in the air' because of the lack of physical goods. To wrap up, the IT cluster in Bangalore is fitting our research need because of: 1. a strong acknowledged presence of extra-cluster relationships, 2. the existence of a certain extent of cooperative practices among local competing firms, 3. the high-tech service characterization, which is likely to entail pure intangible knowledge flows.

2.3.2 Research methodology

Given the exploratory nature of our research questions, an inductive, case-based approach is considered as best suitable, which is aimed at theory-building (Eisenhardt, 1989; Yin, 1994; Eisenhardt, Grabner, 2007). The richness of qualitative evidence from case studies allows for an in-depth analysis of the interplay between governance mode and knowledge

flowing along the relationship, together with the processes through which the knowledge flows are absorbed and leveraged. Specifically, this choice makes it possible to gain a deeper insight into the nature of knowledge and into its flowing trajectories, which the traditional studies addressing knowledge flows through patent data have overlooked (Singh, 2007).

Considering the firm as well as its ego-network, an issue related to the unit of analysis is well known (Capaldo, 2007). Network researchers in the field of inter-firm relationships come to investigate research questions at the intersection of tie- firm- network level (Borgatti and Foster, 2003); hence, network research appears to be cross-level in nature (Hagedoorn, 2006), thus yielding the need for an in-depth methodological consideration. Building on this, Coviello (2005; 2006) first acknowledged a quali-quantitative approach as necessary and best suitable to network analysis, the network being multifold in nature. The author effectively point out the methodological issue as follows: ‘if it is accepted that networks possess both structural and interactional qualities, both quantitative and qualitative data are necessary for a complete network analysis’ (2006: p. 717).

Very much in line with this, we first analyze the knowledge flowing at firm-level, through a first step based on semi-structured interviews. Our qualitative evidence thus gathered fostered a second research step, which aimed at the development of a quantitative questionnaire at tie-level. This research tool has been refined and enriched in multiple stages as long as more qualitative evidence suggested new points deserving further exploration. The tie-level questionnaire investigates differences in the type of knowledge shared along inter-firm relationships by exploring the influence of tie-level attributes. This is conceived as to complement the firm-level investigation undergone through semi-structured interviews during the first step of our analysis. Indeed, beyond across-firm differences, across-tie differences within the same company’s ego-network can arise, which might be associated with differences in the knowledge shared. The need for a second-step, tie-level investigation

fulfils our research wish to explore the role played by the governance mode in fuelling knowledge sharing, which can be but a tie-related attribute.

By deploying a quali-quantitative methodology, our theory-building purpose keeps unaltered, as well as the inductive approach pursued through case studies. Indeed ‘case data can be analysed and interpreted with a bifocal lens, that is, both qualitatively and quantitatively’ (Coviello, 2006: p. 717).

2.3.3 Case selection and data gathering

The case selection has been undergone according to the firm characteristics. Six comparative longitudinal cases are developed, considering six companies located in Bangalore. A multiple-case studies research method is deployed, which is able to yield more robust, generalizable and testable theory than single-case research (Eisenhardt and Grabner, 2007). Following the authors guidelines, the cases have been selected according to theoretical sampling and a ‘polar-type’ strategy has been pursued: extremely different cases are investigated, in order to observe contrasting patterns in data more easily.

The selection of the companies is first of all aimed at representing the three main firm typologies present in the cluster: IT services providers, small technology-focused companies and MNCs’ subsidiaries. Location and industry being equal, a two-paired polar logic is deployed: two large MNCs’ subsidiaries (HP and Yahoo!), two large domestic IT service providers (Symphony and IGate) and two small technology-focused domestic firms (S7 Software Solutions and BangaloreSoftSell) are observed. Within each pair, one old and one young firm is present, in order to account for differences for the age effect, besides foreign affiliation and size. The six companies are very well-known in the local domain as examples of very profitable and fast-growing companies, in the case of the larger MNCs and IT service

providers, while the small technology-focused companies are especially notable for their innovative character. Table 2.1 summarizes the relevant dimensions of comparison across the case studies.

INSERT TABLE 2.1 ABOUT HERE

As for data gathering, we rely on different information sources, namely semi-structured interviews and closed questionnaires.

a) semi-structured interviews. Face-to-face interviews have been held with the top management of the six companies, aimed at understanding the knowledge flows along both extra-cluster and intra-cluster linkages. Moreover, information about the company's start-up, the current main business, the business model adopted and the patterns of interactions to customers has been gathered. Last, we collected information about the firm's ego-networks. Firms have been asked to highlight their most important partners over the last 3 years, as the partners contributing to 80% of the company's income in the case of customers, to 80% of the purchasing expense in case of suppliers and of 80% of innovative performance in case of R&D collaborations. This procedure has been followed both internally and externally, thus drawing the relevant intra-cluster and extra-cluster ties forming the complete ego-networks. Moreover, the top management has been asked to highlight the people most involved into each relationship, in order to allow for the tie-level data gathering. Along with the six firms under exam, 38 ties emerged: the six ego-networks are represented in Figure 2.1, which also illustrates the analytical framework deployed to classify the ties.

INSERT FIGURE 2.1 ABOUT HERE

b) structured questionnaires. In order to source tie-level data, interviews to the people indicated by the CEOs as most involved into each inter-firm relationship allowed for an in-depth dyad-level investigation, with a special emphasis upon the nature of knowledge shared and upon the mechanisms aimed at channelling the knowledge flows. A closed tie-level questionnaire has been submitted to each person for each tie, with 12 items surveying knowledge codifiability, strategic value and specificity. The evolution over time of both the nature of the knowledge and of the characteristics of the tie has been tracked back, in order to highlight the evolutionary patterns. The respondents were asked to rank each item for three points in time, 2005, 2006 and 2007, where applicable. A total of 77 observation points are thus composing the tie-level database.

A retrospective bias concern can arise, since the longitudinal perspective is obtained by tracking back information, thus entirely relying on the person's subjective perception of the past. However, two main reasons are believed to mitigate the issue. First, our aim is to gather subjective data, because of the intrinsically subjective nature of knowledge flows: what really matters to this study is the perception of the knowledge absorbed by the focal cluster company, in relation to the characteristics of the tie. According to this perspective, an effort to gather objective data would have been inconsistent. Hence, no risk of temporal distortion biasing objective data can arise; indeed, subjective data are meant to portray individual perception, which might as well encompass the evolution over time of personal opinions. Second, we believe that, even assuming a potential retrospective distortion, this would be common to all constructs under exam, thus not jeopardizing our results. In this sense, we agree with the methodology followed by Gubrium and Holstein (2003).

2.4 Empirical evidence

The evidence will be presented as follows: a first analysis is devoted to the empirical investigation of the type of knowledge flowing along the bunch of inter-firm relationships as a whole. Then, quantitative results will be presented to support differences both across-companies and across different types of ties: extra-cluster ties and intra-cluster ties will be focused on separately.

2.4.1 Interview data

All firms agree in distinguishing two types of knowledge eligible to be shared through inter-firm relationships. Along with the technical knowledge *strictu sensu*, specific to the single project/product developed along the relationship, a more generic, soft and business-domain focused knowledge emerges, which relates to the

[...] kind of background of what the customer is dealing with.. the understanding of what that product serves and how it serves' (CEO, S7 Software Solutions).

And

[...] the business-domain, subject matter knowledge, is functional expertise. This is deeper than functional, this can be dealing with business policies even' (CEO, BangaloreSoftSell).

The four domestic companies from our sample agree in portraying the direction of business-domain knowledge flows, which appear to stem from external customers and to reach cluster firm through customer-supplier relationships:

[...] Most Indian companies especially almost every small companies have 0 knowledge in the business domain. Subject-matter expert. So probably most Indian companies know software design development they don't know a particular business process so they need a subject-matter expert to develop. Customers give us the business-domain, subject matter knowledge' (CEO, BangaloreSoftSell)

Business-domain knowledge helps in gaining a better understanding of the customers' requirements, and in fostering the sharing of technical knowledge along the relationship:

[...] One thing you should understand is that the reason why a specific customer was able to make us understand what he wants is that we have the technology knowledge of the particular domain he is dealing with. If we had not that particular knowledge, the knowledge of the domain he is dealing with, he might not be able to transfer that knowledge that easily. There is a dependency pattern in this: because of the knowledge we already have, the customer is able to easily transfer his technology to us. The technology happen to be easily transferable because you have the domain understanding. If you did not have this domain understanding it would have been very difficult' (Manager – Business Development, S7 Software Solutions).

Indeed, according to the interviewees, business-domain knowledge must be distinguished from technical knowledge because of its lower degree of specificity and because of its easy transferability within the company to similar projects:

[...] Domain knowledge is a universal thing. Domain knowledge is not specific to a product... The knowledge which comes as open knowledge or generic knowledge is not protected. What is really protected is stick to the product' (Manager – Business Development, S7 Software Solutions).

The lower specificity degree characterizing business-domain knowledge entails a lower partners' effort in protecting the knowledge. For domestic firms, this deeply affects the possibility to absorb business-domain knowledge, to augment their internal knowledge stock and to deploy business-domain knowledge in further projects with different customers:

[...] Certainly knowledge can be redeployed. Company can put a restriction on us, saying that we are giving u the functional knowledge you can't use it with the competitors, monitoring based on trust. Given that restriction, definitely what happens is, we have done and grown up an expense management system and put it on a very different domain, now from a technical applicative point of view, I would say there is no difference between these two. It is just a matter of application. Very easy. Transfer of business domain knowledge' (CEO, BangaloreSoftSell).

[...] The domain knowledge is actually flowing, not the technology not the way we implement the product it is just about the domain.. If we are working on a ERP application we get to know what are the features of an ERP application. So when another customer comes and says, we want to have an ERP application we will not use the knowledge which is embedded into one product onto another one. The domain knowledge will help us get a bigger understanding. The domain knowledge will help us to cut short the time to understand what the customer wants from us. It will help us handle more such applications' (Manager - Business Development, S7 Software Solutions).

Hence, the possibility to create value for the customer is partially due to the company's amount of business-domain knowledge related to the customers' business area. On the other hand, the company's business-domain knowledge stock depends on the number and depth of a company's previous interactions to external customers in the specific business area. A need for vertical specialization upon a specific industry is thus very well perceived by the companies: BangaloreSoftSell is focused on aerospace, whereas IGate is deeply specialized on the financial industry, serving mostly insurance companies and banks all over the world. Given to its young age, Symphony is willing to specialize and recognize explicitly the value of vertical specialization, as able to cut costs and to develop high-quality products:

'[...] We specialize in retail, we specialize in financial services, we specialize in CRM, in SRM, and SCM (supply-chain management). We are actually industry agnostic. While we have strong capabilities in certain areas, for five years since we have been founded we are focalized in those industry segments, but we believe our DNA is product engineering, we can develop product for any vertically specialized company. But of course we have to hire people, to hire people who not only understand product engineering but also understands the particular industry vertical advantage' (Executive Vice President and Chief People Officer, Symphony) .

Given the abovementioned qualitative evidence, common patterns emerge, which can be ascribed to two main concepts. We define business-domain knowledge as the knowledge about a partner's end market and customers, thus about a partner's target industry, in the case of cluster companies producing high-end products, or about partners' internal processes, highly depending on its industry, for cluster companies producing software for customers' internal consumption. Moreover, we define a company's specialization degree as the amount of business-domain knowledge a cluster company has accumulated over time.

2.4.2 Quantitative analyses

The survey questionnaire at tie-level is aimed at measuring knowledge dimensions for the two types of knowledge emerging from qualitative evidence: business-domain knowledge and technical knowledge. The respondents are set by default as knowledge recipients, thus our measures reflect their perception of knowledge inflows, rather than objective knowledge flows. As a starting point we construct our scales by drawing on previous literature (Table 2.2): Simonin (1999) provided measures for knowledge codifiability; Ryssel, Ritter and Gemunden (2004) and OSLO Manual (2005) for knowledge strategic value; Simonin (1999) and OSLO Manual (2005) for knowledge specificity. Two items have been selected to portray each relevant dimension.

Our principal aim pointed at testing the need to differentiate the broad knowledge construct into technical knowledge and business domain knowledge. Hence, we duplicated the items with a coupled logic, in order to measure the constructs for both types of knowledge. This produced a total questionnaire of 12 Likert-scale items: the respondents have been asked to rank the statements with a number ranging from 1 (strongly disagree) to 7 (strongly agree).

INSERT TABLE 2.2 ABOUT HERE

In order to explore whether the two types of knowledge were reflected by the data structure, an exploratory factor analysis has been run. We considered principal component analysis with oblique rotation as appropriate, since we expected the emerging factors to be correlated. Both the Bartlett test of sphericity (chi-square=821,368, d.f.=66 and p -value<0,0001) and the Kaiser-Myer-Olkin measure of sampling adequacy (MSA=0,776) indicated that the starting data matrix was appropriate for factor analysis.

After initial factor analysis, three items were removed because of relevant cross-loading (above 0,4). The analysis was thus re-run and a structure composed by two factors with eigenvalue greater than unity emerged. In order to preserve the coupled logic, we retained the items which were common and relevant to both factors. A final structure of 6 items representing two factors emerged, matching our expectations on business-domain knowledge and technical knowledge: a total variance of 70% is explained. Items and factor loadings are represented in Table 2.3. The items we retained are grey-shadowed and given the general label of the main construct they are measuring according to literature. Interestingly, the factors are two, while we expected them to be six (codifiability, strategic value and knowledge specificity for both business-domain knowledge and technical knowledge). This can suggest a strong correlation between the knowledge codifiability, strategic value and specificity, which jeopardized the possibility to isolate different factors. A stronger relevance is though attributable to the differences between the two different types of knowledge rather than to the differences between codifiability, strategic value and specificity. This is in line with what has emerged from qualitative evidence.

INSERT TABLE 2.3 ABOUT HERE

The tie-level quantitative perspective is of utmost importance, since it allows to catch the companies' different behaviour in knowledge sourcing and knowledge sharing along two different dimensions: extra-cluster and intra-cluster. First, let us consider the MNCs' subsidiaries *vs.* domestic firms. ANOVA test has been run, in order to test for differences between foreign affiliation (MNCs' subsidiaries) and domestic affiliation (domestic firms) along the items measuring knowledge codifiability (items T_COD and BD_COD), strategic value (items T_SV and BD_SV) and specificity (items T_KS and BD_KS). Results are summarized in Table 2.4.

INSERT TABLE 2.4 ABOUT HERE

Statistically significant differences emerge, between the average scores on the items measuring business-domain knowledge codifiability (items BD_COD with p -value $<0,001$), business-domain knowledge specificity (BD_KS p -value $<0,001$) and business-domain knowledge strategic value (BD_SV, p -value $<0,05$). This evidence suggests that MNCs' subsidiaries and domestic firms perceive and use business-domain knowledge in different ways. In particular, business-domain knowledge appears to be much more codifiable, namely understandable, for domestic firms than for MNCs' subsidiaries. Moreover, business-domain knowledge emerges as being far less specific and more likely to be redeployed over different projects for domestic firms than for MNCs' subsidiaries.

Then, an examination at tie-level follows, in order to address the differences across the ties, beyond those across companies. Indeed, differences across ties of the same firm can arise because of: 1. the governance mode ruling the relationships and 2. the different locations of the partners. As already mentioned earlier in this paper, we can identify two main governance modes: the *proprietary mode*, characterizing the tie between a subsidiary and its parent company and the *outsourcing mode*, ruling the tie between a domestic firm and a generic customer/supplier, both domestic and external. As far as location is concerned, as shown in the analytical framework portrayed in Fig. 1, we have identified six different classes of ties. For MNCs' subsidiaries, the extra-cluster ties to the parent companies (MNC-PAR), the intra-cluster ties to domestic firms (MNC-DOM) and the intra-cluster ties to MNCs' subsidiaries. For domestic firms, their extra-cluster ties to other external customers (DOM-EXT), domestic firms' within cluster ties to MNCs' subsidiaries, domestic firms' intra-cluster ties to domestic firms (DOM-DOM). It is crucial noting that proprietary mode and location are considered as not independent in this study. Indeed, proprietary mode can be observed as

ruling the relationship between a local MNC's subsidiary and its external parent company, whereas outsourcing mode can be seen as ruling: 1. all the intra-cluster relationship and 2. the domestic firms' extra-cluster relationships.

Extra-cluster ties. Let us consider first the differences between MNCs' subsidiaries and domestic firms along extra-cluster ties. This allows for the observation of the influence of governance mode on the nature of inflowing knowledge; indeed, the extra-cluster ties are polarized onto outsourcing mode for domestic firms and proprietary mode for MNCs' subsidiaries. Table 2.5 shows the ANOVA results along the knowledge dimensions under observation, namely knowledge codifiability, specificity and strategic value. The grouping variable remains the type of affiliation (domestic vs foreign) and only the extra-cluster ties have been considered.

INSERT TABLE 2.5 ABOUT HERE

The codifiability of the technical knowledge sourced externally through proprietary mode by MNCs' subsidiaries proves to be significantly higher than the codifiability of technical knowledge sourced through outsourcing mode by domestic firms from external partners (T_COD significant, p -value $<0,001$). Hence, subsidiaries seem to hold a stronger understanding of the parent company technology than domestic firms have of external customers' technology. In line with this, technical knowledge sourced through proprietary mode appears to be more valuable (T_SV significant, p -value $<0,05$) and much less specific than through outsourcing mode (T_KS significant, p -value $<0,01$).

As far as business-domain knowledge is concerned, interestingly no overall significant differences can be highlighted, except for the strategic value dimension. This suggests that, if technical knowledge flows clearly benefit from proprietary mode, no such

benefits can be retrieved for business-domain knowledge. Addressing extra-cluster ties, it is worth considering the firm-level business specialization of domestic firms, as able to trigger the knowledge flows according to our qualitative evidence. An ANOVA test has been run, in order to test for differences in the absorption of business knowledge vs technical knowledge between generalist and specialist domestic firms. The specialized companies appear to be learning from their external partners more strategically valuable technical knowledge than their generalist counterpart (T_SV significant, p -value<0,01). BD_KS shows significant difference too, highlighting that, beyond the strategic value, specialized firms learn more business-domain knowledge than generalist ones (Table 2.6).

INSERT TABLE 2.6 ABOUT HERE

Intra-cluster ties. Turning to the local context, a different scenario emerges. An ANOVA test has been run, considering the affiliation as the grouping variable and including only the intra-cluster ties. Table 7 thus shows the differences between MNCs' subsidiaries and domestic firms along the intra-cluster dimension. The comparison focused on intra-cluster ties highlights the differences in the knowledge sourced locally by MNCs' subsidiaries and domestic firms, governance mode being equal across ties. Indeed, as shown in fig. 4, outsourcing mode is ruling all intra-cluster ties, which encompasses the DOM-DOM, the MNC-DOM, the MNC-DOM (different from the previous one because of the different recipient's perspective) and the MNC-MNC mode.

INSERT TABLE 2.7 ABOUT HERE

Business-domain knowledge flows through extra-cluster ties are strongly more codifiable (BD_COD significant, p -value $<0,001$) and way less specific (BD_KS significant, p -value $<0,001$) for domestic firms than for MNCs' subsidiaries. Even on the strategic value dimension, business-domain knowledge appears to score significantly higher for domestic firms than for MNCs' subsidiaries (BD_SV significant, p -value $<0,01$). Thus, domestic firms appear to relevantly source and share business-domain knowledge within the local context, from either other MNCs' subsidiaries or other domestic firms. MNCs' subsidiaries on the other hand, appear to leverage the local business-domain knowledge to a much lesser degree than domestic firms.

Turning to technical knowledge, significant differences can be highlighted, too. Technical knowledge sourced internally turns out to be much more codifiable, thus more understandable for domestic firms than for MNCs subsidiaries (T_COD significant, p -value $<0,05$). Furthermore, it appears to be far less specific, thus more likely to be redeployed over other projects, to domestic firms than to MNCs' subsidiaries (T_KS significant, p -value $<0,01$).

2.5 Discussion

On the basis of the above-mentioned evidence, we advance some propositions. Qualitative evidence clearly highlights the need for a distinction between technical and business-domain knowledge, which we leveraged and further explored through the quantitative tie-level survey. Let us first consider the extra-cluster dimension, both at tie- and at firm-level. Domestic firms and MNCs' subsidiaries which have been developing software or R&D for external customers/parent companies, are likely to source both technical and business-domain knowledge, which is fuelling both the company and the local cluster.

Considering MNCs' subsidiaries as opposed to domestic firms along extra-cluster ties at tie-level, strong difference can be retrieved on the technical side. Technical knowledge appears to be much more codifiable, understandable and less specific to MNCs' subsidiaries than to domestic firms. This can be due to the much stronger technical disclosure a company deploys towards a proprietary structure located in an offshore cluster, which guarantees extreme control on the technical core competencies and capabilities. Companies are likely to devote efforts to codify the knowledge, thus minimizing the costs related to knowledge transfer and sharing. Moreover, the constant exclusive interaction to the parent company triggers a trust-based reciprocal learning, which best channels technical knowledge flows.

On the contrary, within a generic outsourcing agreement, technical knowledge is likely to be locked and highly protected by the external customer. This compels the generic supplier to undergo specific investments on the relationship, in order to build the trust which can fuel the understanding of the external customers' technical requirements and can ultimately lead to a progressive sharing of complementary technical competencies. The lock-in of technical knowledge fosters domestic companies to acknowledge and capture the business-domain side of the knowledge, in order to maximize the benefits from the specific relationship. Interestingly, our four domestic companies clearly pointed out the concept of business-domain knowledge as opposed to its technical counterpart, while MNCs' subsidiaries, though acknowledging the distinction, were very much less keen on discussing it. And indeed, while a strong difference can be retrieved on the technical side, between domestic firms and MNCs' companies, nearly no difference can be seen in the business-domain knowledge absorption and retention on the external dimension. This can be explained by the fact that subsidiaries give less value to business-domain knowledge than domestic firms, since they were born as over-specialized and exclusively devoted to a specific customer, the parent company. The governance mode thus appears to influence the type of

knowledge shared and sourced along the extra-cluster relationship. Hence, we advance our first and second propositions:

Prop. 1 – Proprietary mode is positively associated with technical knowledge flows

Prop. 2 – Outsourcing mode is positively associated with business-domain knowledge flows

Addressing the extra-cluster dimension at firm-level, further speculation is needed, considering domestic firms. Qualitative evidence suggests that, during the interactions to external customers, domestic firms mainly benefit from the retention of business-domain knowledge, which helps in understanding the customers' technical needs, thus triggering the subsequent absorption of technical knowledge. Business-domain knowledge also appears to cumulate over time within the company, through repeated interactions to partners working in a specific business area.

Quantitative evidence further supports this point. Considering the knowledge absorption by MNCs' subsidiaries as opposed to domestic firms, strongly significant differences emerge in the absorption of the business-domain knowledge, as far as both business-domain knowledge codifiability and business-domain knowledge strategic value are concerned. This is very much in line with the previous argument: domestic firms are likely to interact with more than one external customer whereas the MNCs' subsidiaries under observation serve one customer only, the parent company. This leads the domestic firms first to be more likely to span the whole customers' business area; second, they tend to develop a further tendency to acknowledge business-domain knowledge, as able to fuel the internal knowledge accumulation and to nurture further collaborations with different customers within the same business area. Thus, our third proposition follows, arguing the role of repeated

interactions as a first firm-level feature able to foster business-domain knowledge inflows and absorption:

Prop. 3 – Multiple repeated interactions to external partners within a specific business area are positively associated with business-domain knowledge inflows.

The company comes to develop over time a business-specialization degree, which further fosters technical knowledge accumulation as well as further business-domain knowledge refinement. Quantitative evidence further supports this line. The accumulation of business-domain knowledge can nurture the sharing of technical knowledge on the specific relationship, but, due to its low specificity, it can be fruitfully redeployed over other customers within the same business area, in order to get deeper understanding into their technical needs. That is why, when considering domestic firms along extra-cluster ties, highly specialized suppliers appear to significantly absorb more highly strategic valuable technical knowledge than their generalist counterpart. A dependency pattern emerges directly from the field: business-domain knowledge helps in transferring the partner's technology to the company, since it triggers the understanding of technical knowledge. Given the subjective measure of codifiability we are considering, namely the possibility for the recipient to understand the partner's technology, we can argue that in the eyes of the beholder, as in the recipient company, technical knowledge appears to be more codifiable thanks to the business-domain knowledge cumulated within the company's business specialization. Having defined business specialization degree as the amount of business-domain knowledge related to a specific business area, our fourth proposition sounds as:

Prop. 4 – The domestic firm's business specialization degree is positively associated to technical knowledge inflows.

Moreover, our evidence suggests that whenever a specialized domestic firm is interacting to an external customer through an extra-cluster tie, it seems to be sourcing less specific business-related knowledge than its generalist counterpart. Given that business-domain knowledge is defined as the knowledge of a company's market, customers' needs or internal processes, it is supposed to be bounded and to hold novelty degree with decreasing rates. Our somehow counterintuitive evidence suggests that prior business-domain know-how fosters further business-domain knowledge to be sourced and accumulated along inter-firm relationships. Indeed, a domestic firm with high business specialization degree is likely to develop a special capability to recognize and sources business-domain knowledge, which can explain the higher scores along this dimension given by specialized firms as compared to generalist ones. The following proposition is thus suggested:

Prop. 5 – The domestic firm's business specialization degree is positively associated with the business-domain knowledge inflows.

Considering the local domain of inter-firm collaborations, a different scenario emerges. By collecting the perception of both MNCs' subsidiaries and domestic firms related to the knowledge sourced locally, intra-cluster investigation succeeds in gathering an overall perspective on local knowledge sharing. Focusing on the local dimension, strong differences can be retrieved between MNCs' subsidiaries and domestic firms. As mentioned earlier, domestic firms seem to be sourcing from the local cluster significantly more codifiable and less specific business-domain knowledge than their foreign counterpart. On the technical side, domestic firms have a plus in considering the local technical knowledge as more codifiable and less specific, thus more likely to be accumulated within the company and redeployed across different projects. This evidence suggests a significantly stronger leverage of the local domain for domestic firms than for MNCs' subsidiaries. Since the local cluster

encompasses other domestic firms as well as other MNCs' subsidiaries, this evidence can be extended to embrace the opposite perspective, not just considering knowledge absorption but also knowledge sharing. Domestic firms are more likely to share both business-domain knowledge and technical knowledge than MNCs' subsidiaries in the local context. Since both governance mode (outsourcing) is equal among ties and geographic location is equal across companies, the domestic origin seems to be affecting the degree of leveraging of the local domain.

At first glance, domestic affiliation can be thought as fostering local interaction, since domestic firms can leverage a common cultural background with local actors. In this sense, a liability of foreignness could be retrieved and an argument supporting the cultural difference effect on local sharing can be advanced. Though, MNCs in India are used to hiring mostly Indian employees to populate their subsidiaries; this nullifies the supposed domestic affiliation advantage. The most likely explanation for the higher tendency of domestic firms to share and source knowledge locally can relate to their ownership structure itself: being locked to the parent company, the MNCs' subsidiaries comes to source and share very little within the local domain. This is both due to knowledge spill-overs concerns and to the fact that knowledge flows are highly focused on the parent company, with little organizational capability left to devote efforts in building trust and growing long-term, knowledge-based relationship within the local cluster. Thus, our sixth proposition, considering the features affecting knowledge sharing at local level, is:

Prop. 6 – Domestic affiliation is positively associated with local business-domain knowledge sharing

2.6 Conclusions

2.6.1 Contribution to extant literature

Relating to our first research question, differences emerge in the knowledge flows according to differences in governance modes. Our evidence suggests that proprietary mode seems to be fostering technical knowledge flows; indeed, technical knowledge sourced from extra-cluster relationships is much higher in codifiability and strategic value for proprietary mode than for outsourcing mode. On the contrary, domestic firms, through outsourcing mode, appear to be acknowledging and sourcing mainly business-domain knowledge.

Business-specialization in this sense acts as a moderating variable, triggering further both business-domain and technical knowledge absorption along outsourcing mode. Being in touch with high-added value knowledge, which is locked on the technical side and is perceived as very tacit and thus difficult to understand, the suppliers deliberately and intentionally develop a special feeling to acknowledge business-domain knowledge in order to feed their own knowledge stock. The accumulation of this knowledge, in turn, develops a sharp business specialization, which positively affects the possibility to better understand customers' technical knowledge. This allows us to provide an answer to our second research question: particularly leveraging their business-domain side of the knowledge, the domestic firms succeeds in promoting self knowledge accumulation, both on the business-domain side and technical side.

As for our third research question, our evidence highlights that domestic firms leverage local business-domain knowledge and technical knowledge significantly more than MNCs' subsidiaries. Since our qualitative evidence highlights that business-domain knowledge is sourced mainly from external customers, this result suggests that domestic firms are sharing business-domain knowledge locally, which is then acquired by other

domestic firms. This result is of major importance, since business-domain knowledge ultimately turns out as fuelling the local domain through local sharing.

The novelty of the study is threefold. Theoretically, we promote a radical shift in the perspective driving the speculation, compared to previous literature, by considering both MNC subsidiaries and domestic firms as part of an offshore high-tech cluster. This allows us to extend considerably previous scholarly work, by focusing not only on knowledge flows fuelling the single firms from abroad, but even the knowledge flows within the cluster.

Empirically, we highlight different types of knowledge, exploring the distinction between *technical* and *business-domain* knowledge, thus adding to the traditional one-dimensional framework portraying tacit and codified knowledge (Polanyi, 1966). Moreover, the role of business specialization of the recipient domestic company is acknowledged as influencing the knowledge inflows from the extra-cluster domain. Building further on this, and considering the tie-centered level of analysis, we highlight the role of governance mode in fuelling different types of knowledge flows. Technical and more specific knowledge is flowing mainly along proprietary mode while business-domain, more generic knowledge is shared along the outsourcing mode, in line with what Kogut and Zander theorized in their seminal work (1993). Though, a counter-intuitive finding, somehow building on the argument expressed much later by Fey and Birkinshaw (2005) emerges: outsourcing mode can fuel the transfer and sharing of technical knowledge, when the supplier becomes more specialized and the relationships is cemented by repeated interactions.

From the methodological point of view, the use a quali/quantitative inductive approach and the focus on the process entail a better understanding of the knowledge flows dynamics both within and across the cluster. This is particularly relevant if compared to more traditional purely quantitative studies based on patent data, which assume either a MNC-centre perspective or a macro level of analysis and ultimately fall short in portraying the

dynamic evolution of the phenomenon. Moreover, the choice of the empirical setting is of particular interest, since we set our research into a mainly horizontal cluster, eligible to gain strong stimuli from external customers and to share poor amount of knowledge internally.

2.6.2 Managerial implications

Several managerial implications can be drawn. From the external firms' point of view, in order to minimize the risk of technical knowledge spill-overs along a strategic relationship, it is of utmost importance to assess the right balance between the governance mode used to manage the relationship and the type of knowledge which flows along the relationship itself. In particular, external customers must be aware of the flowing of their business-domain knowledge to the cluster, which is ultimately fostering the local suppliers' business specialization. This turns out to have positive effects for external companies, since they can ultimately rely on an increasingly specialized and vertically-focused supply of software development.

Particular important is the effectiveness of the outsourcing mode, which clearly stands out against common wisdom and previous scholarly work. Effective knowledge transfer can be implemented along outsourcing relationships, which become strategic over time and can approach the level of knowledge sharing occurring along a proprietary mode. This entails major strategic implications for external companies, especially for SMEs: the outsourcing solution cuts the costs related to physical infrastructure and fuels new opportunities to benefit from the local knowledge pool for those companies lacking large scale and liquidities.

From the domestic firms' perspective, the chance to leverage upon the knowledge sourced externally, to promote both internal and cluster-based knowledge accumulation, is strictly related to their business specialization degree: this enhances both the possibility to gain further business-domain knowledge and the chance to trigger technical knowledge

flows. Thus, business specialization is to be pursued, in order to fuelling the overall knowledge absorption and to promote knowledge accumulation.

The mechanisms and dynamics underlying knowledge accumulation within the cluster, as a result of extra-local linkages, are unfolded. A self-feeding co-evolution between the external and the internal domain emerges: on the one hand, the business-domain knowledge flows trigger local business-specialization, which fosters more business-domain and technical knowledge flows from the external to the internal domain. On the other hand, increasingly specialized supply is offered back to the external domain, thus promoting a two-way learning and reciprocal knowledge accumulation.

As for the proprietary mode, MNC's subsidiaries appear to be as islands within the local cluster: a strong knowledge-based connection emerges with the parent company while poor knowledge is sourced from the local domain. This fails to fuel the abovementioned self-feeding co-evolution, thus jeopardizing both benefits of local presence for MNCs' subsidiaries and the benefits of control due to proprietary mode for parent companies: neither local knowledge nor global knowledge is upgrading. This argument highlights the superiority of the outsourcing mode in pursuing a global knowledge sourcing strategy, since it triggers advantages along both local and global dimension. The interplay of local knowledge sharing and extra-cluster linkages through outsourcing mode turns out to be a win-win strategy to promote local knowledge accumulation, refinement, re-elaboration.

2.6.3 Limitations and directions for future research

Several limitations of this work need to be acknowledged, which can nurture future research. First, the specificity of the context, along with the idiosyncrasy of the six companies, undermines the possibility to extensively generalize the propositions. The inductive approach heading to theory-building (Eisenhardt and Graebner, 2007) aims at

suggesting new constructs, new causal patterns, or both. Within this theoretical goal, generalizability is pursued through theoretical sampling, instead of statistical sampling: multiple cases are chosen for theoretical reasons such as replication, extension of theory, contrary replication, and elimination of alternative explanations (Yin, 1994). In order to guarantee the strongest generalizability of our results, we implemented a polar-type strategy, as suggested by Eisenhardt and Graebner (2007), according to which extreme different cases can better highlight contrasting patterns and provide robustness to the theory-building discussion. More troublesome, as far as generalizability issues are concerned, is the peculiarity of the context. The IT cluster in Bangalore displays unique features: the horizontal orientation, the strength of the external linkages, the high-tech technology, the service-based business model entailing pure intangible knowledge flows. Thus, our main results, like the differentiation between technical knowledge and business-domain knowledge and the possibility to transfer highly technical and tacit knowledge along repeated outsourcing contracts to vertically specialized companies might only be consistent with the specific domain. Further research is needed in order to test or disconfirm the theory in other contexts.

Turning to more specific methodological issues, the limited number of alliances, their cross-sectional nature and their non-independence due to their affiliation to the same six companies might question the robustness of the ANOVA analyses. To address the latter issue, our assumption posits that considerable variance can be retrieved in the across-ties dimension, as well as in the across-companies, thus approaching the inter-tie independence. Indeed, the set of relationships held by the same company show relevant differences, as far as the strategic goal, the duration and the technological content are concerned. Considering the cross-sectional nature of the alliances, we believe that notable evolution can be retrieved and mapped in the alliances over time, thus reducing the redundancy of the information carried by the same alliance in different time points. However, further research is needed, to fruitfully

unfold the evolution over time of the type of knowledge sourced from outside and shared locally. Moreover, given the importance of the outsourcing mode in channeling technical and tacit knowledge, it is of utmost importance to devote scholarly effort in expanding the understanding of how IT providers build trust and set up proper channels to transfer knowledge over time.

Another interesting aspect which can trigger further research lies in the types of services provided. This work considers the supply of services in a very general way and does not distinguish which kind of knowledge is shared through which type of service. Interesting scholarly speculation can be devoted to matching the type of knowledge shared with the type of service, by developing a classification of services and then by considering the multi-faceted nature of knowledge.

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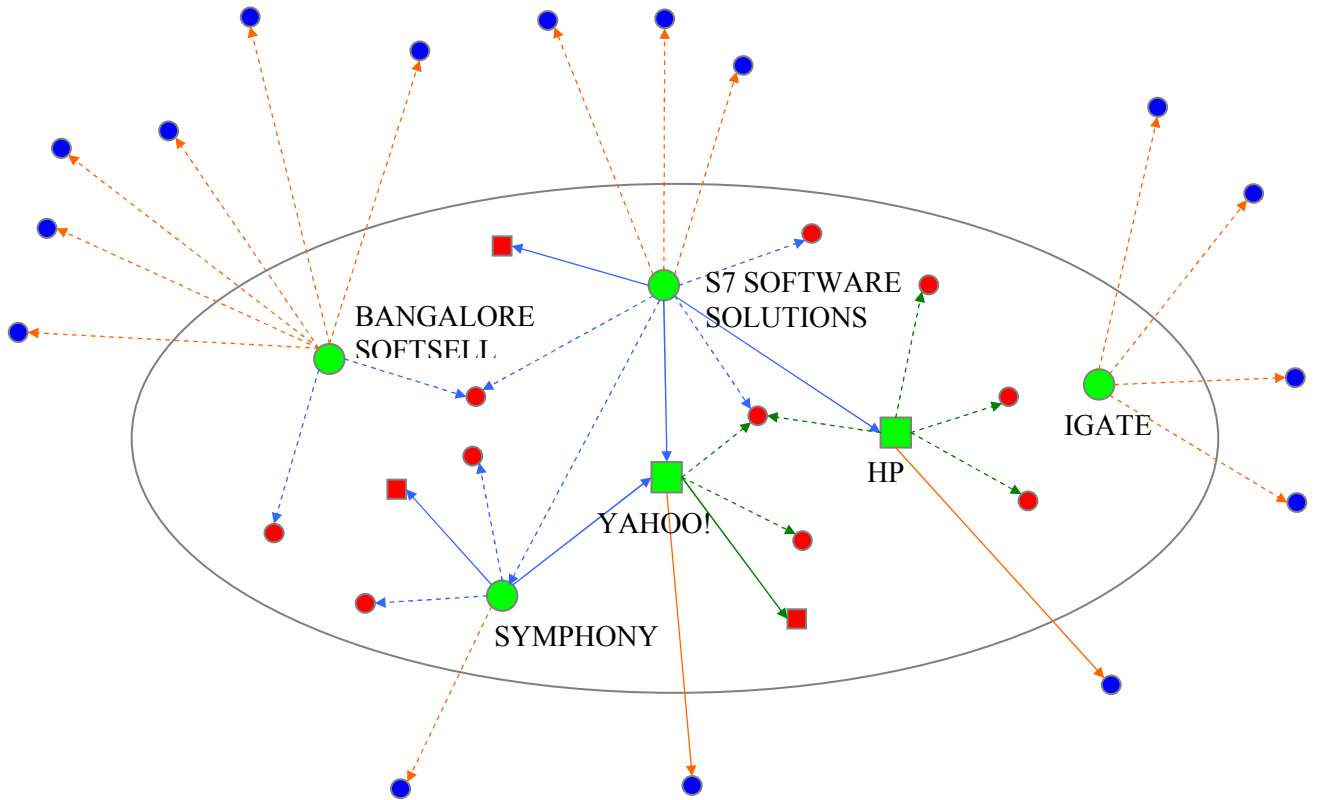
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Exhibits (Chapter 2)

Table 2.1 – Comparative table across cases

Company	S7 Software Solutions	BangaloreSoftSell	Symphony	IGate	HP	Yahoo!
Size (employees)	50	40	3400	6500	30.000	13.000
Year of foundation	2004	1987	2002	1993	1989	2000
Ownership structure	Domestic firm	Domestic listed firm	Domestic listed firm	Domestic listed firm	Captive R&D centre	Captive R&D Centre
Type of business	IT Services	IT Services	IT Services	IT Services	Software development	Product R&D
Business model	IT Services - Migration technology solutions along with 'deep re-engineering of customer's internal processes' - providing 'not trivial solutions'	IT Services - Migration technology - They develop a migration tool. First it was a 'migration tool which could move any legacy to Microsoft-based platform, a different engine was developed, able to migrate any type of language and convert it to any other platform'. This is conceived to give a 'special flavour' to the company.	IT Services - High-end product development: 'we are not the typical IT service company, like Wipro or Infosys. What we really do is we created a niche for ourselves in what is called OPD segment, which expands in Outsourcing Product Development'	IT Services - 'what we do is, we provide the platform, the process and the people and we shift the cost from a service-based fixed cost to a variable cost' 'What we do is we transition client's work onto our platform and technology and provide the service on a transaction based pricing model.	R&D Captive Centre - 'different divisions are providing the parent company with different services and knowledge - here we are developing high-end segment of parent's company product'	R&D Captive centre - 'we are a captive R&D centre developing software for the parent company'
Vertical business specialization	Generalist	Aerospace	Generalist	Financial sector	Hardware	Software
# of extra-cluster relationships	3	7	1	4	1	1
# of intra-cluster relationships	7	2	4	0	4	4
Characterization of extra-cluster relationship	The relationship to the customer is conceived with 'a minimum interaction threshold of once a week minimum in teleconference and more than once via email. A shift of the team onsite is also considered as a viable option, especially in the very first phases of a project, which shows an average duration of 3-6 months'.	relationship to customers is said to be 'very close during the project The company's strength is technological specialization: instead of nurturing the relationship to the client through maintenance services, they would rather find 'new trust offering the technology to some other customers'	They are 'loyal customers because we provide them with high-end life-or-death products, which are branded and directly sold'	The relationship with the customer is seen as very strong and trust-based and long-term oriented. The contribution to the customer business is considered as high-value	'we feel as we are the same company'	'We share the same goals, there is no difference between here and US'.
Characterization of intra-cluster relationship	R&D Collaborations and software suppliers	Customers within the cluster and software suppliers	Their customers are mostly MNC subsidiaries located within the cluster	Absent	Suppliers according to two main modes: OPD (Outsourcing Product Development) or body sourcing	Software suppliers



●	External customer
●	Domestic firm
●	Domestic firm in the sample
■	MNC subsidiary
■	MNC subsidiary in the sample

--->	DOM/DOM: tie from domestic firm to domestic firm
—>	DOM/MNC: tie from domestic firm to MNC subsidiary
—>	MNC/MNC: tie from MNC subsidiary to MNC subsidiary
- - ->	MNC/DOM: tie from MNC subsidiary to domestic firm
—>	MNC/PAR: tie from MNC subsidiary to parent company
- - ->	DOM/EXT: tie from domestic firm to external customer

Fig. 2.1 – The six ego-networks at a glance and an analytical framework to classify the ties

Table 2.2 – Initial measurement items and scales, with internal consistency reliability

Measurement items	ITEM CODE	Internal consistency reliability (α)
Knowledge Codifiability[†]		
To what extent (scale: 1= strongly disagree; 7= strongly agree):		
<i>Technical knowledge</i>		
1. Your partner's technology is easily codifiable.	T_COD	0,926
2. Your partner's technology is more explicit than tacit.	T_COD2	
<i>Business-domain knowledge</i>		
1. Your partner's business-domain know-how is easily codifiable.	BD_COD	0,745
2. Your partner's business-domain know-how is more explicit than tacit.	BD_COD2	
Knowledge Strategic Value[‡]		
To what extent (scale: 1= strongly disagree; 7= strongly agree):		
<i>Technical knowledge</i>		
1. You use this partner's technology to create new ideas for products/services.	T_SV1	0,893
2. The technical knowledge you have been sourcing from your partner is novel and valuable.	T_SV	
<i>Business-domain knowledge</i>		
1. You use of the partner's business-domain know-how for product improvement/other projects.	BD_SV1	0,862
2. The business-domain knowledge you have been sourcing from your partner is novel and valuable.	BD_SV	
Knowledge Specificity[§]		
To what extent (scale: 1= strongly disagree; 7= strongly agree):		
<i>Technical knowledge</i>		
1. Your company has learned a great deal about the technology held by your partner.	T_KS	0,731
2. The technology held by your partner has been assimilated by your company and has contributed to other projects developed by your company.	T_KS2	
<i>Business-domain knowledge</i>		
1. Your company has learned a great deal about the business-domain know-how held by your partner.	BD_KS	0,764
2. The business-domain know-how held by your partner has been assimilated by your company and has contributed to other projects developed by your company.	BD_KS2	

[†] Scale adapted from Simonin, 1999

[‡] Scale adapted from Ryssel, Ritter, Gemunden, 2004 and OSLO Manual, 2005

[§] Scale adapted from Simonin, 1999 and OSLO Manual, 2005

Table 2.3 – Final set of oblimin rotated factors with final loadings

	Business-Domain Knowledge	Technical Knowledge
T_COD1 (TCOD)	-0,038067286	0,92390317
T_COD2	-0,092639294	0,918975606
T_SV2 (T_SV)	0,28930806	0,674850831
T_KS1 (T_KS)	0,10771669	0,763776903
BD_COD1 (BD_COD)	0,777219329	0,163548396
BD_SV1	0,958403569	-0,169525817
BD_SV2 (BD_SV)	0,827224054	0,143847395
BD_KS1 (BD_KS)	0,622502015	0,292648831
BD_KS2	0,875157452	-0,050080806

Table 2.4 – ANOVA testing for differences between MNCs' subsidiaries and domestic firms along the items measuring business-domain and technical knowledge codifiability, strategic value and specificity.

Item	Affiliation	N	Mean	F	P-value
T_COD	Domestic	50	4,02	1,253	0,267
	MNC	27	3,44		
BD_COD	Domestic	48	4,75	18,699***	0,000
	MNC	27	2,89		
T_SV	Domestic	50	4,20	1,835	0,180
	MNC	27	3,52		
BD_SV	Domestic	50	4,52	6,142*	0,015
	MNC	27	3,41		
T_KS	Domestic	50	4,22	4,764*	0,032
	MNC	27	3,07		
BD_KS	Domestic	50	4,94	32,12***	0,000
	MNC	27	2,74		

Significance levels: *p <0,05, **p <0,01, ***p <0,001

Table 2.5 – ANOVA testing for differences in knowledge codifiability, strategic value and specificity, between domestic firms and MNCs’ subsidiaries along extra-cluster ties.

Item	Affiliation	<i>N</i>	Mean	<i>F</i>	<i>P</i> -value
T_COD	Domestic	33	4,09	10,689**	0,002
	MNC	6	7,00		
BD_COD	Domestic	31	4,90	0,651	0,425
	MNC	6	5,50		
T_SV	Domestic	33	4,76	6,842*	0,013
	MNC	6	7,00		
BD_SV	Domestic	33	4,76	4,770	0,035
	MNC	6	6,50		
T_KS	Domestic	33	4,45	7,694**	0,009
	MNC	6	7,00		
BD_KS	Domestic	33	5,45	0,007	0,934
	MNC	6	5,50		

Significance levels: **p* <0,05, ***p* <0,01, ****p* <0,001

Table 2.6 – Differences in absorption of technical and business-domain knowledge according to specialization degree of domestic firms

Items	Specialization degree	<i>N</i>	Mean	<i>F</i>	<i>P</i> -value
T_COD	Generalist	25	4,36	1,365	0,248
	Specialist	25	3,68		
BD_COD	Generalist	23	4,52	0,675	0,415
	Specialist	25	4,96		
T_SV	Generalist	25	3,44	8,101**	0,006
	Specialist	25	4,96		
BD_SV	Generalist	25	4,36	0,412	0,524
	Specialist	25	4,68		
T_KS	Generalist	25	3,68	3,301	0,075
	Specialist	25	4,76		
BD_KS	Generalist	25	4,40	6,714*	0,013
	Specialist	25	5,48		

Significance levels: **p* <0,05, ***p* <0,01, ****p* <0,001

Table 2.7 – ANOVA testing differences in knowledge codifiability, strategic value and specificity, between domestic firms and MNCs’ subsidiaries along intra-cluster ties.

Item	Affiliation	<i>N</i>	Mean	<i>F</i>	<i>P</i> -value
T_COD	Domestic	17	3,88	7,084*	0,012
	MNC	21	2,43		
BD_COD	Domestic	17	4,47	22,130***	0,000
	MNC	21	2,14		
T_SV	Domestic	17	3,12	1,680	0,203
	MNC	21	2,52		
BD_SV	Domestic	17	4,06	12,042**	0,001
	MNC	21	2,52		
T_KS	Domestic	17	3,76	13,884**	0,001
	MNC	21	1,95		
BD_KS	Domestic	17	3,94	23,107***	0,000
	MNC	21	1,95		

Significance levels: **p* <0,05, ***p* <0,01, ****p* <0,001

CHAPTER 3

Global Demand Triggering Local Cooperation: the Evolution of Internal and External Networks within Bangalore IT Cluster**

Abstract

In this paper, a self-feeding co-evolutionary relationship between the internal, cluster-based network and the external, globally dispersed network is unfolded, ultimately disrupting the mainstream perspective which conceives the network as a whole and draws causal linkages between the network and firm-level characteristics. More precisely, our empirical setting allowed us to sharply differentiate the two kinds of relational sets while underlining the inter-ties causal relationship which feeds the evolution of both networks over time.

We leverage on the exploration/exploitation theoretical paradigm and present a major counter-intuitive result: the evolution of internal alliance from a exploitation to an exploration strategic intent. This is disruptive towards extant theory, which would predict exploration alliances to be evolving into more in-depth, specialized and mutually committing alliances aimed at exploiting the results of an initial exploration. Our evidences support a co-evolutionary view and have broad implications for future theoretical and empirical research on organizational networks and strategic alliances.

** This paper has been presented at the Strategic Management Society India Special Conference, Hyderabad (Andra Pradesh, India), December 12-15. On this occasion, the paper has been awarded with the 'Best Paper Proposal Award'.

3.1 Introduction

How do firm networks evolve? Nohria (1992:15) has first expressed the need for theories allowing for a deeper understanding of ‘how networks evolve and change over time’. His suggestion has been feeding an increasingly important research stream, which aims at extending further both network-related speculation and empirical research by breaking the classic static perspective and deploying a dynamic longitudinal approach. The speculative and empirical concern to investigate networks evolution over time can be considered as stemming from the well-known endogeneity issue impinging network-based research. Indeed, the causality pattern so far is still ambiguous, whether firm characteristics are antecedents to network structure or whether network structure is shaping firms.

Beyond notable exceptions considering the impact of industry events (Madhavalan, Koka, Prescott, 1998) and environmental effects (Madhavan, Koka, Prescott, 2006) on network change over time, the main research efforts considering network evolution have been focusing on the network dynamics of young new ventures. Different types of networks are theorized to be differently leveraged over the firm early growth phases, according the evolution of the firm growth need (Yli-Renko, Autio, 1998; Lechner, Dowling, 1999; Hite and Hesterly, 2001; Lechner, Dowling, 2003; Schutjens, Stam, 2003).

Though, two speculative limitations of these studies can be retrieved: a) they sharply focus on young entrepreneurial firms in their early stages, thus overlooking the dynamics of networks for established firms b) the different types of networks are considered as mutually independent: any causal linkage between them has been strikingly overlooked so far. Given the presence of many sub-networks within the overall firm egocentric network, are some sub-networks’ characteristics likely to foster the evolution of other sub-networks, thus promoting an overall network evolution?

Network speculation finds an ideal empirical setting within industrial clusters. Several studies have been arguing the effects of network embeddedness to be positive, because of the privileged access to novel and valuable knowledge flows (Porter, 2000). Though, a threshold is acknowledged, beyond which undesirable effects of overembeddedness can occur (Uzzi, 1997), which can prevent new knowledge flows from reaching the cluster and fuelling local innovation capability. Assuming the perspective *internal/external*, several studies argue the need for cluster firms to leverage channels to external environment, in order to benefit from new external knowledge and original knowledge re-elaboration and re-assembling (Keeble, Wilkinson, 2000; Owen-Smith, Powell, 2004; Giuliani, Bell, 2005).

However, to our knowledge a causal link remains unexplored so far, between the type and nature of the relationships directed across-cluster, forming the external network, and the type and nature of the relationships directed within cluster, forming the internal network. More specifically, is external network likely to influence the evolution of internal network? Bridging the two perspectives, as well as the two gaps in the literature thus identified, this work aims at unfolding the causality between external relational structure and internal relational structure from a cluster-based point of view, by deploying a longitudinal perspective. Overcoming the traditional endogenous problems affecting the firm/network causal pattern, we originally propose the network to be self-feeding, thus finding a causal antecedent within the network itself. A fruitful theoretical contribution in order to properly frame our investigation and findings comes from the exploitation/exploration approach, as first theorized by Koza and Lewin (1998) and broadly leveraged to gain deeper theoretical understanding of alliances and network evolution (Rowley, Behrens and Krackhardt, 2000; Lavie and Rosenkopf, 2006; Hoffmann, 2007).

Following the widespread approach used to investigate network evolution, we deploy case-based inductive methodology, in order to pursue a theory-building attempt (Eisenhardt,

Grabner, 2007). We observe the evolution of the egocentric networks of six companies within Bangalore IT cluster over three years, from 2005 to 2008. The sample encompasses both MNCs' subsidiaries and domestic firms, allowing for high variance in age and size.

First of all, our findings highlight a common pattern of evolution of the strategic relevance of the internal network: from an exploitation-based knowledge-leverage set of alliances to an exploration-based knowledge-creating network. Moreover, a bi-directional causal link is highlighted between internal network and external network, which ultimately unfold into a co-evolution over time: long-term orientation of external network and its capabilities dispersion are respectively negatively and positively associated to local exploration, with a relevant moderating effect of firm age. This work aims at originally contributing to two main streams of literature. First, it builds on the set of studies addressing network evolution, by suggesting that firms' sub-networks cannot be considered as independent resources, but mutual dependency patterns must be considered. Second, it adds on cluster-related literature, by unfolding the positive effects of external linkages.

The paper is structured as follows. In the next section we present the previous literature that has analyzed network evolution within a broader social network approach. Then, we highlight the important contribution of the exploration/exploitation theoretical framework in gaining deeper understanding into inter-firm alliances and their strategic role. A section addressing the research methods follows, which presents the empirical setting, the case selection and the data gathering. Our results are then unfolded and discussed; in line with our theory-building intent, some propositions are advanced. A conclusion section follows, which underlines the theoretical contribution of the paper as well as its managerial and policy implications.

3.2 Network evolution within a social network approach

Network approaches make it possible to consider the inter-firm alliances through a systemic lens, abandoning the dyadic perspective and adopting a network-centred view (Gulati, 1998). Network approach received its first systematization by economic sociologists such as Granovetter (1985), who have proved how the social structure of ties within which economic actors are embedded can influence their subsequent actions. Distinct social structures entail different opportunities for information access and for knowledge flows (Burt, 1982).

This triggers further speculation about the effect of firm networks on the performance. Lorenzoni and Lipparini (1999) highlight the importance of the distinctive network capabilities of focal firms within a cluster in order to leverage inter-firm relationships and lower overall coordination and production costs. This new point of view turns out to be useful to isolate the effect of inter-firm alliances, and of the network of knowledge flows they create, on the innovative output of the firm. In an outstanding contribution, Ahuja (2000) argues innovative performance to be a direct consequence of the firm capability to hold direct and indirect ties, with a negative moderating influence of direct ties upon indirect ties' effect. Building upon this line of reasoning, Zaheer and Bell (2005) shows network structure to positively affect both financial and innovative performance, originally isolating the network effect, due to alter innovativeness and relative position of the focal firm, from firm ego innovativeness. The concept of strategic networks thus arise (Gulati, Nohria, Zaheer, 2000).

Network approaches fruitfully nurture speculation and empirical research about industrial clusters. The embedded nature of firms within the clusters has been broadly recognized since the first shift from Marshallian conceptualization of clusters as relying on arm's length contacts to the acknowledgment of stronger, long-term relationships between

actors (e.g. Lorenzoni and Lipparini, 1999). Cluster participation provides access to complementary assets, which are better sourced externally than generated within the firm and are accessed more effectively through geographic proximity (Storper, 1997; Scott, 1998; Porter, 1998). Though, within industrial clusters, the benefits of networking are mixed. Uzzi (1997) proves embeddedness to trigger a twofold effect firm's performance, which he labels as the 'paradox of embeddedness'. According to his argument, an inverted U-shaped emerges between level of embeddedness and performance. The benefits of embedded ties rise up until a threshold, beyond which too embedded firms become vulnerable to external shocks and isolated from external information, jeopardizing innovative performance. Considering the situation beyond the optimal embeddedness point, a substantial stream of literature has been developing a perspective that distinguishes between *internal* and *external* environments and highlights the importance of channels to access external knowledge. Zaheer and George (2004) emphasize the need of extra-local linkages to source external knowledge. Recent contribution acknowledges the presence of focal firms within industrial clusters, endowed with superior relational capabilities (Lorenzoni, Lipparini, 1999) and 'gatekeeping' external knowledge (Giuliani, Bell, 2005; Malipiero, Munari, Sobrero, 2005). These external linkages have been used intensively as an organising framework to examine the behaviour of firms in clusters (Keeble, Wilkinson, 2000). An interesting study is offered by Nachum and Keeble (2003), which investigates the differences between the knowledge sourced internally as opposed to the knowledge sourced externally by MNCs' within industrial clusters.

A limited amount of literature analyzed the evolution of networks. The theoretical roots of most contributions lie in the concept of networks as a viable entrepreneurial growth strategy (Lechner and Dowling, 2003; Yli-Renko, Autio, 1998) and as a strategic resource (Gulati, 1999) which can be shaped by managerial action (Madhavan, Koka, Prescott, 1998). Hite and Hesterly (1998) argue new ventures' networks to be evolving from identity-based,

embedded, path-dependent ties to calculative, arm's length, intentionally managed networks. Larson and Starr (1992) suggest the transformational of exchange relationships from a set of relatively simple, often mono-dimensional dyadic ties into a thick set – a network – of stable, multidimensional and multi-layered inter-organizational relationships. Particularly focusing on industrial clusters, Lechner and Dowling (2003) recognize each new venture to hold a specific relational mix, which changes over time according to the firm growth needs. Considering again a regional context, Schutjens and Stam (2003) distinguish between sales relationships (market space), suppliers and contractors relationships (production space) and cooperation with other firms (supporting space). They analyze the evolution of the different sub-networks separately over time according to variation, source and proximity.

This work aims at bridging two main literature gaps. First, considering the literature addressing network evolution, a causal link has been overlooked so far. We argue that the assumption of independent sub-networks within the same firm egocentric networks is too strong and that a dependency pattern might be missing. What if some ties or sub-networks would be shaping some other ties or sub-networks? An outstanding contribution in this sense comes from Gulati (1999), who proves that accumulated network resources arising from firm's participation in the network of accumulated prior alliances are influential in firms' decisions to enter into new alliances. Though, does not consider a direct link between sub-networks' evolution and he focuses rather on the accumulation of resources that the previous alliances trigger within the firm.

Turning then to the cluster-related literature, and assuming the *internal/external* perspective, the causal link between the external ties or networks and the internal ties of networks has been unexplored. Remarkable exception in this sense comes with the study by Nachum and Keeble (2003). Though, this study deploys a static perspective and limits its scope to MNCs' subsidiaries and fails to portray the upper-level picture of the overall cluster

dynamics, which encompasses both domestic firms and MNCs. Inheriting on the one side the need for tracing causal links within the network, and deploying on the other side the cluster-based internal/external distinction, we aim at exploring two main research questions: a. - *Is external network likely to shape internal network evolution?*; and b.- *Which characteristics of external networks are likely to foster internal network evolution?*

3.3 Explorative and exploitative networks

In order to manage high environmental uncertainty, companies can either choose to exploit the current resource endowment through exploitation efforts, or to take earlier advantage of opportunities created by the environmental evolution through exploration (Hoffmann, 2007). March (1991: 85) states that ‘the essence of exploitation is the refinement and extension of existing competencies, technologies and paradigms. The essence of exploration is experimentation with new, uncertain alternatives’. Koza and Lewin (1998) first applied the exploration/exploitation paradigm on the inter-organizational learning dimension and highlighted a distinction between exploration-based and exploitation-based alliances. Drawing on the March’s definition of exploration and exploitation, Koza and Lewin define exploitation alliances as involving ‘the joint maximization of complementary assets by sharing in the residual return from a business activity’ and exploration as involving the desire to discovering new opportunities’.

The contribution of exploration/exploitation paradigm in enriching the social network-related literature is highlighted by the contribution of Rowley, Behrens and Krackhardt (2000). Exploration requires broad and new information upon different viable alternatives; exploration ties can thus be associated to firms occupying networks structural holes, the ‘positions between other actors that are not directly connected’ (Rowley et al., 2000). Exploitation, on the other hand, requires a ‘deeper understanding of specific information

rather than a wider grasp of general information'. Dense networks, formed by strong ties entailing information redundancy, are thus more suitable to exploitation purposes. Exploitation ties are thus theorized as strong and long-term oriented while exploration ties are weak and with limited depth (Rowley et al., 2000; Hoffmann, 2007).

Various definitions and further declinations have been flourishing over time, which tried to unfold the characteristics of exploration and exploitation nature of alliances. Lavie and Rosenkopf (2006) bring the evolutionary dimension in. Previous literature, by focusing on the dichotomy existing capabilities/new capabilities only, has identified but one of the domains of exploration and exploitation, the *function* domain. The authors thus identify two additional domains: *structure* and *attribute*. Structure refers to the prior network positions of a firm's partner. Recurrent alliances between firms are considered as a form of exploitation, while alliances formed to access new partners are considered as exploration. According to the attribute dimension, instead, an exploratory behaviour is evident when the company seeks for partners with increasing different attributes over time, while exploratory intent, on the contrary, can be retrieved when a firm forms new alliances with partners with decreasing difference in attributes. Drawing on both Lavie and Rosenkopf's work (2006) as well as on Hoffmann's (2007), the longitudinal speculation on exploration and exploitation alliances suggests an evolution from weak, new, knowledge-seeking exploration ties to the strong, recurrent, knowledge-leveraging exploitation ties.

Sticking to the very first definition, in this work we consider the novelty of opportunities and capabilities as the key turn-point in distinguishing exploration alliances from exploitation alliances. Exploration ties are thus aimed to seek for new opportunities and to develop new capabilities for both the companies involved. Our use of the concept aims to be broad: exploration alliances might encompass both R&D activities, as the previous

literature has acknowledged, but also marketing-associated alliances which lead to the discover of new customers and new markets.

3.4 Methods

3.4.1 Empirical setting

Bangalore IT cluster is worldwide recognized as the most well-known, fast-paced growing site providing highly technology-intensive IT services to customers across multiple industries and countries. Bangalore belongs to the new generation of high-tech clusters which have been flourishing as a direct consequence of the offshoring phenomenon, namely the delocalization of technology-intensive activities to low-wage countries (Sako, 2007). New geographical concentrations of highly skilled talent and specialized service providers using this talent have evolved in India, China, and other emerging countries. Unlike industrial clusters in Western economies, such as Silicon Valley for IT companies or southern Denmark for biotechnology companies, or the very well-known manufacturing clusters in Northern Italy (Lorenzoni, Lipparini, 1999) these new geographic clusters tend to develop around particular functions or upstream services rather than industries.

Bangalore is best known for having evolved into a cluster providing IT and software skills that multinational companies across industries use to better perform their IT and software development functions (Bresnahan et al., 2001; Athreye, 2005). A key role in the development of the cluster has been played by the MNCs, which first set up subsidiaries in Bangalore and triggered the development of focused capabilities (Giarratana et al., 2004; Basant, 2006). After an initial search for a cost-driven advantage, which is fast shrinking, MNCs are now increasingly attracted by the local pool of highly formed and specialized engineers. An evolution has been well-portrayed in the literature, which leads from the

delocalization of activities with low technological content to increasingly core and technology-intensive tasks (Maskell et al., 2006; Manning, Massini, Lewin, 2008).

Manning et al. (2008) observe the concentration of companies and skills in Bangalore as a cluster, in line with what Alfred Marshall first defined as an industrial district, i.e. a cluster of subcontractors, readily available skilled talent, and a knowledge base shared by a local community of firms and people. Building on this, we consider the concentration of IT firms located in Bangalore as a cluster because of the co-presence of competing, and to a certain extent cooperating, firms in the same industry, according to the definition provided by Porter (1990). Yet, Bangalore IT cluster needs to be considered as an horizontal cluster, with a thick network of co-located supplier firms exporting nearly 70% of their IT services to globally dispersed customers.

Our exploratory research questions find in Bangalore an ideal research setting for a number of reasons. First of all, an in-depth analysis, which can unfold the patterns of evolution of cluster firms' network, by distinguishing the internal – local – from the external – global – dimension is needed, which either supports previous evidence with deeper insight or otherwise disconfirm prior findings by highlighting different behaviours. Further light needs to be shed in order to understand why MNC keep on shifting activities to Bangalore, irrespective of the increasingly narrow cost gap, whether the local environment can offer something more than a pool of qualified skills, in systemic terms. Last but not least, Bangalore IT cluster is emerging as knowledge-intensive high-tech cluster. Cluster-related literature has traditionally addressed manufacturing clusters (e.g. Lorenzoni and Lipparini, 1999) where knowledge is likely to be embedded in both tangible physical goods and into intangible flows. Unlikely, the service-based focus of Bangalore IT cluster entails the knowledge to be shared through intangible channels only. With respect to this, the internal cooperation through inter-firm alliances as well as the bundle of alliances forming the

external network can be a very close representation of knowledge-flows, because of the lack of physical goods and because of the supply of technology-intensive services.

3.4.2 Case selection and data gathering

Given the exploratory nature of our research questions, an inductive approach has been considered most suitable, which allows for an in-depth analysis of the phenomenon under observation (Yin, 1994; Lee, 1999). The case studies approach enhances the richness of the specific domain, both considering the instantaneous situation and recollecting information about the evolutionary patterns. Indeed, case studies allow to trace links between variables over time (Yin, 1994; Hoffmann, 2007) and represent a widespread research methodology especially when processes of change are under observation (Doz, 1996; Arino and de la Torre, 1998; Koza and Lewin, 1999; De Rond and Bouchikhi, 2004).

Six comparative longitudinal cases are developed, considering software service companies located in Bangalore. A multiple-case studies research method is deployed, which is acknowledged to potentially yield more robust, generalizable and testable theory than single-case research (Eisenhardt, Grabner, 2007). The cases have been selected according to theoretical sampling, and a 'polar-type' strategy is pursued, which aims at investigating extremely different cases, in order to observe more easily contrasting patterns in data. In this sense, an analytical rather than a statistical significance of our sample is pursued, which aims at representing the population of the firms by considering some segmentation dimensions. First of all, three main types of companies can be detected in the clusters, which essentially differ in terms of the business model adopted: 1. large IT software providers, 2. MNCs' subsidiaries, 3. small high-tech firms, providing a specific technologically intensive service. An equal number of firms have been picked from each category, in order to account for differences related to the business model and to the size. Within each category a two-paired

polar logic is deployed: in order to account for differences in age, one old firm and one young firm have been selected.

Data gathering has been undergone drawing on different information sources, primarily semi-structure face-to-face interviews, according to three steps: i.- in a first phase, the CEOs and top management of each firm have been asked to highlight firm-level information, related the core business of the company, the business model used to deliver value and its evolution over time, the key features of the company's competitive advantage. In this first phase, CEOs and top managers have been asked to highlight their most relevant alliances, to vendors, customers and partners both external and internally, over the years 2005, 2006, 2007, 2008, through a retrospective history (Hoffmann, 2007). For each inter-firm relationship herein highlighted, the respondent has been asked to name one or more people within the firms who had been most involved in the management of the partner; ii.- in-depth interviews have been conducted to second-level managers, who were acknowledged to hold most in-depth awareness of each alliance in the first phase. Information about how each relationship generated, evolved and ended over time has been collected. Particular emphasis has been given to the need of capabilities related to the relationship, to the strength of the linkage, to the strategic role of the partner, whether it added in generating new knowledge or in leveraging existing one, both technology-wise and business-wise. These dimensions have been explored with the specific intent of unfolding their evolution over time for each relationship; iii.- in order to guarantee internal validity to our construct and our information, the information collected in the second phase have been cross-checked with the top management in a third round of interviews. Moreover, the third series of interviews aimed at recollecting the firm-level perspective on the set of alliances deeply surveyed in the second phase. Hence, the third round of interview specifically aimed at gathering information about

the respondents' perception on the evolution of the firm internal and external networks over time, thus trying to link the variables emerged in the previous research stages.

Table 3.1 summarizes the relevant characteristics of the six companies, in a comparative mode along with the number of interviews conducted and the total amount of hours.

INSERT TABLE 3.1 ABOUT HERE

3.5 Empirical evidence

3.5.1 Evolution of the internal network from exploitation to exploration

Fig. 3.1 highlights a considerable increase in the number of local inter-firm relationships involving the six companies over the 4 years of observation, while Fig. 3.2 shows all the linkages considered simultaneously. The in-depth tie-centered interviews allowed for a deeper understanding of the considerable heterogeneity in the genesis, nature and evolution of the local linkages.

INSERT FIGURE 3.1 ABOUT HERE

INSERT FIGURE 3.2 ABOUT HERE

We considered three types of inter-firm linkages: 1. alliances or cooperative agreements, and, among the vertical relationships: 2. Relationships to local vendors 3. Relationships to local customers. Both IGate and Symphony appear to be very weakly connected to the local domain, considering both presence of local vendors first and local customers then. When asked to highlight the reasons why the company had chosen not to benefit from any local vendor, the manager of IGate pinpoints the importance not to

outsource phases of the process to vendors in the local domain. The decision is seen as strategic, deliberately shaped in order to minimize the customers' fears towards knowledge leakages and loss of control:

'[...] We are seen as an outsourcing company, our core is to provide services and if we start outsourcing our core, who else would do the core? So, if you look at it, our non-core area, like administration, transportation, those are all outsourced. But not the services we are providing' (Manager, IGate)

The position of Symphony towards the possibility to engage into customer/suppliers to local vendors is very similar, as Symphony's Vice President outlines to ensure the customer with the control upon time-to market and on the intellectual property on the knowledge transferred: *'[...] Not to outsource is strategic because it has enormous impact on our final client (Vice-President, Symphony)'*. Neither IGate nor Symphony hold any local customer. Reasons advanced for that relate to the strong export-orientation of the two companies, which were born to serve internationally located customers. Their set of capabilities have been adapting over time to increasingly stick on specific international partners' needs, and substantial switching costs are acknowledged in trying to address local markets, which would hinder any possible advantage.

Given the weak linkages toward the local domain and the strong orientation to the external dimension, a doubt concerning what advantage is left to the local domain arises. When asked directly whether they leverage the local domain, both Symphony and IGate recognize the possibility to engage into partnerships to local MNCs' subsidiaries. Both IGate and Symphony hold partnerships with well-known local MNCs' subsidiaries, yet with different characteristics. IGate's linkages appear to be stable over the 4 years of observation and consist of technological partnerships aimed at keeping the company constantly upgraded on the partner's technology. Symphony's technology partnerships in the local domain are in a much earlier development phase. The company highlights two relationships to Yahoo! and to

another well-known local MNC subsidiary. These linkages consist of a pure supply of employees from the IT service provider to the subsidiary, according to a widespread practice called 'staff augmentation'. Although no technological knowledge has been shared as yet, there is a deliberate intent promote an evolution of these relationships into technology-based partnerships:

'We are trying to do some partnerships.. we have just started with staff augmentation, we will eventually evolve into partnerships' (CEO, Yahoo!).

The paradigm exploration/exploitation applied to inter-firm alliances helps in framing the abovementioned inter-firm relationships: exploitation alliances are meant to exploit existing capability of the focal firms, while exploration alliances are considered as attempts to develop new capabilities (Koza and Lewin, 1998). We consider the technology-focused partnerships portrayed by the managers of IGate as exploration alliances, since they are explicitly established to capture new technology. Moreover, no strong investment is engaged in order to support these relationships, which remain superficial, broad and light to informally share knowledge when needed. This defines these alliances as exploratory, according to the framework theorized by both Hoffmann (2007) and Rowley and al. (2000). The current situation of Symphony is very different: purely staff-based alliances can be seen as exploitative, even though the final strategic intent is revealed as exploration-related. Considering the difference in age, we argue an evolutionary process, which leads the sharply export-oriented large IT providers to leverage on the local domain with an exploration-related intent, after an exploitative genesis of the relationship. According to this perspective, we argue Symphony to be at an initial phase of the process, establishing exploitative linkages with a technology exploration goal, while IGate has achieved the final configuration, relying on a set of local exploration alliances stable over time.

Turning to the case of small technology-focused companies, BangaloreSofSell and S7, Fig.1 clearly shows a relevant evolution of the internal network of the two companies, in terms of number of partners. When asked to consider the degree of leverage of the local domain, the managers of the two companies firmly claim the strategic importance of the local relationships in scouting for new customers. S7 pinpoints that local inter-firm linkages are mostly partnerships, rather than customer/supplier relationships, through which they get referenced:

'[...] Mindtree, Infosys, TCS, Mphasis, they are all trying to refer us to the client when they cannot handle their migration needs. So this was the core of the relationship. Strategy, contacts, are the main advantage of the relationship. I will give you an example. For example, this year we are working with HP in 5 divisions. The relationship to internal HP lead to the relationships to 5 different HP, we have 1 in Europe, 2 in US and then 1 Singapore, 1 Australia. All these HP are linked today because of the HP in India. Local contact helps you to get the client contact' (CEO, S7SoftwareSolutions).

Exactly on the same line, with striking similarity, BangaloreSoftSell pinpoints that local relationships are mainly marketing partners and are conceived to be long-term oriented and trust-based, in order to ensure a strong basis to establish other external alliances:

'[...] The 3I example is really interesting. 3I US came from 3I Bangalore and J&J came from 3I US: we were talking about migration to 3I US, they were selling migration to J&J, so it came back to us, because we do all the migration within 3I. The UK Insurance company 2007 came from 3I UK. And Malaysian Insurance Company came through 3I APAC. See, basically all of these, the UK Insurance company came from 3I UK and the US Insurance company came from 3I US. For us, the starting node within 3I is 3I Bangalore' (Technical Director, BangaloreSoftSell).

The two small companies leverage on the local domain in order to reach new customers and new markets. Although business-related alliances are mainly seen as exploitative (Koza, Lewin, 1998), different voices claim the need to disrupt the sterile dichotomy associating R&D-based relationships to exploration and market-related alliance to

exploitation (Hoffmann, 2007; Lavie and Rosenkopf, 2006). The importance of market alliances to a firm's exploratory strategy is recognized, since 'contractual alliance with local market partners are frequently used as an explorative step in entering a new market' (Hoffman, 2007: 831). According to our interpretation, which rely on the capabilities and knowledge-generating concept, market-related alliances, whether aimed at the discover of new customers and markets, have to be considered exploration-oriented. These relationships trigger the development of new capabilities which are not technology-related, as we observed in the two previous cases, but business-related. Thus, acknowledging the knowledge generation process, we consider these relationships are exploratory. Glancing back at the genesis of these internal alliances, though, we find out that the very starting point for most of them has been exploitation-based: both S7 and BangaloreSoftSell were developing migration project for local customers which subsequently evolved in strategic marketing partners. Once again, we observe an evolution from exploitation alliances to exploration ones.

The MNCs' subsidiaries in our sample further confirm this trend. Both Yahoo! and HP are moving from exploitation-based local alliances to a more strategic, exploration-oriented leveraging of the local domain. Yahoo! is promoting an evolution of local partners from an insourcing model, based on staff augmentation, to an 'outsourcing product development' (OPD), which aims at seeking the capabilities which are not present in-house within the local domain. Very likely, though focusing on business-related capabilities rather than technological ones, HP acknowledges an evolution of its local relationships over time. Local partners have been recently leveraged to explore new markets; this marks a major shift in HP's strategy, and an important evolution in the role of HP India within the corporation:

'[...] A change is actually happening in our relationships to the local domain. As an example with Wipro, and TCS and to some extent even Infosys also, the relationship is changing towards doing more business. With Wipro we started selling more into India, which it was not doing earlier' (Technical Head, STSD, HP).

'[...] With Iflex it's a different relationship. Iflex is much stronger in markets abroad, like Latin America, Europe, while Infosys we won the large number of deals in India. So, in those markets where they are stronger we partner with them over there' (Technical Head, STSD, HP).

The two MNCs' subsidiaries show a different degree of evolution in the use of local domain as an exploration base. The difference in age might help in explaining the difference: we argue that Yahoo! and HP can be considered at different stages of the same evolutionary process, which moves from an exploitation-based leveraging of the local domain to a more exploration-based perspective. A common evolutionary pattern among the companies under observation thus emerges, which leads their local relationships to evolve from being exploitation-based to be exploration-based. This is in contrast with what stated by previous literature, which predicts an evolution of exploration-based relationships to exploitation-based. The main argument supporting this view relies on the conception of exploration alliances as developing new technology that subsequently is commercialized and exploited via an exploitation-oriented evolution of the same relationships. We highlight a main theoretical shortcoming of this perspective, which bounds the development of new capabilities and opportunities to the technological domain. The business-related domain needs to be considered, along with the opportunities to access new markets and to acquire new business-related capabilities. The evolution of an exploratory, technology-based alliance to an exploration, business-related one is thus likely: along with the development of trust among the partners and the growing awareness of reciprocal business, alliances can arise in order to increase the individual value delivered to respective final customers through a co-joint business effort. Drawing upon the abovementioned evidence and theoretical discussion, we advance the following proposition:

P1. Exploitation alliances in the local domain are likely to evolve towards exploration alliances over time

Fig 3.3 highlights the relationship between the degree of exploration of the local domain and the age of the firms. The degree of exploration has been ranked according to the abovementioned qualitative evidence and to the authors' perception. The aim of the graph is of pure representation of the supposed relationship, without intent of quantitative measurement.

INSERT FIGURE 3.3 ABOUT HERE

3.5.2 External network as triggering (or hindering) local exploration

Though underlining a common evolutionary pattern, previous empirical evidence also highlights striking differences among the companies' internal networks. Differences are major when considering the number of local partners, the intensity of the exploration effort, the effectiveness of exploration effort and the pace of change of these dimensions over time. Fig 1. shows the evolution of the number of local partnerships of the companies in our sample. Fig. 2 is conceived to show simultaneously all the local linkages which happened to generate over time, thus highlighting the causal link among ties (relationships to foreign customers which have been fostered by local partnerships). The in-depth interviews we conducted suggest a relationship between the configuration and evolution of the external network and the configuration and evolution of internal network. Network-related literature recognizes 3 configuration parameters as best suitable to describe a network: the number of linkages, the linkage strength, their dispersions (Granovetter, 1985; Rowley, Behrens, and Krackhardt, 2000; Kenis and Knoke, 2002).

The number of alliances determines the quantity of information and resources a firm can access and acquire through its network (Koka, Prescott, 2002). The quality and richness of the information and resources that a company has access to via its network of alliances is

primarily determined by the linkage intensity of the alliances (Kraatz, 1998; Koka and Prescott, 2002). Only strong ties, which have developed and have been maintained over a longer period of time and which are supported by a close and trustful collaboration between partners, can enhance the sharing of in-depth information and tacit knowledge (Coleman, 1990; Hansen, 1999). We will capture this dimension by considering the *long-term orientation* of external network.

The *dispersion*, on the other hand, is the spread of alliances in terms of different strategic groups and industries which are reached through the network (Hoffmann, 2007). Dispersion determines the diversity of information and resources that the company has access to with its alliances (McEvily and Zaheer, 1999; Koka and Prescott, 2002). Dispersion also determines the number of different business-related capabilities, required to the focal firm in order to be able to interact with firms from different industries and business domains. The next two sections will try to highlight the influence of long-term orientation and dispersion of external network, as moderated by its size, on the evolution and characterization of internal network.

Long-term orientation of the external network. The companies in our sample deeply differ as far as their relationships towards external customers and their evolution over time are concerned. What seems to emerge as an important feature is the long-term orientation of the relationships to external customers as a key measure of the broad construct of linkage intensity and of the trust developed over time (Rowley et al., 2000; Hoffmann, 2007). Long-term orientation can also be seen as the pace of change of partners composing the external network and give considered as a proxy of the degree of strategic investment between the two companies.

Let us revise first the case of MNCs' subsidiaries, which hold by definition the most long-term oriented relationships towards their external customer, as in their parent companies. The degree of commitment and investment towards the parent company is highest throughout the whole entire company's life. Though, an evolution is portrayed, which marks a relevant increase of the strategic relevance of the subsidiary to the overall corporation's strategy. Yahoo! highlights an evolution of its role within the overall corporation over time, which lead to the establishment of a centre of excellence for the global corporation. Yahoo! Bangalore is now the engineering hub for emerging markets. HP describes the evolution of the relationship toward the parent company in a very similar way, pinpointing the increasingly strategic role of the subsidiary within the overall corporation strategy. Interestingly, the two companies clearly recognize the key role of the local network in increasing the value that the subsidiary is able to deliver to the parent company. Yahoo! has sustained its 'disciplined growth-model' by focusing on core areas and outsourcing the rest to the local partners; HP has leveraged on the local partners in order to access new markets, thus enhancing the value delivered to the corporation.

Considering IGate and Symphony, relationships to external customers are professed to be strongly strategic, characterized by long-term orientation and relevant degree of specific knowledge investment and commitment. Building up a trust-based, long-term relationship, appears as a necessary requirement to Symphony, in order for its business model to be profitable. The company contributes to the customer's product engineering and delivers high-end applications, which the customers just '*brand and sell*'. The relationship thus needs to be supported by high levels of trust and established routines which can enhance the sharing of core tacit knowledge. The relationship to the customer is evolving over time towards a strategic partnership:

'[...] The relationships evolves. It's a matter of building trust. Today of course every company we come to develop a product for we think about as a partner because we do about a thousand releases a year. And all the relationships are still going on, the stickiness is very high. Very very strong strategic partnerships, it is not just a vendor/customer relationship, it is a customer. We never lost a customer, we let to go one or two which were quite large companies like IBM, whereas some companies like Siebel and Hyperian although they were acquired by Oracle they chose to scale up, to carry on' (Vice-President, Symphony).

IGate's external network appears to hold a pace of change slightly higher than Symphony's, which mirrors a lower average length of the relationships and thus a lower degree of strategic investment of the customer towards IGate. Indeed, IGate management describes as strategic a couple of long-term oriented relationships only. These relationships kept on deepening over time, while some others just faded away and were substituted by other customers. Turning to BangaloreSoftSell and S7, a complete different scenario can be observed. Their external networks appear to be highly dynamic and the average duration of a project to a specific customer can vary strongly. BangaloreSoftSell's relationship to the customer is project-based and short-term oriented and no organizational effort is made to build trust or to invest in order to deepen the tie. Very likely, S7's relationships to the customers appears to be time-based and sharply focused on the migration project itself, with very less post-project maintenance. This leads to a sensible turnover of the customers within the external network.

The abovementioned evidence suggests that a long-term oriented external network is associated to few exploration-based local alliances. Since the cluster firm can anchor its income on a group of customers with high 'stickiness' over time, there is no need to exert further effort in scouting for customers locally and engaging in exploration-based alliances, which are aimed at discovering new opportunities as a reaction to unstable environment (Lavie and Rosenkopf, 2006; Hoffmann, 2007). Moreover, given a set of very strong ties, relevant commitment and a long-term based investment are required, in order to gain deeper

reciprocal knowledge and build the necessary trust (Granovetter, 1985; Rowley et. al, 2000). Thus, few capabilities are left to concentrate effort on exploration-based relationships, which are supposed to be reaching different domains and gathering broad information to support discovery. The size of the network and its evolution over time are relevant to this argument: as the number of strong ties to external customers to handle simultaneously increases, the more the company efforts will be located on the external domain. Indeed, the time and resource obligations of strong ties (compared to weak ties) diminish the number of contacts a firm can realistically maintain at a time (Rowley et al., 2000). The empirical evidence, along with the theoretical discussion, suggests our first proposition:

P2. Large external networks of long-term oriented inter-firm relationships are negatively associated to local exploratory networks

Exploration alliances are conceived as being able to bring up new capabilities (Koza, Lewin, 1998). The evidence suggests that local exploration-based alliances are mainly focused on the scouting of new business and new customers rather than on the acquisition of new technological capabilities. Thus, we can consider local alliances as exploration-based in order to acquire new business capabilities and contacts: local network serves as referral network (S7 and BangaloreSoftSell) and offers the possibility to reach new markets, including the local one (HP).

As the output of the exploration effort in the local domain, we can observe either new capabilities internally developed (HP) or the number of new customers acquired globally (S7 and BangaloreSoftSell). The stronger the exploration effort the higher the company's strategic flexibility (Hoffman, 2007), which is achieved by short-term, broad information spanning, weak and superficial ties (Rowley et al., 2000). Our empirical evidence, and the theoretical argument thus advanced, suggests the causal pattern to be bidirectional: a co-

evolutionary process emerges, between the local exploration effort and the size and long-term perspective of the external network. Hence, we can derive our third proposition:

P3. Local exploratory networks are positively associated to large external networks of short-term oriented inter-firm relationships

Fig. 3.4 is aimed at representing the relationship between the degree of local exploration and the long term orientation of external network. In line with our inductive approach, the figure has a pure representation intent, without any intent of quantitative measurement of the constructs emerging from the field. The visual representation emphasizes the inverse correlation between the two constructs. Moreover, it interestingly highlights the moderating effect of the age, thus further supporting our first proposition: firm age fosters the exploration intent towards the local domain, by shifting upwards the correlation curve. Indeed, HP, BangaloreSoftSell and IGate shows the same correlation pattern as their young counterparts, thought shifted forward. The red dotted lines underlines the effect.

INSERT FIGURE 3.4 ABOUT HERE

Evolution of the dispersion of the external network. The *dispersion* is the spread of alliances in terms of different strategic groups and industries which are reached through the network (Hoffmann, 2007) and determines the span of different business-related capabilities a company is required to possess in order to interact with a given set of external customers. IGate pinpoints a progressive specialization on the US market and on specific industries, and a precise choice not to scout for potential customers across different locations or business areas. The span of business-related capabilities is thus decreasing over time, along with an increasing specialization:

'[...] It is largely because of capabilities reasons. You can specialize across multiple verticals but then it means building capabilities in each of the verticals. We are at a size in which it is important to develop deeper relationship and in order to build deep relationship you need to have good capabilities. So it is easier if you restrict yourself to a familiar terrain and that's probably why we are here, focusing on financials..' (CFO, IGate).

Symphony highlights the same need to build up capabilities related to the specific business-domain of the customers, and to promote a constant and focused evolution of the capabilities over time. While IGate is by now strongly focused on financial services, Symphony is undergoing a fast-paced attempt to specialize into retail, financial services and storage. Considering the age difference between the two companies, their external network can be considered as two different stages of the same process, which points towards a reduction of the number of customers and of the capabilities dispersion of the network due to an increasing business-domain specialization on specific industries. The decreasing capability dispersion of both IGate's and Symphony external networks jeopardizes the need for these companies to scout for further business-related capabilities in the local domain.

As far as the MNCs' subsidiaries are concerned, the stock of internal capabilities is perceived as evolving in order to meet the parent company requirements. Even though the business-related capabilities span related to subsidiaries' external network is very narrow, because of the presence of one single partner, both Yahoo! and HP have leveraged the local context in order to find appropriate directions for capability development in order to enhance the value delivered. The evolutionary directions have been established by the subsidiaries themselves, through an exploration of opportunities mainly focused on the local domain. HP has made use of the local alliances in order to upgrade its business capabilities and to better meet the requirement of the parent company:

'[...] Since we are leveraging the local context in order to increase market share, we are trying to increase our capabilities too. So now, if we are doing that we need to determine what will be the future worldwide map for networking products not only now but in two years, three years down the road. It requires a total different set of capabilities. It requires no longer programmers now, it requires strategists, program managers, it requires product managers, it requires business developers...' (Technical Manager, HP)

Considering the small high-tech companies of our sample, the technological capabilities requested from the external network are very well-defined, since both the companies sharply focus on migration. A variety of industries are spanned by the external networks of these two companies and this can be explained by the fact that *'migration does not really differ across industries'* (BangaloreSoftSell). Thus, even though technologically focused, the external network appears to be very disperse as far as the business-domain capabilities are concerned. While the technological capabilities are very well-monitored and rooted within the company, the business-domain capabilities seem to be acquired mainly from the local domain, through an exploratory behavior.

This is in line with the predictions of exploration/exploitation theoretical paradigm. Stable, trust-based inter-firm relationships to external customers can be seen as exploitation alliances, which *'require a deeper understanding of specific information rather than a wider grasp of general information'* (Rowley et al., 2000: 374), which leverage upon capabilities which the focal firm already possesses. On the contrary, exploration alliances are aimed at scouting for new capabilities through inter-firm relationships. Considering our empirical evidence as a whole, the two large IT-service providers show very poorly dispersed external network, whose dispersion keeps stable over time. Thus, their need for scouting of new capabilities, both on the technological and on the business-domain side, is very poor. Similarly, the dispersion of technological capabilities of the external network of MNC subsidiaries is low. Though, according to both subsidiaries, the business of the parent company is changing with a fast pace, which requires them to develop the business-related

capabilities in order to increase their delivered value over time and maintain their competitive advantage towards other worldwide sites. This comes to foster their interest in developing and exploration-based local network, in order to build up new capabilities. The size of the external network is important. Unlike Symphony and IGate, the uniqueness of the subsidiaries' relationship to the parent company, though very strong, leaves them enough organizational resources to explore the capability space through alliances (Rowley et al, 2000). Thus, the companies can engage into new exploration-based alliances in order to develop new business-related capabilities, as required in order to upgrade the value delivered to the parent company.

This allows us to advance our fourth proposition:

P4. Large external networks with high dispersion, both technology and business-domain related, are positively associated to local exploratory networks.

On the other side, we can observe the behavior of S7 and BangaloreSoftSell. These firms, characterized by a short-term oriented external network with a very dispersed set of capabilities, do not need to make any organizational effort in deepening their external relationship, neither from a technological nor from a business-domain point of view. Organizational resources are thus left to explore the business domain engaging into with weak, broad-information spanning ties to as many local partners as possible, in order to seek for new business opportunities by getting referenced to third parties. The bundle of new customers deriving from these broad and several local ties can be very heterogeneous as far as the business-domain is concerned. The industry dispersion of the set of customers largely depends on the size of the internal network, since every local referee is likely to master a specific industry and a specific set of clients. Thus, we advance our fifth proposition, which highlights the bidirection of the causal pattern, as well as a co-evolution between the

likelihood of local explorative cooperation and the capability dispersion of the external network.

P5. Local exploratory networks, either technology-focused or business-domain focused, are positively associated to large external networks with high dispersion.

Fig. 3.5 is aimed at representing the relationship between the degree of local exploration and the dispersion of the external network. In line with our inductive approach, the figure has a pure representation intent, without any intent of quantitative measurement of the constructs emerging from the field. The visual representation emphasizes the positive correlation between the two constructs. Moreover, it interestingly enhances the moderating effect of the age, thus further supporting our first proposition: firm age fosters the exploration intent towards the local domain, by shifting upwards the correlation curve. Indeed, HP, BangaloreSoftSell and IGate show the same correlation pattern as their younger counterparts, though with the intercept shifted forward. The red dotted lines underline the effect.

INSERT FIGURE 3.5 ABOUT HERE

3.6 Conclusions

3.6.1 Contribution to extant literature

The paper contributes to extant literature in several directions. The evolutionary patterns of external and internal networks of the firms under observations are unfolded, through and in-depth longitudinal comparisons of case studies. Beyond the supply of new empirical evidence and of new theory to the literature addressing network evolution, a key element emerges as a major extension of previous theories and as an important starting point

for further scholarly work: the causal link between the network and the network itself. A self-feeding co-evolutionary relationship between internal linkages and external linkages is unfolded, ultimately disrupting the mainstream perspective, which conceives the network as a whole and draws causal linkages between the network and firm-level characteristics.

Our empirical setting allows us to sharply differentiate two kinds of network – the internal, cluster based one, and the external, global one – and underlines the clear inter-ties causal relationship, which feeds the evolution of both internal and external network over time. In this sense, an important role is played by the choice of the companies in our sample: despite differences in age, all the firms are well-established and present in the cluster for at least 4 years. This further contributes to extant empirical work, which has mainly focused on the network evolution of early stage, fast-growth companies. Our theoretical discussion leverages on the exploration/exploitation theoretical paradigm and highlights a major counter-intuitive result: the evolution of internal alliance from a exploitation to an exploration strategic intent. This is disruptive towards extant theory, which would predict exploration alliances, weak, broad and superficial to be evolving into more in-depth, specialized and mutually committing alliances aimed at exploiting the results of initial exploration. An inconsistency is thus highlighted in existing theory, which considers exploration ties to be weak and broad on the one side (Rowley et al., 2000), but able to share the amount of tacit and core knowledge necessary to carry on highly innovative R&D activities (Koza and Lewin, 1998; Lavie and Rosenkopf, 2006). Both our empirical evidence and our theoretical discussion tries to resume this theoretical inconsistency by arguing a different evolutionary pattern. Exploitation-based alliances over time come to establish in-depth reciprocal knowledge and established routines and trust, which can foster the sharing of core, tacit knowledge. The increasing reciprocal awareness and trust turns out to triggers organizational

mechanisms that promote the strategic upgrading of the alliance and the search for new technological and business-related opportunities, ultimately entering the exploration space.

3.6.2 Managerial and policy implications

Considering the world-wide growth of offshoring phenomenon, the dynamic race for acquiring new sources of competitive advantage other than a mere, fast-shrinking cost-driven benefits, the managerial implications of our study are several. Most important, this work clearly highlights the possibility to leveraging the local domain with a strategic, exploration-based intent, thus unfolding the advantage of being located in an offshore high-tech cluster such as Bangalore. All the companies surveyed can be considered as success stories: all of them independently have developed a degree of exploration of the local cluster, which goes far beyond the seek for local skills or cost advantages documented by the literature so far. Despite what previous studies have claimed, Bangalore shows to offer an increasingly rich systemic environment, which leverages on inter-firm cooperation and cross-reference to enhance both local and global value. Considering previous empirical evidence, our findings can also witness a further stage in the development of the local cluster, which has now managed to trigger the proper mechanisms to enhance its attractiveness for both domestic firms and MNC subsidiaries.

3.6.3 Limitations and directions for future research

We need to point out several limitations of this study, which can be considered as starting points for future research. First of all, a generalizability issue arises, due to the specificity of the six case studies and the idiosyncrasy of the context. A relevant effort has been made, in order to guarantee extremely different cases and thus to enhance the generalizability of the proposed theory, according to what stated by Eisenhardt and Graebner

(2007). Yet, some problems can arise from the specificity of the empirical setting, which is common to all case studies. Bangalore IT cluster holds some unique features, which sharply differentiate it from other traditional industrial clusters. Far below the overembeddedness threshold, Bangalore IT cluster is strongly export-oriented, which entails a limited local networking activity and a strong local focus on external linkages. Moreover, the service-based nature of the products engenders knowledge flows which are purely intangible. Fast-paced dynamics of change can be observed in this relatively young cluster. On the one side, this has given us the opportunity to gain a close insight into the key turning point of the evolution of the cluster and of the strategy of the companies under observation. On the other side, limited longitudinal evidence could be gathered, covering only four years of the companies' history with a retrospective bias. Further research is needed, to gather extensive longitudinal evidence on the evolution of internal and external networks and to test the shift from an exploitation-based to an exploration-based leveraging of the local domain.

Considering the networks, the present work has focused on the relational dimension only of the social capital, namely considering the quality and strength of the linkages involved. The cognitive as well as the structural perspective of the social capital, as theorized by Nahapiet and Goshal (1998) have been neglected. A much more exhaustive analysis can be undergone through large sample data, which could specifically allow appreciating the structural dimension of the network. In particular, the exploitative/explorative strategic intention could be operationalized through the company's position in the network, as suggested by Rowley et al. (2000). By thus tracing the evolution over time of the firms' structural behaviour, one can observe and give strong empirical test to the evolution over time of the firm's strategic leveraging of the local domain.

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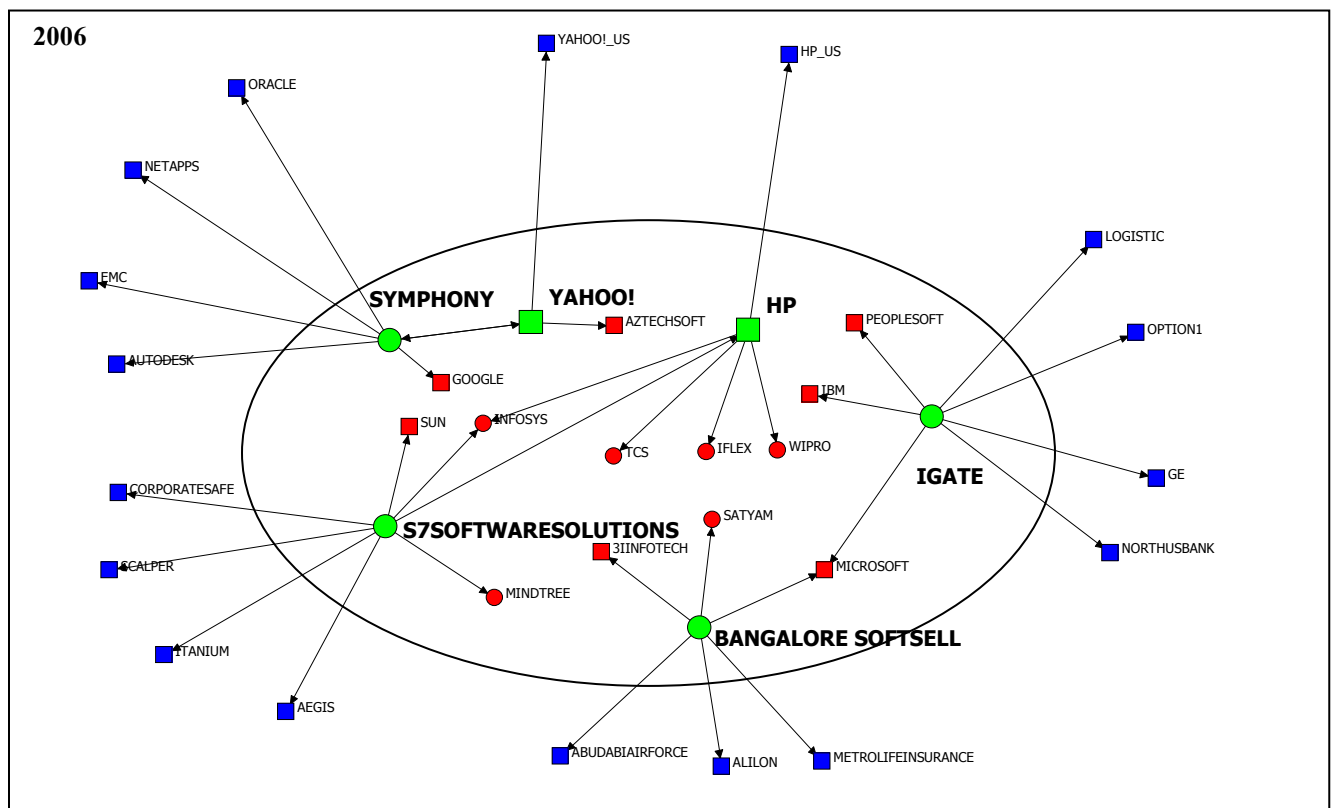
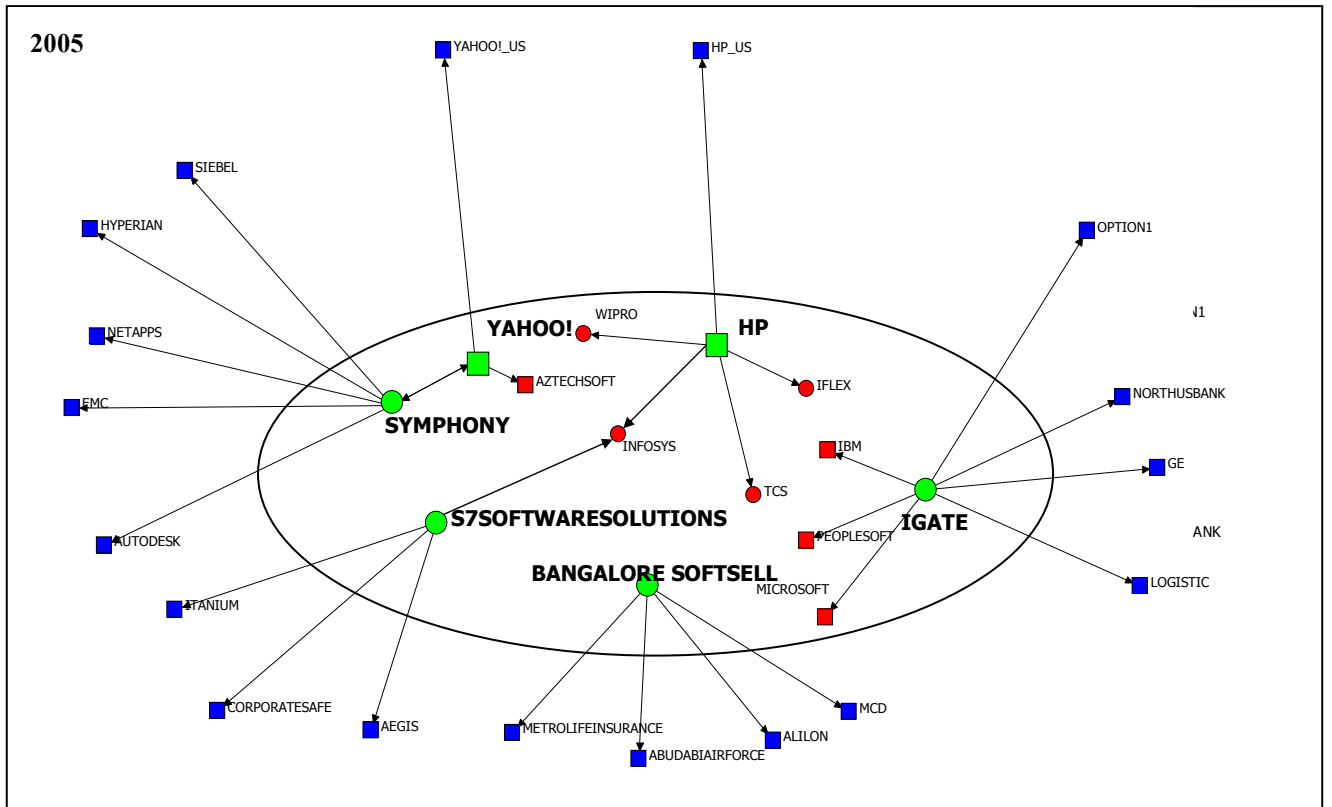
Exhibits (Chapter 3)

Table 3.1 – Comparative table across cases

Company	S7 Software Solutions	BangaloreSoftSell	Symphony	IGate	HP	Yahoo!
Size (employees)	50	40	3400	6500	30.000	13.000
Year of foundation	2004	1987	2002	1993	1989	2000
Ownership structure	Domestic firm	Domestic listed firm	Domestic listed firm	Domestic listed firm	MNC Subsidiary	MNC Subsidiary
Core business	High-technology IT services. Sharp technological specialization on providing migration technology	High-technology IT services. Sharp technological specialization on providing migration technology	IT services – focus on product engineering and high-end product development	IT services – they develop technological platform in order to manage the customers operations (ITOPS)	STSD (System Technology and Software Division unit) – they provide Software and product development for the server side of HP business.	Software development and engineering management for Yahoo!'s emerging markets
Business model	IT Services - Migration technology solutions along with ' <i>deep re-engineering of customer's internal processes</i> ' - providing ' <i>not trivial solutions</i> '. ' <i>We still work on a service-based business model, in the future we will try to evolve to something different</i> '.	IT Services - Migration technology - They develop a migration tool. First it was a ' <i>migration tool which could move any legacy to Microsoft-based platform, a different engine was developed, able to migrate any type of language and convert it to any other platform</i> '. This is conceived to give a ' <i>special flavour</i> ' to the company, which operates on a service-based business model (headcount)	IT Services - High-end product development: ' <i>What we really do is we created a niche for ourselves. We provide software that the customers just brand and sell. We help the customer to redefine their core business</i> '. <i>Many different business models are now developing, we are still operating on a headcount base but we are trying to move to an utility business model</i> '	IT Services - ' <i>we provide the platform, the process and the people and we shift the cost from a service-based fixed cost to an variable cost</i> ' ' <i>What we do is we transition client's work onto our platform and technology and provide the service on a transaction based pricing model.</i>	On-going project to project collaboration with the parent company. Evolution over time to a ' <i>excellence centre, which now aims at developing new business scenarios for the worldwide corporation</i> '	The company has become the ' <i>engineering hub</i> ' for the corporation, for all emerging markets. Specialization in some areas like search, advertising system, public websites.

Company	S7 Software Solutions	BangaloreSoftSell	Symphony	IGate	HP	Yahoo!
Characterization of external network	The relationship to the customer is conceived with 'a minimum interaction threshold of once a week minimum in teleconference and more than once via email. A shift of the team onsite is also considered as a viable option, especially in the very first phases of a project, which shows an average duration of 3-6 months'.	The relationship to customers is said to be 'very close during the project The company's strength is technological specialization: instead of nurturing the relationship to the client through maintenance services, they would rather find 'new trust offering the technology to some other customers'	They are ' <i>loyal customers because we provide them with high-end life-or-death products, which are branded and directly sold</i> '	The relationship with the customer is seen as very strong and trust-based and long-term oriented. The contribution to the customer business is considered as high-value	The relationship towards parent company is very strong: <i>'we feel as we are the same company'</i>	The relationship towards parent company is very strong: <i>'We share the same goals, there is no difference between here and US'.</i>
Characterization of internal network	R&D Collaborations and references in order to scout for new customers	Local partnership in to develop migration work and references in order to scout for new customers	Staff-augmentation relationships, which eventually will evolve into partnerships	Technology-based relationships towards MNC subsidiaries	Software suppliers and marketing relationships	Suppliers according to two main modes: OPD (Outsourcing Product Development) or insourcing (staff augmentation)
Number of people interviewed	3	3	4	4	2	2
Hours of interviews	5,5	5	5,5	6	3,5	4

Fig. 3.1 – Evolution of the six ego-networks over time (2005-2008). The circle portrays the boundary of the cluster. Within the cluster, the square symbol indicates a MNC subsidiary while the round symbol represents a domestic firm.



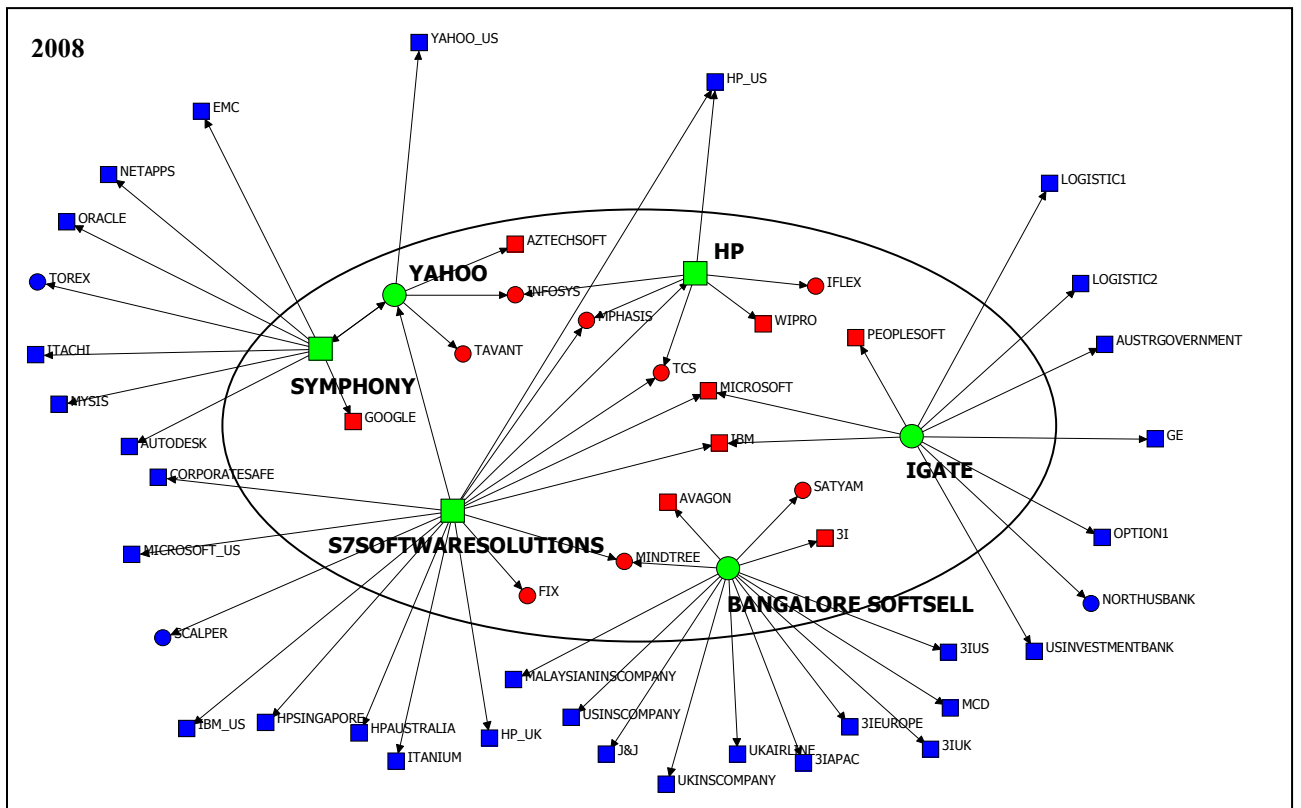
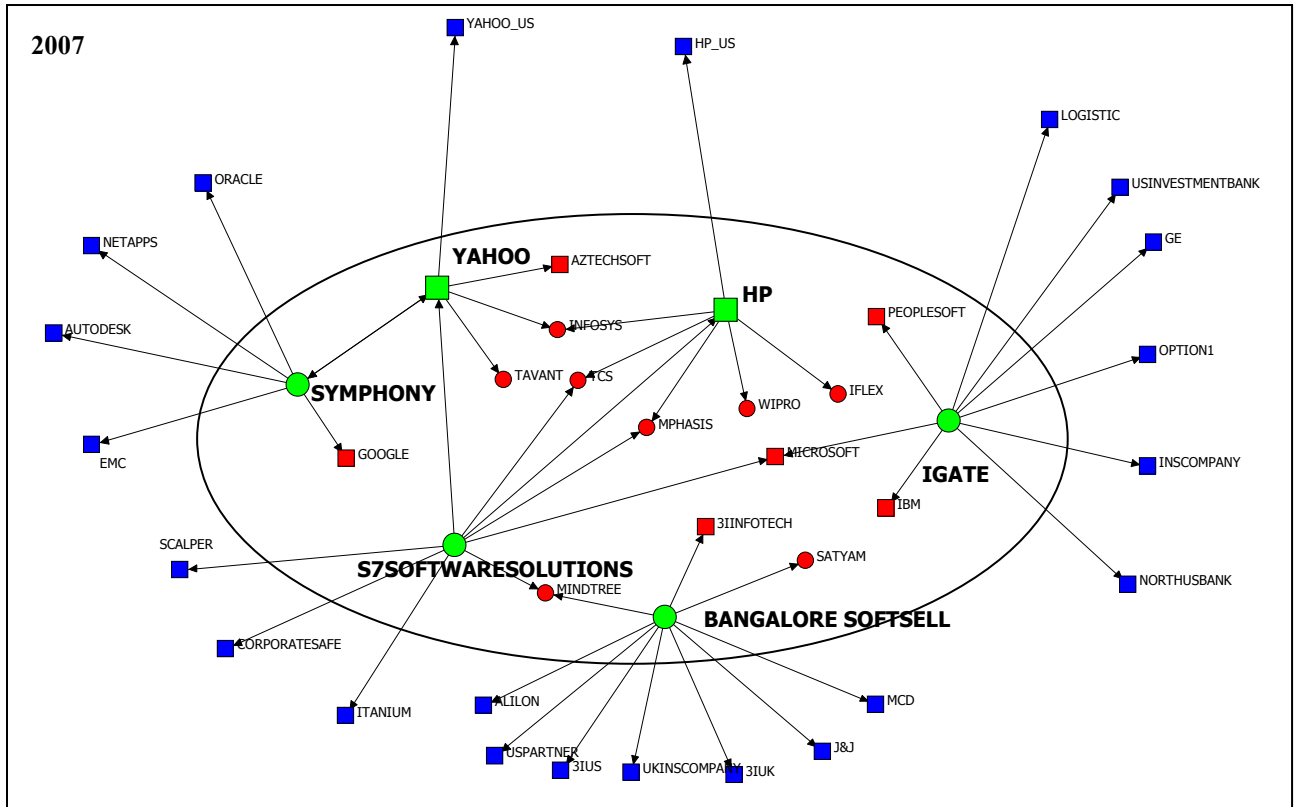


Fig. 3.2 - The six ego-networks represented simultaneously to highlight the role of some partners in generating new alliances. The dotted arrows highlight the causal linkages between the inter-firm relationships

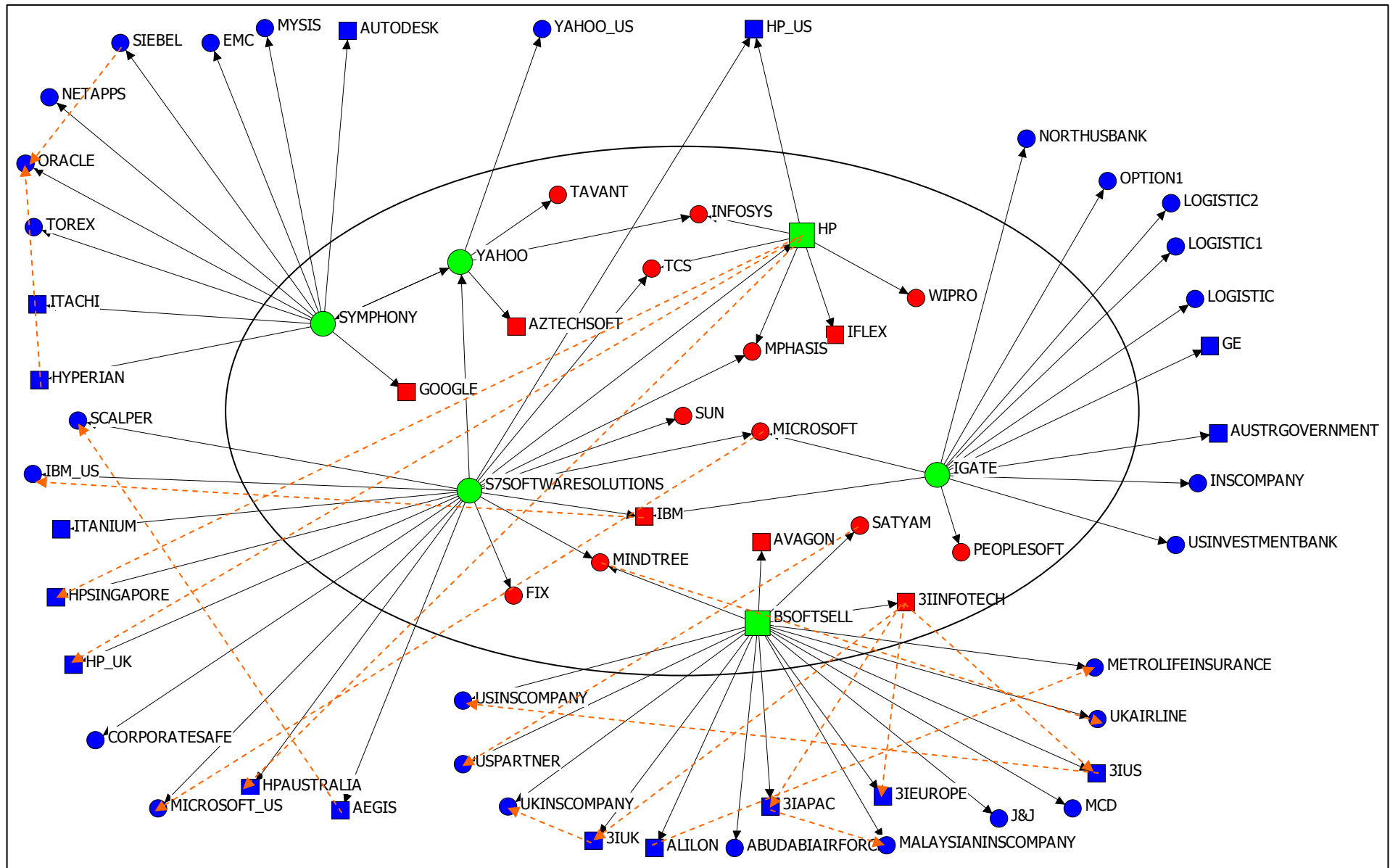
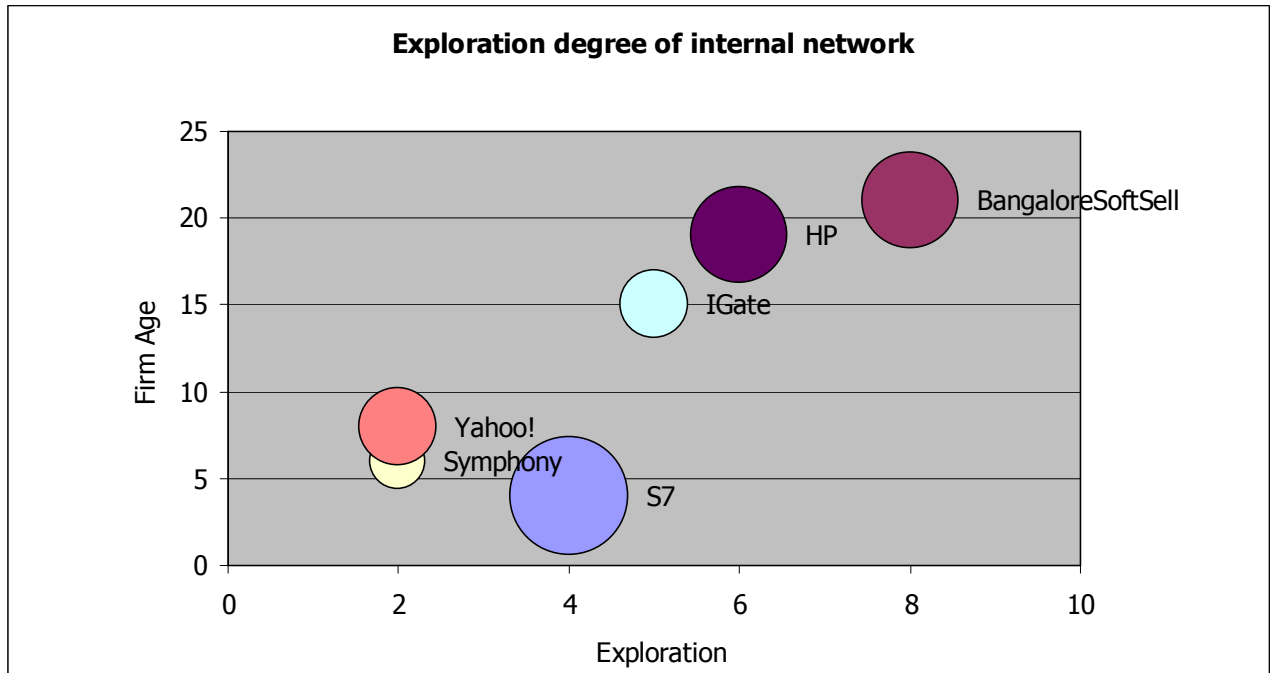
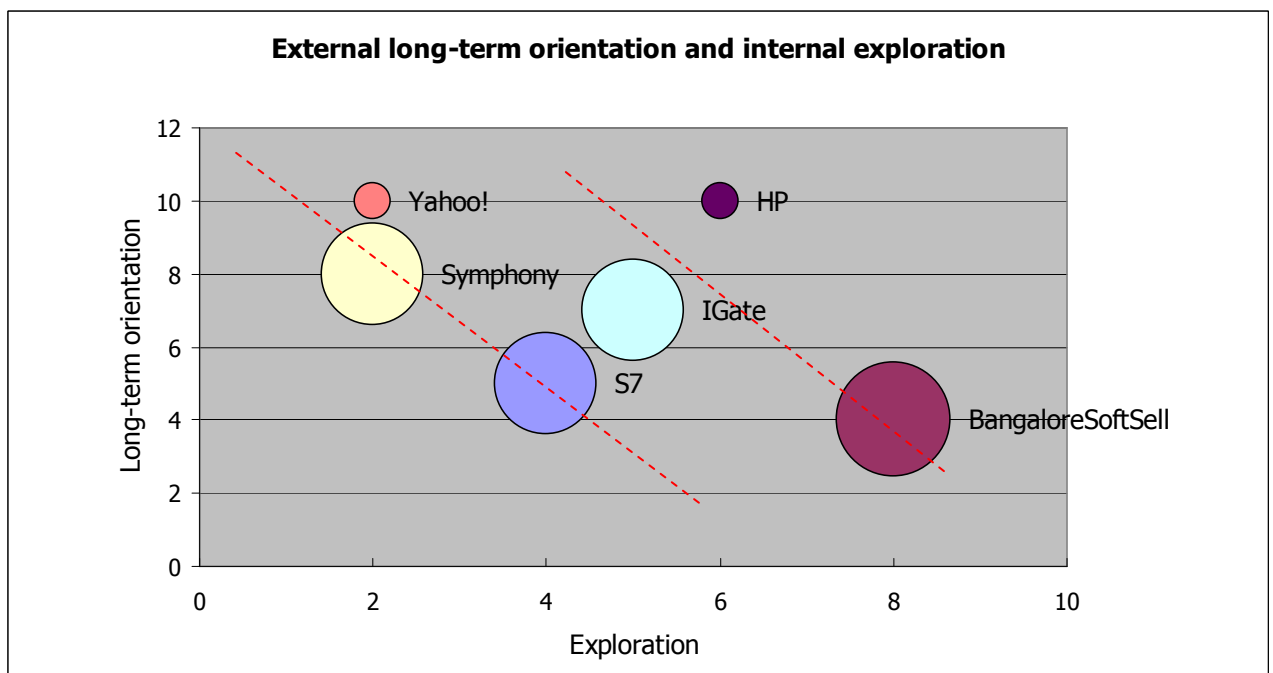


Fig. 3.3 – Relationship between firm age and average exploration degree of the local network.



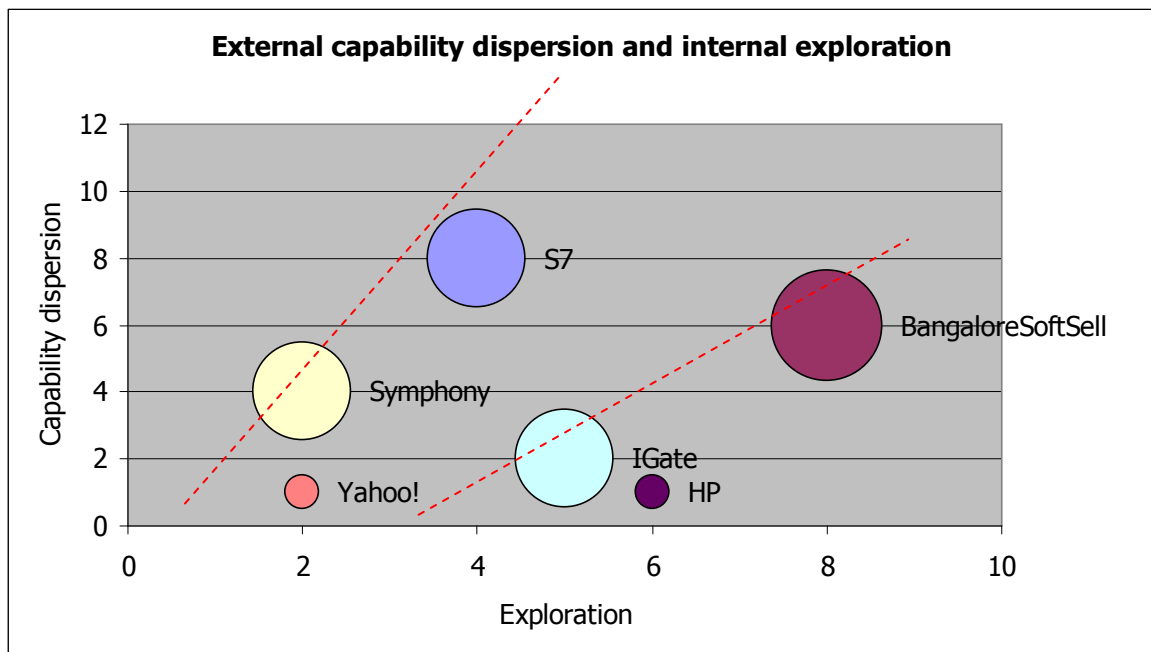
Note: The size of each mark is proportional to the size of internal network.

Fig. 3.4 – Relationship between the long-term orientation of external network and average exploration degree of the local network.



Note: The size of each mark is proportional to the size of external network. The red dotted lines highlight the influence of firm age on the relationship.

Fig. 3.5 – Relationship between the capability dispersion of external network and average exploration degree of the local network.



Note: The size of each mark is proportional to the size of external network. The red dotted lines highlight the influence of firm age on the relationship.

CHAPTER 4

Directions and Paths of Knowledge Flows through Personnel Mobility: A Social Capital Perspective

Abstract

This paper unfolds the directions and paths of knowledge flows through personnel mobility, originally unravelling the uneven distribution of personnel mobility across companies, due to the effect of cluster affiliation, industry affiliation and foreign affiliation. In formulating our hypotheses and in interpreting our results we deploy a social capital perspective, through which we take into account the capability of employees to build ties across companies and to extend the overall company's social capital.

We test our hypotheses through an original database encompassing 3895 employees' movements across and within the IT cluster in Bangalore, which produce 1331 cross-sectional directed dyads between 397 companies. Our negative binomial regressions at dyad-level highlight three major findings. First, in line with previous literature, both outflows and inflows of valuable employees are more likely to occur between local firms, further denoting Bangalore as a cluster. Second, and counter intuitively, flows of valuable employees highly concentrate along the path leading from MNCs to domestic firms, thus apparently favouring knowledge transfer from MNCs to local domain. Third, inflows of valuable employees mainly occur from rivals, while outflows distribute equally to rivals and to non-rivals.

4.1 Introduction

Knowledge transfer in localized regions has received strong attention by scholars over the last decades. When considering knowledge flows involving clusters or geographically localised spaces in emerging economies, the classic and most well-known set of studies emphasizes the role of Foreign Direct Investments (FDI) in fostering knowledge spillovers in the local domain.

Martins (2008) highlights an evolution of these studies over time, in three major waves. A first analyzed knowledge spillovers relying on cross-sectional data and found that domestic firms based in industries that exhibited a larger concentration of foreign firms were also more productive. This was assumed by many to imply that foreign firms generated positive productivity spillovers. A second wave benefited from more detailed longitudinal data. Being thus able to relate differences in foreign presence in each industry over time and differences in productivity in domestic firms in the same industry again over time, the new analyses were more robust to the possibility that foreign firms were more likely to be based in more productive industries, rather than effecting the productivity of domestic firms. The results in most studies using these data sets were indeed consistent with the latter hypothesis. For instance, in a widely-quoted study, Aitken and Harrison (1999) find no evidence of spillovers in Venezuela. They even argue that foreign firms may make domestic firms less productive as they steal market share from the latter forcing those domestic firms to produce at a less efficient scale. More generally, this lack of positive effects was also obtained in other similar studies, as indicated in a meta-analysis by Görg and Strobl (2001).

However, a third wave in this line of research seems to again reverse the conclusions of the previous wave, even if similarly rich data and sophisticated econometric methods are used. Although this wave is still in its infancy, some papers have argued – and presented

consistent evidence – that the existence of a productivity impact of foreign presence depends crucially on the type of domestic firms considered and the relationship between those domestic firms and foreign firms that may generate the spillover (Javorcik, 2004; Blyde et al., 2005).

Considering the macro level of analysis deployed by these studies, a major limitation emerges. These contributions assume the knowledge to be flowing only from MNCs to domestic firms, as a dangerous leakage. Possible inflows of knowledge from the host countries towards MNCs are completely under-investigated, along with the flows between domestic firms.

A disruptive study in this sense comes from Singh (2007). By using patent data at firm level, the author acknowledges and tests the bi-directionality of knowledge flows, which both lead from MNCs to host country and from the host country to MNCs. Indeed, in technologically advanced countries, knowledge outflows to foreign MNCs greatly outweigh knowledge inflows. Even in technologically less advanced countries, knowledge outflows are only slightly weaker than inflows. The contribution leads to question the assumptions of the previous set of studies, even though two main caveats remain: 1. the use of an indirect measure of knowledge flows (patent data), which fails to capture the type of knowledge which is flowing and the channels of knowledge flows, 2. the lack of an exhaustive typology of knowledge flows which takes into account all possible paths within localized spaces as clusters.

This paper originally contributes to extant literature by developing a different perspective. First, we portray the richness of all paths of knowledge transfer, along four directions: 1. from MNCs to MNCs 2. from domestic firms to MNCs 3. from MNCs to domestic firms 4. from domestic firm to domestic firms. Second, we point at emphasizing the

importance of knowledge transfer as a shared resource, able to bond the source and the destination firm.

Considering knowledge flows in the local domain, Fosfuri et al. (2001) recognize three main channels of knowledge transfer between MNCs and domestic firms: ‘demonstration effect’, where the best practices, internal processes and organizational features of the MNCs are observed by domestic firms through geographical proximity and imitated; backwards and forward linkages from MNCs to domestic firms; personnel mobility, particularly when MNCs come to internally train an employee who subsequently moves to a domestic firm. In this paper we focus on the latter channel as a direct proxy of knowledge transfer.

4.2 Knowledge transfer and personnel mobility

Personnel mobility has attracted scholarly attention because of its ability to transfer the most tacit portion of organizational knowledge (Madsen, Mosakowsky, Zaheer, 2003). When individuals move between organizations, they are likely to apply the knowledge they absorbed and developed with their previous employer to new contexts, thus effectively promoting knowledge transfer (Argote and Ingram, 2000; Song, Almeida, Wu, 2003). Since tacit knowledge and skills are likely to embed the core of a firm’s knowledge stock (Kogut and Zander, 1993), how individuals move across firms has become increasingly important (Gruenfeld et al. 2000; Kratz and Moore, 2002; Rao, Drazin 2002). The issue is of particular relevance within industrial clusters, because of the ‘stickiness’ of tacit knowledge (von Hippel, 1984) which tends to remain localized within firms, regions and countries (Jaffe et al. 1993; Szulansky, 1996; Audretsch, Feldman, 1996; Saxenian, 1996; Almeida, Kogut, 1999; Casper, 2001;).

Scholarly work has been focusing so far on how the knowledge transferred through personnel mobility can be affecting firm's financial and innovative performance. Rosenkopf and Almeida (2003) point out that the most direct evidence of the link between mobility and knowledge transfer stems from studies using patent records. Almeida and Kogut (1999) show that after a semiconductor firm hired a new engineer, there was a significantly greater tendency for the hiring firm to cite the prior patents of the newly employed engineer than would be expected given its technology profile. In addition to that, Song et al. (2003) demonstrate that during the early stage of development of Korean semiconductor firms, the practice of bringing U.S.-educated and U.S.-employed nationals back home leads to similar patenting practices. Thus, they suggest that when inventors move from one firm to another, they transfer knowledge from the prior employer to the new one.

Besides technical knowledge, employees embed a significant amount of knowledge about organizational routines and procedures; the movement of employees along with their organizational knowledge can engender consistent disrupting effects in both the source and the recipient firm. Wezel, Cattani and Pennings (2006) highlight that the dissolution risk of the previous employer due to the movement of top decision makers is highest when the movement is collective and when the recipient firm is a start-up in the same geographical area. Madsen, Mosakowsky and Zaheer (2003), on the other side, consider the different sources of personnel mobility (intra-firm versus inter-firm; local versus cross-border) and prove that the inflows of personnel mobility from different sources increase the retention activity.

Turning to the competitive implications of personnel mobility, a consistent stream of literature mainly considers its negative effects, focusing on knowledge spillovers risks and appropriability problems, especially in the local domain (Zhao, Alcacer 2007). This follows the seminal work of Gilfillan (1935), who suggested that labor mobility, especially among

engineers, erodes the differential level of knowledge among firms, thus jeopardizing competitive advantage. On a different line, though, some studies are emerging, which consider personnel mobility as a inter-firm learning mechanism, which can be deliberately shaped through firms' strategy. In particular, the contribution by Rao and Drazin (2002) highlights how recruitment from rivals can compensate from firms' internal constraints in developing new technology. Disruptive in this sense is the study by Somaya et al. (2008), who consider as strategic not only the search but also the loss of employees. The authors test that movement of employees both to and from clients enhance firm performance, while only inflows from competitors entail focal firm's benefits.

By deploying a social capital argument, and thus considering the 'social capital changes wrought at the organization level by employee mobility' (Somaya et al., 2008: 938), the authors explain their results by interpreting the employee's movement as the establishment of a new social tie, which ultimately strengthens the relationship between the two firms and enhances mutual trust.

On this line, we argue that the social capital perspective can be a key framework to shed new light on knowledge flows through personnel mobility. We believe that personnel mobility results from the interplay of two factors: the recipient company's strategy to hire a new employee and the source company's effort to retain the employee. According to our view, a strong organizational effort can be posited in shaping firms' social capital, intended as the network of linkages a firm builds through its personnel mobility. Given that companies make use of personnel mobility to change/shape their social capital (Somaya, 2008), how do they differ in doing so? This paper addresses this question, trying to highlight factors which can explain differences in shaping the social capital.

4.3 Theoretical framework and hypotheses

A social capital perspective is best suitable to unravel the dynamics underpinning personnel mobility at firm level and to understand its competitive outcome. Through a social capital perspective, we consider employees' mobility as building ties across companies. A tie established by the movement of an employee can be considered as the least deliberate and strategically planned form of social capital, due to the large portion of individual-based reasons underpinning the movement decision. Nevertheless, strategic literature broadly recognizes the firm's strength in shaping personnel flows and in defining precise hiring and retention policies (Rao, Drazin, 2002). We thus argue that a consistent portion of personnel mobility can be defined by firm strategy to either retain or attract employees. In our view, consistent with the perspective developed by Somaya et al. (2008), firm's hiring policies have to be considered according to a twofold strategic point of view: 1. to change/preserve the current human capital, namely the collection of skills, organizational knowledge, routines embedded in the firms' current personnel (Becker, 1964) 2. to change/preserve the current social capital, namely the set of ties linking the focal firm to other firms through the outflows and inflows of employees. We will focus our arguments on the second strategic point of view, which has been strongly under-investigated by literature so far.

According the theorization offered by Nahapiet and Goshal (1998), social capital needs to be considered along three main dimensions: structural, relational and cognitive. Structural embeddedness refers to the relative position of the firm within the network, as the 'impersonal configuration of linkages between people or units' (Nahapiet and Ghoshal, 1998: 244). As Moran et al. (2005) points out, structural embeddedness substantially portrays the presence or absence of network ties between actors, including features like connectivity, centrality and hierarchies. Structural embeddedness essentially gives answer to the question:

who knows whom? Turning to the natural subsequent question of ‘*how well ones knows them?*’ relational embeddedness is defined as ‘the personal relationship people have developed with each other through a history of interactions’ (Nahapiet and Ghoshal, 1998: 244).

Relational embeddedness is characterized and specified in its strength by the presence and the strength of embedded ties. Focusing on individual level, Granovetter (1973) defines tie strength as ‘a combination of the amount of time, the emotional intensity, the intimacy (mutual confiding), and the reciprocal services which characterize the tie’. The stronger the values on these dimensions, the stronger the tie. Building upon this definition, Uzzi (1996) argues embedded ties to have three unique features, namely, trust, fine-grained information transfer and joint problem-solving, which differentiate them from arm’s length relations, low in embeddedness and requiring little investment and mutual obligation. Hence, key issues of relational embeddedness lie in the concepts of trust, trustworthiness, overlapping identities and feelings of closeness or interpersonal solidarity (Moran, 2005). Literature has broadly recognized and supported the importance of embedded ties for both reciprocal learning and development of trust (Larson, 1992; Uzzi, 1996) together with the possibility to transfer more tacit knowledge. Indeed, based on a deeper understanding of a partner’s operations, tacit knowledge is more readily transferred across organizational boundaries, which are blurred by close contact (Rowley, Behrens and Krackhardt, 2000). Moreover, embedded ties are proved to promote private knowledge transfer (Uzzi, 1996), because expectations of trust and reciprocity guarantee the transfer being used for mutual benefit of both parties.

The third element of social capital highlighted by Nahapiet and Goshal (1998) refers to the cognitive dimension and considers those resources providing shared representations, interpretations and systems of meaning among parties. According to the theoretical model offered by the authors, knowledge transfer and access to valuable resources, which lie at the

core of social capital, are best achieved whenever shared codes and language are present, leading to knowledge recombination and new knowledge creation.

According to a social capital approach, firms can have multi-fold reasons to be willing to implement a hiring policy which maximizes the inflow of fruitful knowledge and minimize the risks of leakages of core knowledge. We consider three main firm-level elements as possibly shaping differences between firms' search for social capital through personnel mobility, thus influencing the dynamics of personnel mobility: the cluster affiliation, the industry affiliation and the foreign affiliation of the firm.

4.3.1 Cluster affiliation

Concerns about knowledge spillovers particularly arise within geographic clusters, where proximity prompts positive effects but also important appropriability dangers. Starting with the seminal work by Marshall (1920), researches have suggested that firms in industrial clusters benefit from inter-firm knowledge spillover, access to specialized labor, and access to specialized intermediate inputs. In particular, geographic proximity in technology clusters enables frequent interpersonal interactions through existing social networks (Almeida, Kogut 1999) and local institutions (Gilson 1999; Stuart, Sorenson 2003), which facilitate the transfer of tacit knowledge.

Literature has abundantly theorized and proven how knowledge tends to localize geographically (Almeida, Kogut, 1999; Saxenian, 1996; Audretsch, Feldman 1996; Casper, 2007). This is mainly attributable to knowledge stickiness (von Hippel, 1984) and to the tendency of personnel to remain bounded in specific and limited geographical areas because of the high costs of relocation. Extensive literature, on the other side, highlights the risks due to the co-location, in terms of erosion of firms' competitive advantage (Gillfillan, 1935) and in terms of appropriability of innovation (Oxley and Sampson 2004; Zhao, Alcacer, 2007;

Cassiman and Veugelers 2002). Knowledge tends to flow easily within the cluster due to social ties among individuals, which trigger trust and knowledge transfer. Firms thus try to enact strategic measures to minimize the risks of knowledge leakage in the local domain. We argue that, even though incentives will be planned in order to prevent movement of employees to local domain, the stickiness of knowledge and the tendency of personnel to remain bounded in the limited geographical space will prevail. Our first hypothesis thus follows:

1a. Employees' outflows to cluster firms are more likely than to non-cluster firms.

On the recruitment side, cluster participation is theorized as being driven by firms' desire to gain access to certain complementary assets, which are better provided externally than internally and are accessed more effectively in geographic proximity (Scott, 1998; Storper, 1997; Porter, 1998). Yet, some studies emphasize the need of extra-local linkages (Zaheer, George, 2004) by referring to the dangers of local networks that are too close, too exclusive and too rigid. Such social relations could pose a threat to the competitiveness of a firm or a group of firms. In an empirical study of the Manhattan garment cluster, Uzzi (1997) has highlighted a phenomenon that he refers to as over-embeddedness. He demonstrates that close social relations of suppliers with their local customers are only positive to a certain extent. The stronger a large group of suppliers is embedded with the same set of customers, the more likely are firms to fail. A substantial stream of literature claims the importance of channels to access external knowledge, referred to as 'pipelines' (Owen-Smith, Powell, 2004).

Considering the above arguments, firms might find it convenient to hire people from outside the cluster, in order to refresh their knowledge stock and to avoid the risks related to overembeddedness. Observing the cognitive dimension of social capital, Madsen,

Mosakowsky and Zaheer (2003) consider the retention capability of a firm, when faced to inflows of personnel from different geographical and organizational sources. A combination of people coming from different backgrounds is likely to engender difficulties in merging the different cognitive schemes and values associated to different background. Yet, somehow counterintuitive evidence emerges: organizational routines are enhanced by the heterogeneity of personnel inflows.

Drawing on the abovementioned literature, which observes the firms' incentives to both hire non-locally (new fresh knowledge) and to hire locally (shared cognitive schemes and knowledge of the territory), we argue that the latter would prevail, also considering once again the tendency of knowledge to remain geographically bounded (Jaffe, 1993; Almeida, Kogut, 1999).

Thus, we hypothesize:

1b. Employees' inflows from cluster firms are more likely than from non-cluster firms.

4.3.2 Foreign affiliation

Differences in foreign affiliation between companies have been fairly under-investigated by extant literature addressing knowledge transfer through personnel mobility. The presence of both MNCs subsidiaries and domestic firms within clusters have been largely acknowledged and observed (Nachum, Keeble 2003; Giuliani, Bell, 2005; Albu, Bell, 1999). The contribution of Singh (2007) based on patent data highlights the asymmetry of knowledge flows due to foreign affiliation and constitutes an important premise in trying to unfold the knowledge inflows and outflows between MNCs and domestic firms. Building on this and considering industrial clusters, Angeli, Grimaldi and Lipparini (2008a) captures the different types of knowledge flowing and the paths of knowledge flows between MNCs and

domestic firms through qualitative evidence. This suggests that, specifically addressing personnel mobility as the channel of knowledge flows, difference in foreign affiliation between firms needs to be accounted for. From a strategic point of view, the firm's hiring policies in the local domain are likely to be different for MNCs subsidiaries and domestic firms.

MNCs' perspective towards the local territory is radically different than the domestic firms', for several reasons. MNCs decide to set up a subsidiary in a host country to look for new resources and new business opportunities, which can substantiate in new linkages towards local clients and suppliers. Considering the knowledge-seeking perspective, MNCs' decision to locate a subsidiary within a high-tech cluster is driven by the proximity to key resources, such as excellence centres in cutting-edge technologies, academic institutions, easy availability of skilled talents, a general and widespread system of innovation which can be leveraged through proximity (Porter, 2000).

In this view, the social capital perspective adds in understanding the unfolding of MNCs' hiring strategy in the local context, at two levels. Along the relational dimension, several contributions have observed the behaviour of MNCs' subsidiaries in establishing relational embeddedness within the local domain. The study by Andersson, Forsgren and Holm (2002) interestingly proves the positive effects on performance of subsidiary's relational embeddedness towards the host country. Relational embeddedness, as achieved through recurrent and strong linkages, favours the consolidation of trust and the transfer of increasingly tacit part of organizational knowledge. Following this line, personnel mobility and the subsequent firms' hiring policy can be considered as the most micro-founded means to achieve local embeddedness. Indeed, employees' inflows and outflows are able to affect the softer and more tacit sphere of organizational knowledge, the cognitive dimension, which is composed by high-order and low-order shared routines (Wezel et al., 2006), shared

language and code and common patterns of understanding (Madsen, Mosakowksy, Zaheer 2003).

To pursue local embeddedness both on the relational and on the cognitive level, it is of utmost importance for MNCs to apply measures to shape their social capital locally. The inflows of local personnel serve this purpose on a twofold basis. First, local employees can establish or enhance the proper cognitive framework for the subsidiary to better interact to the local domain. Second, local employees offer a thick bundle of both professional and personal individual ties to the local domain which provide the new employer with an incredibly reach relational resource to be leveraged. Thus, MNCs will try to attract as many people as possible from domestic firms in the local domain.

The perspective driving domestic firms' hiring policies follows the same line of reasoning, producing a mirror image of the MNCs' strategy, yet entailing a counter running force. Knowledge spillovers from MNCs to domestic firms are very well acknowledged for their capability to boost local learning and productivity. According to this perspective, the refined knowledge produced within MNCs at a global level and to a large scale can be sourced and internalized by domestic firms locally, adding to internal knowledge stock and organizational skills. Fosfuri et al. (2001) highlight three major channels leading to knowledge spillovers: alliances to local domain, demonstration effect and personnel mobility. Thus, domestic firms have strong incentives in trying to attract personnel from MNCs.

Considering the two abovementioned and counter running arguments, we argue the first to be prevalent, thus conducing to an uneven distribution of knowledge flows between MNCs and domestic firms. Literature offers essentially two more reasons, now micro-founded, that help in understanding why MNCs are more likely to attract personnel than domestic firms locally. First, due to scale effect and to wage differentials especially when the host country is an emerging economy, MNCs are able to offer a substantial salary premium to

employers (Martins, 2008); second, MNCs benefit from a reputation effect due to international exposure. Both reasons add in smoothing the MNCs' implementation of targeted recruitment policies aimed to attract local talents. In addition to that, MNCs are likely to enact incentive measures to prevent personnel holding key organizational knowledge to spill into the local domain.

Accordingly, we predict:

2a. Employees' flows from domestic firms to MNCs are more likely than from MNCs to domestic firms.

Turning to the homogeneous knowledge flows in terms of foreign affiliation, different arguments can be expressed. MNCs, as we argued above, have strong incentives in trying to enhance their local embeddedness and to drain employees from domestic firms, in order to enhance their local social capital to leverage the local knowledge and skills (Singh, 2007). On the contrary, few incentives and high barriers can mitigate the efforts of MNCs to attract employees from other MNCs, which are thus more likely to devote their organizational efforts to implement effective hiring policies to attract local talents. The cognitive dimension of social capital further strengthens this argument: while domestic firms share a common geographical and cultural background, a shared language and shared cognitive schemes, MNCs carry very heterogeneous cultural roots, which can ultimately hinder the transfer of employees' between one another. We thus argue:

2b. Employees' flows between domestic firms is more likely than employees' flows between MNCs.

4.3.3 Industry affiliation

A rich set of studies underlines the strategic choice to hire new employees from rivals, in order to appropriate from core knowledge which cannot be developed internally (Rao, Drazin, 2002). Another stream of contributions considers on the other side the willingness of some companies to strengthen their ties to customers by means of personnel flows, with positive effects on performance (Somaya, 2008). Industry is thus a crucial element in understanding knowledge transfer through personnel mobility.

The social capital framework helps in formulating hypotheses in this sense. On the relational dimension, the benefits deriving from interlacing ties to customers and suppliers also through exchange of employees are highlighted (Somaya, 2008). Relational embeddedness is conducive to trust and to smoother knowledge transfer, which strengthen the relationship to the customers/suppliers and increases loyalty and reciprocal commitment. This ultimately entails a major differential of the focal firm towards competitors, which ultimately leads to the establishment of competitive advantage. Somaya (2008) underlines how effective ties enhancing social capital can be created through the loss of personnel to potential co-operators. We formulate our hypothesis accordingly:

3a. Employees' outflows to rivals are less likely than to non-rivals

On the other side, the cognitive dimension of social capital and related arguments suggest the importance of shared knowledge and cognitive framework, as important in fostering knowledge sharing. Even though differences in geographical and organizational origins do not seem to affect the success of knowledge recombination within a firm (Madsen et al., 2003), differences in the individuals knowledge basis due to difference in the source industry have been over-looked so far. We argue that mobility within the same industry is easier because of the presence of a shared and massive knowledge base, which entail a

common cognitive framework and smooth the process of knowledge recombination and enhancement. Moreover, firms find strong incentives in hiring employees' from competitors, especially when faced to the need to overcome internal constraint in forming new technologies. We thus formulate our hypothesis:

3b. Employees' inflows from rivals are more likely than from non-rivals

4.4 Data and methods

4.4.1 Sample

In order to test our hypotheses, we populated an original database on personnel mobility in India, with a special focus on the IT cluster in Bangalore. The interest in India, and in Bangalore specifically, draws on a consistent stream of literature which has been considering the emergence and growth of offshore high-tech clusters (Giarratana, Pagano, Torrasi, 2001; Arora, Gambardella, Torrasi, 2001; Manning, Massini, Lewin 2008). Bangalore shows the characteristics of a horizontal cluster, a conglomeration of competitors who provide IT services to customers located all over the world, mainly in US and EU. This specific characterization has arisen doubts and scholarly debates about the nature of Bangalore as a cluster. Scant evidence of inter-firm relationships among companies is present, and firms appear to be as 'virtual extensions' of the customers, rather than cooperating partners within the same geographical area (Lema, Hesbjerg, 2003). Even though more recent studies underline the fast-paced growth of domestic inter-firm relationships towards an explorative strategic perspective (Angeli, Lipparini, Grimaldi, 2008b), micro-evidence from personnel mobility is still missing, which can qualify Bangalore as a proper cluster, though with different characteristics from the more traditional manufacturing-based clusters.

The individual-level data are sourced from the leading jobsite in India, Naukri.com. Naukri.com offers the possibility to people from all over India to post their professional resumes on the website, in order to advertise their positions and skills to potential new employers. Likely, employers can post the announcements of job vacancies on the site, in order to attract potential applicants. The complete profile database, RESDEX, collects to date around 14.000.000 resumes covering the whole Indian territory and all economic activities, with an average of 15.000 new resumes posted every day.

Every detailed resume collects the candidate's personal details and highlights the previous candidate's employers since the beginning of his/her career, tracking back his/her professional shifts from a company to another over time. This allows us to draw a line connecting the companies in chronological sequence. The cross-sectional overlap of all resumes would return a network of inter-firm ties and a set of cross-sectional dyads connecting the source firm and recipient firm.

The selection of the profiles deserves some clarifications. Extensive filters are available, to browse the profiles along multiple key dimensions of the candidate's resume: education, key skills, current employer, current position, current town, current industry. Though, our research intent is to portray both inflows and outflows of employees involving Bangalore IT cluster over time. Thus, a search based on a filter set on the current situation would have missed out a considerable portion of flows occurred in the past. As a solution to this tricky issue, we constructed our sample of flows – and thus our network – by considering all personnel movements involving six focal companies in Bangalore: HP, Yahoo!, BangaloreSoftSell, S7 Software Solutions, IGate and Symphony. The six companies are acknowledged to be fairly representative of the three main types of companies present in Bangalore. MNCs' subsidiaries are HP, producing software for hardware platforms, and Yahoo! developing software for website, the former established in Bangalore in 1989, the

latter just in 2000, which allows us to account for age effect. Bangalore Soft Sell and S7 are small high-tech companies sharply focused on migration solution, the first being present on the territory for the past 15 years, the latter for the past 4 years only. Finally, Symphony and IGate represent the population of large IT service providers, the first just 8 years old, the second 15 years old. Considering the notable differences in age, size and technological activity of the firm, along with the different vertical specialization (see: Angeli, Grimaldi, Lipparini, 2008a; Angeli, Grimaldi, Lipparini, 2008b), we argue that the bundle of personnel movements and thus knowledge flows involving these six companies over time can portray a fair idea of the knowledge flows occurring at large.

Following this line of reasoning, we selected all profiles which had at least one of the six companies listed as an employer, previous or current. Through this first individual-level selection step, we collected 11064 profiles. In order to retain only the profiles able to produce at least one flow between companies, we selected out all resumes which contained only one work experience; this led us to isolate 6132 profiles, involving 1332 companies from all over India. The collection of data at firm-level has been the major constraint to our sample. Firm-level information has been sourced from PROWESS, a database provided by the Centre for Monitor Indian Economy (CMIE), which collects firm-level detailed data about over 20.000 large and medium Indian companies, culled from the audited annual accounts, stock exchanges, company announcements. PROWESS comprises all companies traded on India's major stock exchanges and several others including the central public sector enterprises; the whole of the companies listed in PROWESS accounts for the 75% of all corporate taxes and over 95% of excise duty collected by the government of India. Out of our 1332 companies, only information about 397 companies could be collected, encompassing all relevant firm-level data: year of incorporation, economic activity description and code, ownership structure, location of branches and headquarters, total income and EBITDA, both in 2008.

Our 397 companies involve 3277 profiles and 3895 knowledge flows, namely personnel movements among companies.

In addressing the employees' movements as a proxy of knowledge flows we are adopting a social capital perspective, thus focusing on the network-related and tie-related benefits and characteristics. Two analytical options are thus available. The first emphasizes the structural dimension of social capital: we can observe the firm's structural position within its network of cross-sectional knowledge flows, by adopting a firm-centred level of analysis. The second focuses on the relational dimension of social capital, according to which the level of analysis is tie-centred, fostering the observation of the linkages and the subsequent dyad-level speculation. We decided to adopt the second option, unfolding our analysis through a tie-level perspective. This allows to get deeper insight into the specific features of every single dyad; we will thus test and explain the likelihood of an employee movement to occur from one company to another, considering directed dyads. The 3895 employee movements between 397 companies generate 1331 cross-sectional directed dyads, which constitute the records of the final database. Figure 1 represents the network thus formed. The figure also qualitatively highlights the position of the six focal companies in the network of flows. Their centrality stands out quite clearly, but a good amount of knowledge flows do not involve any of the six companies; at the same time, other companies appear to hold strong centrality positions. The dispersion of the network thus highlighted further supports the ability of the six companies to represent the knowledge flows through personnel mobility within the cluster.

INSERT FIGURE 4.1 ABOUT HERE

4.4.2 Measures

Dependent variable

Our dependent variable, the knowledge flows between companies through personnel mobility, is operationalized as the number of people that over time left company A to move to company B. In order to account for the value of the intellectual capital that these employees are embedding, we weighed every flow with the higher education degree of the person moving. In order to do that, we codified all the spectrum of possible Indian education levels into 7 layers, and we weighed each personnel movement accordingly.

Independent variables

Our three main explanatory variables have been operationalized through three four-layered categorical variables. Each layer of the variable behaves as an independent variable within the model. In order to measure the effect of gain from competitor or loss to a competitor, which in our model is operationalized as two different layers of the same variable, Somaya et al. (2008) have opted for two different dummy variables. We believe that our choice of three multi-layered categorical variables carries the benefit to explain the likelihood of different scenarios along the three different dimensions, adding in clarity and quality of the analysis.

Foreign affiliation. In order to test the effect of foreign affiliation on the probability of a personnel movement to occur from company A to company B in a directed dyad, we made use of a four-layer categorical variable. A simple dummy variable indicating either homogeneity or heterogeneity between the source and the recipient firm would have missed out the direction of the flows, which is of utmost importance to clearly understand the distribution of personnel mobility.

Considering our data on companies' ownership, we thus coded every company holding a foreign affiliation as a MNC and every company owned by an Indian private or an Indian group as a domestic firm. Building on this, the four types of possible dyads have been coded, shaping the four layers of our categorical variable: 1. flow from domestic firms (DOM) to domestic firms 2. from domestic firms to MNCs 3. flow from MNCs to domestic 4. flow from MNCs to MNCs.

Cluster affiliation. To test the effect of the co-location on personnel mobility we coded the companies with headquarters or branches in Bangalore as a cluster company, while every other company has been generically considered an Indian company. The case of people moving cross-border, i.e. from India to some other country, was sought for, in order to add further variance to our scenarios. Yet, no case emerged from empirical evidence.

Considering the directed dyad, we used a multilayer categorical variable to portray the 4 types of employees' flows as emerging from our coding: 1. flows within the cluster (from Bangalore to Bangalore) 2. flows from the cluster to outside (from Bangalore to India) 3. flows from outside to the cluster (from India to Bangalore) 4. flows from outside to outside (from India to India).

Industry affiliation. Industry affiliation has been coded according to the companies' economic activity. Our focal interest, like the Bangalore cluster for the geographical dimension, is the IT industry. Considering this as the reference point, companies have been coded as IT whether their economic activity is listed as computer software or ITES (Information Technology Enabled Services), else otherwise. Similarly to the procedure followed from the two previous variables, in order to portray the differences of industry affiliation in our directed dyads of companies, we used a multilayer categorical variable, distributed as follows: 1. flows within IT industry 2. flows from IT to other industry 3. flows from other industry to IT 3. flows from other industry to other industry.

Controls

We consider three main control variables that might be correlated to the probability of employees' movements between two companies: age, size and financial performance, which translates into the differential of age, size and financial performance at dyad-level.

Age has been operationalized drawing on the year of incorporation for each firm: the differential has been computed for each dyad of companies. We believe that the age difference can be correlated to the likelihood of employees' flows between firms for several reasons. A young firm is likely to be willing to attract new resources drawing on the knowledge of more experienced companies. Likely, older firms might be willing to encourage inflows of people previously employed in younger and dynamic companies, in order to renew and refresh the internal knowledge base. In both events, there are reasons to think that age differential might play a role in influencing the distribution of personnel mobility between companies.

Size has been measured through the total income of the company; the differential has been computed for each dyad. Size is likely to influence the probability of employees' movement between two companies. A strong differential in size can intuitively lead to a strong attraction power of the larger company towards the employees of the smaller, because of reputation effects, sensible wage differentials and a stronger exposure to structured internal processes. On the other side, larger companies might be interested in attracting employees from smaller firms, because more keen on easily absorbing larger companies' complex internal routines.

Likewise, *profitability* gap is intuitively conducive to a flow from less profitable to more profitable companies, because of the latter's attraction power. Though, a steady policy will be enacted by the less profitable companies to attract employees from the more profitable ones, in order to enhance the internal management, skills and knowledge base, thus draining

some competitive advantage or best practices. Differential in profitability has been operationalized by computing the EBIDTA difference of the companies in the companies for each dyad on year 2007.

4.4.3 Model estimation

Our dependent variable is a count which only takes non-negative integer values. The natural baseline model for such data is a Poisson regression (Henderson, Cockburn, 1996; Gilsing, Noteboom, Vanhaverbeke, Duysters, Van den Oord, 2008). As acknowledged by a broad set of studies, though, the use of a Poisson model may lead to several important biases, when the basic assumption of equality between mean and variance is violated, which is often the case. Over-dispersion can be controlled by introducing a new parameter α (alpha) which is an estimate of the degree of over-dispersion. The introduction of the parameter α produces a negative binomial distribution. Negative binomial distribution is an extension of the Poisson distribution allowing the variance to differ from the mean and widely used by scholars to model count data such as patent data (Hausman et al. 1984; Rosenkopf, Almeida 2003; Song, Almeida, Wu, 2003).

In our negative binomial models, the probability of N employees with an average education level of x to move from company A to company B of a given dyad i is:

$$\Pr(Y = y_i) = \frac{e^{-\lambda_i} \lambda_i^{y_i}}{y_i!}$$

Where $(N^*x)_i = y_i$.

The distribution of λ_i is what distinguishes Poisson models from negative binomial models. In Poisson models, λ_i is both the variance and the mean of the model, specified as

$$\ln \lambda_i = \beta' \mathbf{x}_i$$

Where x_i is the array of regressors. In negative binomial models, λ_i is respecified so that:

$$\ln \lambda_i = \beta' x_i + \varepsilon$$

Where $\exp(\varepsilon)$ has a gamma distribution with mean 1 and variance α^2 .

4.5 Results

Before discussing our findings it is important to note that results are presented in details for every layer of each categorical variable, which can be considered as an independent variable entering the model separately. Yet, the results for each layer are relative to the baseline of the correspondent categorical variable. To favour the understanding of the tables and of the regression results, we considered as the baseline the homogenous and ‘focal’ case, i.e. the dyads representing employees’ flows between domestic firms for foreign affiliation, between cluster firms for cluster affiliation, between IT firms for IT affiliation.

Table 4.1 presents the descriptive statistics and the correlation matrix. No troublesome multi-collinearity issues can be observed among variables. Descriptive statistics highlight the percentage breakdown of dyads across different layers of our categorical variables. Observing the distribution of dyads within cluster affiliation, the domestic homogenous case, considering the dyads formed by cluster firms, appears to be the most common, gathering 69,5% of cases. Considering foreign affiliation, a similar evidence emerges: 61,45% of dyads occur between domestic firms. A different result can be highlighted for the IT affiliation variable, which shows a more spread out distribution. The highest number of dyads fall within the IT industry (31,93%), but a relevant number of dyads happen between firms affiliated to other industries (26,57%), from other industries to IT (22,36%), from IT to other industries (19,14%).

INSERT TABLE 4.1 ABOUT HERE

Descriptive statistics for our continuous control variables also highlight interesting results. The average difference in profitability for our 1331 dyads is negative, which means that in most dyads the source company is more profitable than the recipient company. The same happens for the size, as measured through the total income: on average, the recipient firm is smaller than the source firm. A different result emerges for the age. The source and the recipient firm have an average difference of 2 years, being the recipient older than the source.

Table 4.2 shows the results of the negative binomial regressions. Model 1 represents the base model with only the control variables, Models 2-4 consider the regressions with only one explanatory variable at a time, while Model 5 gathers all variables and constitutes the full model. Regressions testing also interaction effects between the categorical variables have been run but showed to be non significant. Because of the high number of variables involved (4*4 for each of the three interaction effects among the explanatory variables = 48 variables), and their difficult interpretation, we decided not to report the results in the final table. For each model, χ^2 statistics is reported, which compares every fitted-model with the intercept-only model. We can see that the explanatory powers of the models 2-4 are sensibly higher than model 1 with only control variables. Model 5, encompassing all effects, reports the highest explanatory power, $\chi^2 = 275, 202$ and $p < 0,0001$.

Model 1 highlights the role of control variables. Difference in size is not significant in explaining the weighted number of employees' flows for our dyads. On the contrary, difference in profitability (Δ EBIDTA) is significant with a negative sign throughout all

models, which means that a higher number of valuable employees is flowing from a more profitable to a less profitable firm. Age is significant in Model 1, 4 and 5, with positive sign and low magnitude. This means that valuable flows tend to happen from a younger firm to an older firm, though the difference in age is typically not very relevant.

Hypothesis 1a argues that employees' inflows from cluster firms are more likely than from non-cluster firms (BLORE->BLORE vs. INDIA->BLORE). Model 6 shows our first explanatory variable to be significant. Differences between the layers are all highly significant as well. It is important to note that the test of these differences between layers is equivalent to a one-way ANOVA. The hypothesis finds empirical evidence, since the coefficient of INDIA->BLORE as compared to the baseline BLORE->BLORE is negative and significant, highlighting that the number of valuable employees flowing from non-cluster firms to cluster-firms is significantly less than the number of employees flowing from cluster firms to cluster firms.

Hypothesis 1b claimed the employees' outflows from cluster firms to cluster firms (BLORE->BLORE) are more likely than to non-cluster firms (BLORE-INDIA). The hypothesis is tested, since the coefficient of BLORE->INDIA is negative and significant as compared to the baseline, highlighting that the number of valuable employees leaving cluster firms to join non-cluster firms is significantly less than to cluster firms.

Hypothesis 2a and 2b argue the significant explanatory power of the foreign affiliation in explaining the number and quality of employees' flows between companies. Hypothesis 2a states that employees' flows from domestic firms to MNCs (DOM->MNC) are more likely than from MNCs to domestic (MNC->DOM). The hypothesis is not tested and the regressions analyses reveal an interesting counterintuitive result. Relative to the baseline, DOM->DOM, the MNC->DOM has a significant and positive coefficient, while DOM->MNC has a significant negative coefficient. This means that the dyads where the source

company is a MNC and the recipient company is a domestic show the highest number of valuable people flowing, with statistically significant difference compared to the baseline DOM->DOM. Consequently, we can infer that the MNC->DOM path involves more and more valuable employees than the other way around, the DOM->MNC path. It is important to highlight that HP 2a compares two intermediate layers of the categorical variable that do not encompass the baseline. Thus, in order to strengthen our results, we have run an additional ANOVA analysis, which can be visible in Table 4.3, and which shows the significant difference between layer 2 (DOM->MNC) and layer 3 (MNCs->DOM). Hypothesis 2b compares the case of flows between firms homogeneous in their foreign affiliation and argues that employees' flows between domestic firm (DOM->DOM) would be more likely than employees' flows between MNCs (MNCs->MNC). The hypothesis finds empirical test and the latter case shows a strongly significantly negative coefficient compared to the baseline.

Hypothesis 3a and 3b posit the explanatory role of industry and specifically of IT affiliation in channelling the employees' flows. Hypothesis 3a considers employees' outflows to rivals (IT->IT) to be less likely than to non-rivals (IT->OTHER). The hypothesis is not verified: no empirical significant difference can be retrieved between the two layers, since the coefficient of IT->OTHER is positive but not significant. This means that the outflows of valuable employees from the IT industry to non-IT industry are equally probable and valuable. Hypothesis 3b considers the inflows, arguing that the probability of inflows of valuable employees from rivals (IT->IT) is higher than from non-rivals (OTHER->IT). The hypothesis finds empirical evidence, since the coefficient of OTHER->IT is negative and significant.

INSERT TABLE 4.2 ABOUT HERE

INSERT TABLE 4.3 ABOUT HERE

4.6 Discussion and conclusions

Mobility of employees as a proxy of knowledge flows between companies has received strong scholarly attention over the past decades, at multiple level of analysis: at macro level, through the studies analyzing FDI and knowledge spillovers (e.g. Fosfuri et al. 2001; Gorg and Strobl, 2001); at firm-level, with important contributions addressing the competitive implications and strategic meaning of inter-firm mobility (Rao and Drazin, 2003; Somaya et al. 2008; Wezel et al., 2006); at micro-level, with contributions addressing the importance of wage differential between the MNCs and domestic firms (Martins, 2008). A unified perspective is missing, which gives direct measures of knowledge flows through personnel mobility and explores all possible paths.

This paper unfolds how personnel mobility distributes between companies, according to differences in geography (cluster affiliation), industry (inter-industry mobility as opposed to intra-industry) and foreign affiliation, especially exploring the mobility-generated ties between MNCs and domestic firms. The formulation of the hypotheses and the consequent interpretation of the results makes use of a social capital perspective, which allows us to consider the employees' mobility as building ties across companies. Drawing on this line of reasoning, we argue the companies to make a strategic and deliberate effort to channel and carefully shape their social capital, from a structural, relational and cognitive perspective.

This paper highlights some important findings. First, counterintuitive evidence which deserves further attention is related to the role of firm profitability in channelling the

personnel flows. A negative difference is significant, proving that personnel flows are mostly occurring from more profitable firm to less profitable firms. Several interpretations can be advanced to explain this result; according to our perspective, successful hiring policies are enacted by less profitable companies to attract talents from more profitable companies. This result is of major importance especially considering the micro-level incentives. A more profitable employer can assure higher wages, higher long-term stability, stronger reputation and prestige to the job position. Though, the strategic effort of less profitable firms to attract personnel succeeds in overcoming these other important micro-level incentives.

Our hypotheses receive robust empirical test. The role of cluster affiliation is proven as crucial in determining the direction and the value of knowledge flows through personnel mobility. Our findings are in line with what several studies have argued and tested in the past, and adds further evidence to the geographical localization of knowledge and mobility (Jaffe, 1993; Kogut, Almeida, 1999; Song et al., 2003; Rosenkopf, Almeida, 2003). Moreover, considering the ongoing debate involving the nature of Bangalore as a cluster (see: Angeli, Grimaldi, Lipparini, 2008b), our findings highlight the localization of personnel mobility in Bangalore and thus strengthen its position as a cluster.

The results related to foreign affiliation fail to prove our first hypothesis and give evidence of a result which goes against common wisdom and previous scholarly work: valuable employees appear to be more likely to flow from MNCs to domestic firms rather than the other way round. This is particularly disproving what highlighted by Singh (2007), who predicted and tested that inflows to MNCs would outweigh or equal outflows to host countries, especially in technologically advanced domains. The wage differential, the prestige effect, the exposure to internationally successful organizational processes, apparently fail to retain employees within MNCs, who prefer to move to domestic firms. On the other side of the coin, domestic firms appear to be very convincing in attracting personnel from MNCs,

thus promoting an actual knowledge transfer of the best practices featuring the MNCs. Considering the social perspective according to which a loss of personnel can also be strategically fruitful because of the establishment of a new tie (Somaya et al., 2008), some other conclusions can be drawn. MNCs might also favour the release of personnel towards domestic firms in order to strengthen their connections to the local peculiar social domain and to leverage on their previous employees to get increasingly embedded. We argue this strategic perspective on employees' loss to be the most likely interpretative key to understand the evidence emerging so far. It also is important to highlight the specificity of the results to our empirical context. The IT cluster of Bangalore is a high-tech cluster which gathers highly skilled personnel, trained through high-quality local institutions. The reason why MNCs set subsidiaries in Bangalore majorly draws on the cost differential and on the availability of a local pool of talents; the rationale underpinning the offshoring to Bangalore is evolving from a cost-driven to a knowledge-seeking motivation (Maskell et al. 2006). Our interpretation regarding the loss of personnel towards the local context finds further strength: in order to leverage on the local knowledge, personnel's loss is seen as a strategic bound rather than a dangerous knowledge leakage. The peculiarities of the context also add to mitigate the fears of MNCs towards knowledge spillovers. The IT cluster in Bangalore is a gathering of IT companies who supply service to customers spread all over the world and across industries. Like many other in emerging economies and in China, the Bangalore IT cluster has risen and evolved around particular technological functions or upstream activities rather than a particular industry (Massing, Massini, Lewin, 2008). Thus, the interest of local companies in upgrading and entering the MNCs client's business is very low, thus sensibly decreasing the MNCs concerns of local leakages. An interesting result following our forecasts highlights the highest likelihood for a flow of valuable employees to occur between domestic firms rather than between MNCs. MNCs are least interested to exchange knowledge and to interlace

social connections to other MNCs. This can suggest that the true value of the host countries to these companies lies not in the foreign presence but in the richness of the local knowledge as embedded into local firms.

Industry also proves to be crucial in shaping the evolution of knowledge flows through personnel mobility. Our empirical analysis originally allows us to distinguish between knowledge inflows and outflows and to shed light on two completely different scenarios: while there appear to be a strong tendency to source valuable personnel from rivals, outflows are equally probable to rivals and to non-rivals. This results is important and can probably be clarified drawing on the peculiarities of the context. In order to improve the quality of their service and to decrease the time of delivery, domestic companies source massive portion of business-domain knowledge from their clients (Angeli, Lipparini, Grimaldi, 2008a). This promotes an internal upgrading of the employees' knowledge stock over time, which come to vertically specialize on specific industries. The knowledge thus accumulated can smoothen the movements of employees from the IT company to the client, overcoming the issues related to informational gap about technology or internal practices. Moreover, the typical IT companies would try to establish long-term relationships towards the customers, which can be further strengthen through personnel mobility.

The original contribution to extant literature is multi-fold. First, we highlight the directions of personnel mobility paths, through direct measures of mobility. We provide evidence of massive knowledge transfer from MNCs to domestic firms with individual-level data and on a dyad-basis, adding to the literature which has so far analyzed spillovers from MNCs only from a macro-perspective (Arora, Gambardella, Torrisi, 2001) or using indirect measures like patent data (Rosenkopf, Almeida, 2003; Singh, 2007). Second, we highlight the role of industry in channelling mobility inflows and mobility outflows, by unfolding firms' strategies which has been so far separately observed (Somaya et al, 2008; Rao and Drazin,

2003). Finally, we consider the impact of cluster affiliation, confirming the findings of the studies that proved geographical localisation of knowledge and cluster superiority in fostering local knowledge transfer.

4.6.1 Managerial and policy implications

The study has several policy and managerial implications. From the policymaker point of view, several insights can be gained on how mobility flows evolve and how firms can shape their social capital through personnel mobility. This highlights first of all the strategic value of mobility as recognized by the companies. Second it suggests to the policymakers fruitful measures to enact in order to further shape the mobility networks: not only individual-level but mostly firm-level incentives can be the forces at the basis of mobility evolution in geographical bounded areas.

From the managerial point of view, the uneven distribution of mobility across our three explanatory variables highlights the presence of clear and sharp firm-level strategies to shape mobility across companies, featuring mobility as a further source of social capital. This study builds on Somaya et al's (2008) in further underlining the importance and the strategic impact not only of employees' gain but also of employees' loss, in order to draw further knowledge and resources on individual-based networks. New opportunities to gain and enhance competitive advantage are thus offered, at macro level, at firm-level and – most importantly – at micro-level.

4.6.2 Limitations and directions for future research

The main limitation of the present work, from a pure methodological point of view, lies in the selection of the relevant profiles generating the personnel movements and thus the knowledge flows. In order to overcome searching difficulties and to match the research need to consider flows within and across the cluster, past and present, we followed an original *ad*

hoc selection rationale. Six companies of the cluster have been selected, and all the profiles that have had at least one of the companies as a previous or current employer have been included in the sample. Considerable effort has been devoted to the selection of companies which could be representative of the population within the cluster; the companies are very different along multiple dimensions, such as age, size, typology of business, network features, foreign affiliation. Yet, the selection of profiles is not strictly random, which entails possible bias of the results. The refinement of the selection rationale can definitely lead to a substantial improvement of the robustness of the data and of the results. Moreover, it would allow for the investigation of the structural perspective of the social capital, which has been deliberately overlooked in this work through the choice of a dyad-centered perspective, and thus of a relational-oriented analysis. The structural features of the network, such as centrality, betweenness, degree, etc., can fruitfully complement the study of the relational dimension centered on the dyads. The structural choices of companies can reveal deep insight into companies' strategic leveraging of the local domain (Rowley et al, 2000). Linking the firm-level characteristics to the structural position of companies within the network of knowledge flows through personnel mobility can prove to be very fruitful in further testing our hypothesis with a broader, network perspective.

Another element of weakness of the present work is to be searched in the cross-sectional nature of the data, which stem from the pooling of dyads occurred in different points in time. A much more sophisticated analysis can observe the evolution of dyads over time, thus testing the same hypotheses in different points in time. This could definitely add to the understanding of how the firms' strategies in terms of personnel recruitment and loss have been evolving, entailing a dynamical shift of knowledge flows and social capital among companies.

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Exhibits (Chapter 4)

Table 4.1 – Descriptive statistics and correlation matrix

Variable	%	Mean	S.D	Min	Max	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
# of ID dyad*education		10,94	24,12	1	419																
1 Cluster=4 (INDIA->INDIA)	2,06					1,00															
2 Cluster=3 (INDIA->BLORE)	20,93					0,09	1,00														
3 Cluster=2 (BLORE->INDIA)	7,51					0,05	0,14	1,00													
4 Cluster=1 (BLORE->BLORE)	69,50					.(a)	.(a)	.(a)	.(a)												
5 Foreign=4 (MNC->MNC)	5,72					-0,11	0,03	-0,05	.(a)	1,00											
6 Foreign=3 (MNC->DOM)	17,98					0,04	0,04	0,08	.(a)	0,12	1,00										
7 Foreign=2 (DOM->MNC)	14,85					0,05	0,05	-0,06	.(a)	0,12	0,20	1,00									
8 Foreign=1 (DOM->DOM)	61,45					.(a)	.(a)	.(a)	.(a)	.(a)	.(a)	.(a)	.(a)								
9 =4 (OTHER->OTHER)	26,57					-0,06	-0,11	-0,04	.(a)	-0,14	-0,03	-0,08	.(a)	1,00							
10 =3 (OTHER->IT)	22,36					-0,05	-0,08	-0,02	.(a)	0,00	-0,06	-0,01	.(a)	0,42	1,00						
11 =2 (IT->OTHER)	19,14					0,03	0,00	-0,02	.(a)	0,02	-0,03	-0,02	.(a)	0,39	0,37	1,00					
12 =1 (IT->IT)	31,93					.(a)	.(a)	.(a)	.(a)	.(a)	.(a)	.(a)	.(a)	.(a)	.(a)	.(a)	.(a)				
13 EBIDTA		-235,82	3576,24	-30801,39	21788,43	0,00	0,03	-0,01	.(a)	0,01	-0,01	0,01	.(a)	-0,04	0,02	-0,01	.(a)		1,00		
14 ge		2,54	22,81	-94,00	99,00	0,03	0,05	0,00	.(a)	0,02	-0,04	0,02	.(a)	-0,06	-0,13	0,10	.(a)		-0,09	1,00	
15 Size		-950,37	12464,37	-243730,80	29913,58	0,00	-0,07	-0,01	.(a)	-0,02	-0,04	0,03	.(a)	0,04	-0,01	0,05	.(a)		-0,72	0,29	1

(a) Parameter estimates are redundant

Table 4.2 – Determinants of personnel mobility between dyads of companies through negative binomial regressions

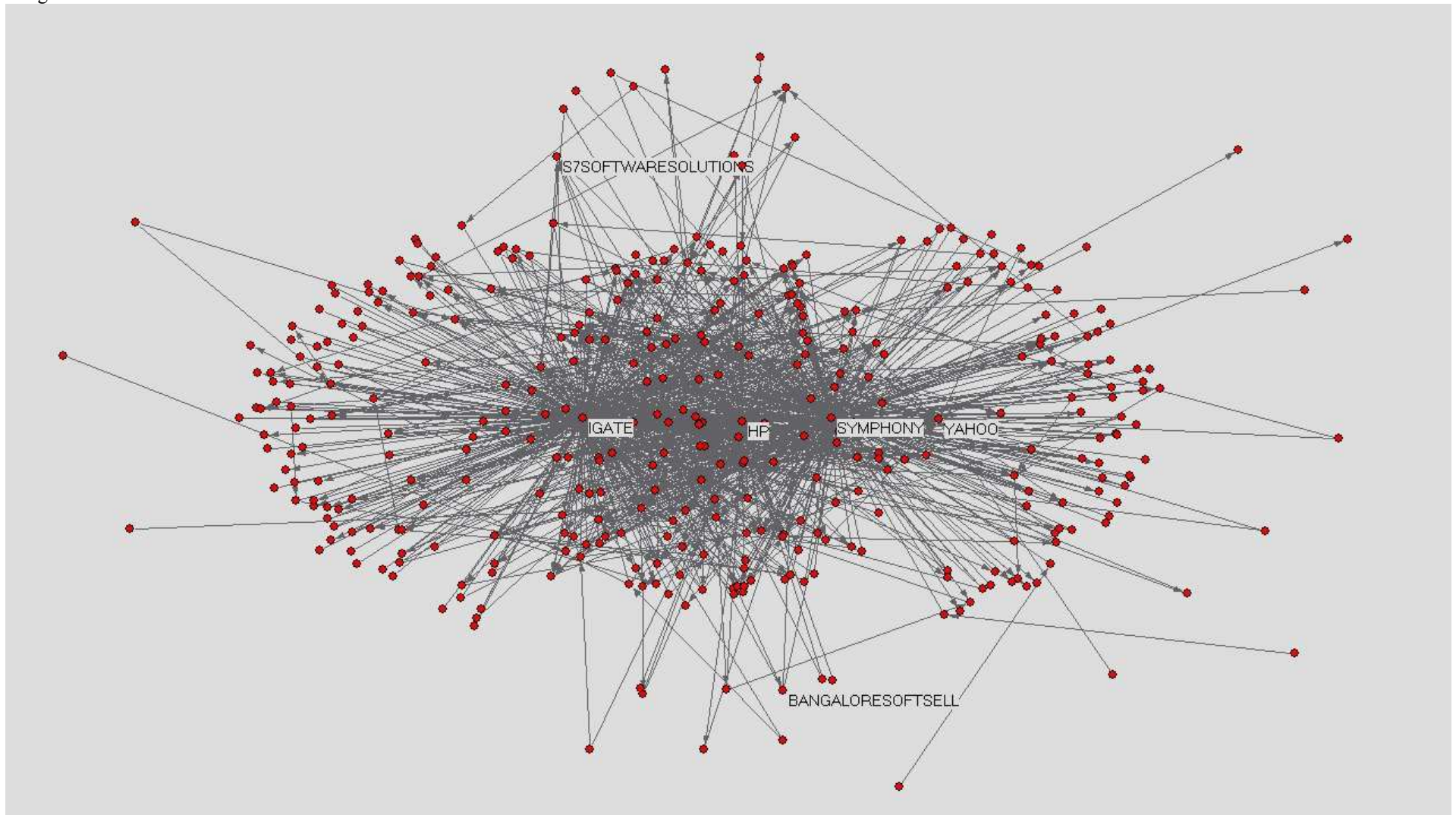
Variable	Model 1	Model 2	Model 3	Model 4	Model 5
ΔCluster affiliation	4.INDIA->INDIA		-1,156***(0,2363)		-0,900***(0,2420)
	3.INDIA->BLORE		-0,530***(0,0795)		-0,467***(0,0808)
	2.BLORE->INDIA		-1.099***(0,1270)		-0,924***(0,1295)
	1.BLORE->BLORE		.		.
ΔForeign affiliation	4.MNC->MNC			-0,872***(0,1430)	-0,636***(0,1482)
	3.MNC->DOM			0,194**(0,834)	0,164*(0,0841)
	2.DOM->MNC			-0,805***(0,936)	-0,757***(0,0953)
	1.DOM->DOM			.	.
ΔIT affiliation	4.OTHER->OTHER				-0,632***(0,0831)
	3.OTHER->IT				-0,458***(0,073)
	2.IT->OTHER				-0,017(0,0902)
	1.IT->IT				0,012(0,0909)
ΔAge	0,03* (0,017)	0,003(0,0017)	0,003(0,0017)	0,05***(0,0016)	0,004**(0,0016)
Δ Size	-2,09E-006 (6,72E-006)	-1,77E-007(6,11E-006)	-4,81E-006(7,05E-006)	-1,64E-006(5,87E-006)	-1,92E-006(5,70E-006)
ΔEBITDA	-3.90E-005** (1,62E-005)	-4,02E-005**(1,60E-005)	-3,87E-005**(1,67E-005)	-3.56E-005**(1,41E-005)	-3,82E-005***(1,46E-005)
Number of dyads	1331	1331	1331	1331	1331
Log-likelihood	-3828,616				
Likelihood-ratio χ^2	27,985***	136,149***	136,875***	106,765***	275,202***
d.f.	3	6	6	6	12

Note: standard errors between parentheses. *p<0,10; **p<0,05; ***p<0,01

Table 4.3 – ANOVA Post-hoc Bonferroni test analyzing the differences between the means of the four layers of the categorical variable ‘Foreign Affiliation’

(I) ΔForeign Affiliation	(J) ΔForeign Affiliation	Mean Difference (J-I)	Std. Error	P-value
1	2	-3,79**	1,75	0,03
	3	2,71	1,77	0,13
	4	-4,51*	2,29	0,05
2	1	3,79**	1,75	0,03
	3	6,49***	2,16	0,00
	4	-0,72	2,60	0,78
3	1	-2,71	1,77	0,13
	2	-6,49***	2,16	0,00
	4	-7,22**	2,61	0,01
4	1	4,51*	2,29	0,05
	2	0,72	2,60	0,78
	3	7,22**	2,61	0,01

Figure 4.1 – Network formed by 1331 cross-sectional directed dyads, generated by 3895 employee movements between 397 companies across and within the IT cluster in Bangalore



CHAPTER 5

Conclusions

This doctoral work has been the product of experimentation and challenge undergone at multiple levels: conceptual, methodological and cultural. On the conceptual side, the theoretical focus of the present work has stemmed from the use of a new interpretative framework, the cluster-based perspective. A radical change in the interpretative framework has been necessary in order to overcome some major limitations of the extant literature, which had so far speculated according to MNC-centred point of view, thus missing out the details of a much broader empirical picture.

The conceptual effort considering together both MNCs and domestic firms as part of the same offshore cluster, engaged in sharing and absorbing knowledge, has allowed to highlight the importance of the cluster boundary for both MNCs and domestic companies. The cluster boundary marks a distinction between two well-defined domains: extra-cluster and intra-cluster. This is of major importance in distinguishing between intra-cluster linkages or linkages within the cluster and extra-cluster linkages or linkages across the cluster; by zooming out, this also entails the difference between internal and external networks. Along these newly conceptualized constructs, I observed and analyzed the different behaviors of both MNCs and domestic companies, both within and across the cluster. New knowledge

paths and knowledge sharing patterns have been disclosed by the new perspective, which succeeded in opening up the ‘black box’ of cluster-related knowledge flows, pushing the speculation much beyond the simple concept of knowledge spillovers from MNCs to local domain.

The quality and quantity of knowledge shared is different for MNCs and domestic companies. In the qualitative evidence gathered on this specific research issue, the difference between business-domain knowledge and technical knowledge emerges. The distinction is disruptive towards the traditional one-dimensional perspective regarding the concept of knowledge – tacit vs explicit. The distinction is also crucial in understanding not only whether knowledge is shared along which path but also which kind of knowledge is actually flowing. ‘Knowledge spillovers’ have always been considered as technical-based and directed from MNCs to local domain. The empirical evidence and the theoretical contribution of this work is now highlighting how the traditional perspective is limited in its power of understand and explain the phenomenon. Indeed, along the intra-cluster dimension domestic companies appear to absorb more business-domain knowledge than MNCs, while MNCs appear to absorb more technical knowledge than domestic firms on the extra cluster dimension. MNCs turn out to absorb technical knowledge and to exchange more strategic knowledge across the boundary than within; domestic companies attribute strong importance to extra-cluster linkages too, but for the possibility to absorb business-domain knowledge rather than technical.

The close observation of all possible different paths has allowed to explore the inner domain through personnel mobility in a new unmatched way. Evidence shows that consistent knowledge flows can be observed along the direction leading from MNCs to domestic companies, significantly higher than any other possible paths. This seems to be consistent with the thesis supporting spillovers; however, the social capital perspective suggests a

different interpretation of the results, by considering the tie-generating power of personnel mobility. MNCs absorb and release knowledge within the cluster; the release of knowledge embedded into individuals is read as a quest for an enhanced social capital in the local domain.

The analysis of the mutual dependence of external and internal network further builds up on this point. By moving from a tie-centered level of analysis to a network-based, a longitudinal evolution of company's social capital through inter-firm alliances can be traced. Beyond the structural features, the purely qualitative evidence allows to get deeper understanding into the relational features of the companies' ego-networks. That is when the strategic importance of the local context emerges, and specifically its evolution over time. For all companies, a dynamic change from exploitation-based to an exploration-based approach to the local cluster is observed. From short-termed, customer-supplier relationships the local relationships have turned over time into strategic alliances, to be leveraged in order to reach for new markets or new customers, rather than for new technology. The local domain thus appears to occupy an increasingly strong role in the companies' strategy.

The distinction between business-domain knowledge and technical knowledge further helps in understanding the nature of the evolution, especially in the case of domestic companies. Through the acquisition of business-domain knowledge, companies tend to specialize: it allows them to deliver a better service in shorter time, to cut cost of internal training, to differentiate from the huge generalist leading companies dominating the cluster. The specialization is both vertical and geographical in most cases; these lead companies to interact with each other to realize economies of scope and to supplement to internal technological shortage. That is why at the very initial stage of the cluster companies showed a strongly export-oriented and scarcely cooperative behavior, which lead scholars to formulate doubts about the nature of Bangalore as a cluster. Their unfocused technology and domain

orientation compelled them to devote all organizational effort towards the external domain, in order to accumulate business-domain knowledge and to become a process of vertical specialization. This released organizational resources to scout for sources of competitive advantage in the local domain; formal alliances started up and the locus of strategy slowly shifted from outside to inside of the cluster boundary.

Very similarly, the strategic approach toward the local domain by MNCs evolved. MNCs initially scouted Bangalore as a pool of inexpensive talent, thus applying a cost-driven, exploitation-based rationale. Later on, the types of tasks delocalized here became increasingly knowledge-intensive, leveraging the high knowledge skilled of local engineers and thus exploring the local capabilities. A further phase can now be witnessed: from the technology-related exploration approach to a marketing-related exploration approach: MNCs come to leverage local domain to reach for new markets and finally increased the added-value they are delivering to the parent company.

Considering the methodological side of the experimentation effort, the use of different methodological devices has allowed to gather empirical evidence from different point of views and to substantiate the findings with a rich portray of the phenomenon. The methods have been tailored on the specific research questions of each paper. The first work sets up the cluster-based perspective and speculates about the type of knowledge flowing along which paths. The qualitative evidence and the theory-building qualitative approach are best suitable to appreciate the nuances of the knowledge and to get a deeper understanding of the phenomenon. The further use of a quantitative questionnaire and ANOVA analyses have allowed to corroborate the emerging differences between business-domain and technical knowledge and to increase the generalizability of the qualitative results, otherwise strictly case-specific. The second work considers the networks, and especially the relational dimension of the network approach: in order to capture the soft nuance of both the ties

composing the network and of the network as a whole, a pure qualitative evidence has been considered as suitable. The third work, then, observes the knowledge flows at the most micro level of analysis, the movement of employees. A pure quantitative approach has been considered as best fitting, because of the nature of the data and also because of the necessity, after two exploratory works, to achieve the test of some hypotheses. Interestingly, the third work is mainly concentrated on the inner dimension of the cluster and tests some hypotheses about how knowledge flows distribute within the cluster according to some firm-level differences. The intra-cluster domain has been most frequently addressed by extant literature, and simultaneously the one which deserves attention because of some limitation of previous studies. Through this last classic regression-based study, some of the limitations are overcome, such the need for direct measures and the lack for a complete framework portraying the knowledge paths. The quantitative approach allows this study to build on, and in some points disconfirm, previous quantitative findings.

An important consideration related to the use of multiple methods deserves further attention. The epistemology of the work needs to be clearly underlined, and relies on a positivistic conception of the world; it thus believes in a objective reality, which can be portrayed and explained by social science. The use of qualitative and quali-quantitative research methods besides the pure quantitative approach does not want to be misleading in this sense: even when theory-building and not theory testing is claimed, the underlying assumption of this work is that causal linkages between objective constructs are present and can be drawn. In the case of theory testing, constructs and linkages are present or can be drawn from existing literature; in the case of theory building, the linkages and/or constructs are not pre-existent in the literature and need be emerging from empirical evidence through an inductive approach. In either case, however, the platonic idea of both objective constructs and the causal linkages is present.

Finally, the cultural experiment. This is more related to the personal effort embedded in this thesis rather than to the professional domain. The data gathering onsite, in Bangalore, has required a consistent daily struggle to drop most pre-existent conceptual schemes and prejudices, in order to approach a different world with the necessary open-mindedness. This tough but incredibly enriching process has led to important personal achievements. On the professional side, this has allowed me to develop the necessary empathy with the local domain, that level of embeddedness and sensitiveness which are crucial in building up a proper interpretative lens. My thus formed self-made tool enabled me to capture nuances, which would be otherwise meaningless without this *ad hoc* conceptual framework. This interpretative *fil-rouge* underpinning this work hopefully benefits the analysis with the original flavor of my Western understanding of what India is, beyond the cluster-related speculation and also beyond the management-related literature. This work has given me the unmatched opportunity to improve myself, both as a researcher but mostly, as a human being.