Inter-organizational Network Structure:

A Cross National Study

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ABSTRACT

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This study proposes to investigate the variance of network configurations between the firms of different countries. The research not only explores the differences but also attempts to explain potential sources for these differences. The model of the project indicates that the structure of inter-organizational networks is a function of two interrelated factors: the availability of strategic resources and the institutional profile of the domain of inter-organizational networks. The results suggest that the institutional profile has a direct effect on the network structure and that the availability of resources fully mediates the relationship between the regulative pillar and the network structure.

This study compares the network structures of 18 countries that have apparent differences in their institutional profiles. To neutralize the industry effect on network structure, the comparison is conducted for the biomedical industry alone. Two databases have been used to ensure the reliability of the network data: SDC Platinum and RECAP Recombinant Capital. Finally, Social Network Analysis and Hierarchical Linear Modeling (HLM) techniques have been utilized in this project.

This research contributes to the international business literature by exploring the significant role that institutional differences play in explaining countries' differences in their network structures. The study also contributes to the discussion on the preference of closed vs. open network structures in the strategic management literature by introducing the contingency of countries to network structure preferences.

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INTRODUCTION

As of the early 1970s, there has been an increased attention to the study of networks in the various branches of the social sciences (Powell & Smith-Doerr, 1994). The significant emphasis on network research can be explained by the general shift in the social sciences from individualistic and atomistic explanations towards more relational and institutional understandings (Borgatti & Foster, 2003). Research on networks enables researchers to model the social relationships among interacting social actors and learn the implications of these relationships (Anderson, Wasserman & Crouch, 1999). This field of enquiry has been increasingly growing in popularity over the years, allowing some to characterize it as a hot "fashion" (Jarillo, 1988).

A network is "a set of nodes and the set of ties representing some relationship, or lack of relationship, between the nodes" (Brass et al., 2004: 795). In inter-organizational networks, these nodes are organizations. Networks represent regular patterns of interaction between actors commonly referred to as 'structures' (Anderson et al., 1999). Network structures can affect many aspects of firms such as their performance (McEvily & Zaheer, 1999; Nohria & Gracia-pont 1991; Rowley et al., 2000; Shipilove, 2006: Uzzi, 1996), innovation (Ahuja, 2000; Capaldo, 2007; Gibbons 2004; Shan, Walker & Kogut, 1994; Schilling & Phelps, 2007), and even the survival of startups (Baum et al, 2000; Powell et al 1996). Burt (1992) emphasizes that well-structured networks can lead to more social capital. Firms with superior network structures are better positioned to exploit their internal capabilities (Zaheer & Bell, 2005). Moreover, the structural characteristics of a network can affect the profitability of firms within that network (Gulati et al., 2000). In brief, the inter-firm network structure is an important factor that

affects the economic activities and performance of network members (Rowley et al., 2000).

Given the importance of network structures for the strategic objectives of firms, we have to recognize the factors that create these structures. This research presents the inter-organizational network structure as a dependent variable, an approach which has not been explored extensively in the literature. There are some attempts to explain network evolution such as Amburgey et al. (2008), Doreian (2008), and Hite (2008). All of these studies concentrate on the internal mechanisms within networks that lead networks to evolve in certain directions. These studies, however, overlook the effect of external factors on network structure specifically in cross-country contexts. Therefore, in this research we emphasize that if we want to fully understand the consequences of network structures, we need to recognize the factors that have created these structures in the first place. Zaheer and Soda (2009) claim that without understanding the causal linkages that create a structure, knowledge of network outcomes remains incomplete.

This study aspires to answer the following research questions: What are the factors that shape inter-organizational network structures? Does the structure of inter-organizational networks differ between countries? If so why? To answer these questions, this research will conduct a systematic analysis of the structural difference of inter-organizational networks across different countries. By doing so, the hope is to assess whether organizations from different countries have different tendencies towards cooperation and different structural configurations to build their networks. More specific questions include: are the organizational networks denser in Japan or China, Canada or France? Acknowledging these differences is not the only contribution of this research, as

I also hope to examine and explain the sources of these differences. The comparison will be performed for 18 different countries in terms of their economies (emerging/developed) or geographic locations (east/west or northern/southern hemisphere).

I argue that the structure of inter-organizational networks is a function of two interrelated factors: the availability of strategic resources and the institutional profile of the domain of inter-organizational networks. More specifically, the availability of resources partially mediates the relationship between the institutional profile and the network structure. For instance, it is hypothesized that countries that have weak legal institutional environments will have fewer resources in open markets, requiring firms to develop more alliances to have access to needed resources. As a result, in such countries there will be denser networks with more ties among their members.

Considering institutional factors as the main determinants in alliance formation (the building blocks of networks) is not something new in the literature; Oliver (1991) presented two institutional forces that affect the formation of alliances among firms, namely necessity and legitimacy. However, very few studies have tried to empirically test the real effect of the institutional environment on alliance formation and more specifically the network structure of alliances. A key contribution of this research is, thus, to identify the magnitude of the influence that the institutional environment has on the network structure. Adding the institutional profile to the model will allow us to explain the apparent differences in network structures around the world.

The Industrial Organization perspective emphasizes the effects of industries on the performance of firms and asks the famous question: does the industry matter (Rumelt, 1991; McGahan & Porter, 1997)? The introduction of the institutional based view (Peng

et al., 2008) has raised another important question: does the country matter? Makino et al. (2004) show that national contextual factors influence firms' behaviors and economic performance. We can ask the same two questions regarding the structure of inter-organizational networks. Rosenkopf and Schilling, (2007) have answered the former question by comparing the network structures of (32) industries, concluding that industry does matter. I will try to answer the latter question and show that the country also matters to the network structures.

This study compares the network structures of the following 18 countries that have apparent differences in their institutional profiles: Australia, Belgium, Denmark, Canada, China, India, Italy, Germany, France, Japan, Malaysia, Netherlands, Singapore, South Korea, Spain, Sweden, Switzerland, and the UK. Networks in the biomedical industry are used in this study for two main reasons. First, this is a kind of industry that requires an extensive number of alliance formations; which means more available data for the purpose of this study. As Powell et al. (1996) argue, the R&D intensity and the level of technological sophistication are positively related to the number of alliances in this industry. Second, there is a wider coverage of cooperative activities in this industry. Hierarchical Linear Modeling (HLM) techniques have been used to test the hypotheses.

This study contributes to two different theoretical streams in the strategic management literature. The first theoretical stream concerns the emerging debate over the grounding of strategy in economics as opposed to institutional conceptualizations. This research combines the two paradigms by incorporating institutional theory and resource dependence theory to explain the factors that affect inter-organizational network structures.

The second theoretical stream that will be covered relates to the contingency approach literature (Bae & Gargiulo, 2004; Burt, 2000; Rowley et al., 2000), which explains the preference of closure (Coleman, 1988) vs. holes (Burt, 1992) regarding network structure. This research contributes to the discussion in particular by focusing on the contingency of countries. It will be argued that many of the institutional forces that vary among countries determine the prevalence of one structure over another. This research also contributes to the international business literature by exploring the significant role that institutional differences play in explaining countries' differences in their network structures.

CHAPTER 1: NETWORKS IN SOCIAL SCIENCE

Network studies span many disciplines such as management studies, health care service, public administration, sociology, psychology, and communications (Provan et al., 2007). Powell and Smith-Doerr (1994) argue that there are two approaches to study networks in social science. The first approach is based on sociology and organizational theory, and it portrays networks as analytical devices to explain intra- and inter-organizational ties and their relationship with the environment. The second approach, which is multidisciplinary, presents the network as a "kind of organizing logic" that functions to arrange economic relationships.

In sociology, networks have been used to explain interpersonal relationships (e.g. Granovetter, 1973) or interfirm relations (e.g. Van de Ven, 1976). Sociologists use networks to explain the role of relationships in creating meaning and order to social life and to explain how networks emphasize structure and constraints (Powell & Smith-Doerr, 1994). A major shift in introducing networks to sociology was achieved when Granovetter (1985) reemphasized and developed Polyani's (1944) notion of embeddedness. Granovetter (1985) explains how the network of social relations affects economic life. The use of networks has become prevalent in sociology allowing Parkhe et al. (2006) to comment that sociologists (compared to other disciplines) have dominated network research since 1970s.

In the Organizational Theory domain, network analyses have been traditionally used to explain how resources flow among actors or how the position in a network affects the status of individuals (Salancik, 1995). Nohria (1994) points out that organizations are social networks and therefore, networks can be considered as a special form of

organization.

Early mentioning of networks can be traced back to Roethlisberger and Dickson (1939) in the management literature. They draw attention to the role of informal relationships (i.e. networks) within organizations. Simon (1945) also noticed the existence of formal and informal communication channels and is one of the pioneers in describing the role of informal social networks inside organizations. This suggests that the earlier studies of network concepts are concentrated on the networks of individuals within organizations.

In strategic management, however, interest in networks did not take place until the end of the 1980s. Researchers did not consider networks in their investigations because they failed to recognize the effect of firms' alliances on performance (Gulati et al., 2000). Jarillo (1988) also explains this late adaptation of network analysis by arguing that strategists do not use the network construct because it is very hard to match with the basic assumption of competitive behavior that values competition over cooperation. The new emphasis on network analysis has been a great contribution to the field, enhancing many traditional research streams in strategy such as industry structure, positioning, dynamic and path dependent constraints and benefits, and the resource based view (Gulati et al., 2000).

Over the last two decades, there has been a surge in the focus on networks in managerial studies. There are many indications that signal the importance of this trend. For instance, in the last 15 years, there have been at least four special issues in leading management journals that dealt specifically with the topic of networks [*Strategic Management Journal* 2000 (Vol. 21, N. 3); *Academy of Management Journal* 1997 (Vol.

40, N. 2) and 2004 (Vol. 47, N. 6); and *Academy of Management Review* 2006 (Vol.31, N. 3)]. We also had a special issue dealing with the Asia Pacific networks in the *Asia Pacific Journal of Management* 2005 (Vol. 22). In addition to these special issues, there is a substantial number of articles that are distributed throughout regular issues and many books that are devoted totally to the topic of networks (e.g. Alter & Hage 1993; Baum & Rowley, 2008; Nohria & Eccles 1992; Nohria & Ghoshal, 1997).

One of the major concerns of management studies is to explore the interactions between individuals, groups, and/or organizations; network research can help to illuminate the relational aspects of these interactions (Brass et al., 2004). In fact, the primacy of relations is the most frequently proposed difference between network research and conventional social science research (Kilduff et al., 2006).

This review of the literature covers three major themes. First, it discusses the use of network analysis in management science across three levels of analysis: individual, group and organizational, with more emphasis being placed on the organizational level. Second, it provides a comprehensive review for the construct of 'network structure'. Finally, it reviews the research concerned with detecting country effect on the networking activities of firms.

1.1. Networks in Management

The focus on networks in management research has grown exponentially in recent years (Borgatti & Foster, 2003). A significant contribution of using networks in management studies is that networks theory emphasizes the attributes of different actors and the relationship among them rather than concentrating exclusively on the attributes of individual actors (Parkhe et al., 2006). According to transaction cost economics, the

network mode of organization, the 'hybrid' mode, displays an intermediate value between two extreme modes, namely the 'market' and 'hierarchy' modes of organization (Williamson, 1991). Moreover, Powell and Smith-Doerr state that “the strength of networks – the flexibility with which they permit recombining various components to exploit new opportunities – may, under certain conditions, outpace the capabilities of hierarchy” (1994: 381).

Networks are essential components of markets since they organize and direct the flow of tangible and intangible resources from position to position within a social structure (Owen-Smith & Powell, 2004). The network mode of organization, when compared to the market or hierarchy modes, can be considered as a more flexible way of production because networks have the ability to add new links and dissolve dysfunctional ones (Contractor et al., 2006). Networks are not only considered as flexible systems, but they also provide flexibility for their members because they allow firms “to enjoy the added flexibility of not having fixed commitments to activities which are not essential to them” (Jarillo, 1988: 35).

Many reviews have been presented to synthesize the network research in management science. As an introduction to a special issue on alliances and networks, Gulati et al. (2000) review the research of networks in strategy. Barringer and Harrison (2000) provide an overview of the literature on inter-organizational relationships. Borgatti and Foster (2003) take a more comprehensive stance and review the “network paradigm” in organizational research as a whole. Brass et al. (2004) provide a very interesting review of network research in management science at individual, group, and organizational levels. Contractor et al. (2006) present a comprehensive overview for

networks theories that have been used in managerial science. Finally, Provan et al. (2007) review the empirical literature on inter-organizational networks at the network level of analysis.

1.1.1. Individual level networks

Paying attention to the interpersonal and informal networks inside organizations has been a long tradition in organization theory. That happened even though the rationale of personal networks goes against the famous argument of Weber (1947) that impersonal and official relations are the basis for the bureaucratic system and a factor of its success. Barnard (1938) claims that informal organizations (i.e. networks) are found within all formal organizations; the former is to provide vitality and the latter to secure order. Udy (1959) supports this argument by emphasizing the existence of "informal organization." Simon (1945) also notes the existence of formal and informal communication channels within organizations.

Homans (1950) adds "sentiment" as a main factor that affects the behavior of persons in groups and also explains how sentiments can assist in establishing informal relations. Criticizing the bureaucratic system and advocating for the role of informal relationships, Crozier (1964) suggests that centralization and impersonal rules permit an escape from reality, what has been termed as "bureaucratic tendencies". He also argues that the bureaucratic system "is too rigid to adjust without crises to the transformations that the accelerated evolution of industrial society makes more and more imperative" (1964: 198).

All the previous arguments have a common theme: informal relationships can complement and give more flexibility to the formal bureaucratic relationships within

organizations and networks. In addition to flexibility, networks can help in the organizing effort within organizations (DiMaggio, 1992). Studying organizations form a network perspective has great relevance, as Nohria states it: “all organizations are in important respects social networks and need to be addressed and analyzed as such” (1992: 4).

Individual level networks can be intra- and inter-organizational. In the former case, the networks are formed between individual employees within their organizations. Inter-organizational individual networks refer to the personal connections between members of a firm with their peers in other organizations or with government officials. In this section, I will concentrate on intra-organizational networks.

Intra-organizational networks are the informal relationships between employees. Examples of these relationships are friendship, help, and advice. Nohria (1992) argues that identifying the position of actors in networks of relationships is a major step in understanding the attitude and behavior of these actors in organizations.

Many factors are suggested to have an influence on the formation of intra-organizational networks. These include similarities between actors and their personality, the organization's structure, and other environmental factors such as environmental jolts, and societal culture (Brass et al., 2004). In building their advice networks, advice seekers employ a variety of human choice and decision-making perspectives, and they decide whom to contact by trading off expected knowledge value versus the cost of obtaining it (Nebus, 2006).

The existence of the informal networks inside organizations has significant consequences for both individuals and the organization as a whole. The rationale behind network consequences can be clarified by the social capital argument. Burt (2000) argues

that the traditional explanations for any variation on performance are based on human capital arguments. He explains that the human capital explanation of inequality between individuals suggests that people who do better are more able as individuals (more intelligent, attractive, articulate, and skilled). On the other hand, the social capital explanation for inequality emphasizes that individuals who do better are somehow better connected. In brief, people who have favorable connections will enjoy better performance and results.

Individual networks, especially weak ties, are a very strong source of employment opportunities (Granovetter, 1973). Not only do networks affect the probability of getting a job, but they also affect advancements and promotions (Burt, 1992). It has been argued that network position has a real influence on work performance (Mehra et al., 2001). Networks play a significant role in the distribution of power and influence within organizations (Nohria, 1992). In addition to promotion and performance, networks shape many other aspects of the work environment such as attitudes, job satisfaction, turnover, leadership and ethical behavior (Brass et al., 2004). Moreover, it has been shown that organizational citizenship behavior and performance are highly affected by social network ties within organizations (Bowler & Brass, 2006).

Nohria (1992) points out that in addition to the positive roles that networks play in organizational life, they may also have restraining effects. Labianca and Brass draw attention to the negative relationships inside organizations, and they define them as "ongoing and recurring relationships within the context of a work organization in which at least one person dislikes another" (2006: 596). They also assert that the liabilities of networks are often ignored in the literature, even though they might have greater

explanatory power than positive relationships.

1.1.2. Group level networks

Within organizations, groups or units can be conceptualized as 'nodes', and the relationship between them can represent networks (Nohria & Ghoshal, 1997). Based on this perspective, group interaction can be understood using network analysis (Tsai, 2000). Moreover, network analysis can be used to understand intragroup dynamics (e.g. Mehra et al., 2006; Reagans & Zuckerman, 2001). Group networks have a significant influence on the functioning of these groups (Joshi, 2006) and on the functioning of the organization as a whole. Intergroup networks can also be formed vertically or horizontally within the organization; the former improve the team's position in the organization, and the latter help to coordinate work and have access to information (Joshi, 2006).

As discussed above, individual networks consist of informal relationships. Group networks, however, can be either formal or informal (Brass et al., 2004). Therefore, we can argue that the factors that create group networks differ from those that create individual networks. Organizational processes such as the design of operations and control mechanisms, like centralization for example, impose formal constrains on the creation of group networks (Brass et al., 2004; Joshi, 2006). The size, performance record, and resource endowment of a group can affect the ties it creates with other groups in an organization (Brass et al., 2004). The creation of intergroup networks will be affected by interpersonal interactions between the members of a group and their contacts outside the group. Thus, the interpersonal ties and the personalities of the group members will affect the creation of intergroup networks (Brass et al., 2004).

Group networks have many implications for group performance (Brass et al., 2004). For instance, Mehra et al. (2006) find that the configuration of the external and internal social networks of a group's leader is related to the objective performance of the group. Reagans et al. (2004) support this argument by confirming that inter and intra-group networks have a significant effect on the speed at which projects are completed. Zaheer and Soda (2009) concentrate on the external relationships of teams, and they argue that the design of this network affect the performance of teams. Oh et al. (2006) argue that groups that have more social capital tend to have greater effectiveness. Two major objectives for the establishment of intergroup networks are the exchange of resources and the transfer of knowledge (Tsai, 2000). Brass et al. (2004) indicate that intergroup networks have a considerable influence on the innovation and knowledge creation of groups.

1.2. Inter-organizational Networks

"Interfirm networks are collections of firms joined by ties that vary in formality, but are stable and significant enough to create reasonably persistent interfirm structure" (Rowley et al., 2004: 453). Organizational networks encompass a wide range of forms that starts with informal relations between individuals (Uzzi, 1996) or interlocking directorships among firms (Davis et al., 2003) and end with formal contractual agreements in terms of joint ventures and strategic alliances that are defined as "voluntary arrangements between firms involving exchange, sharing, or co-development of products, technologies, or services." (Gulati, 1998: 293).

A major difference between inter-organizational networks and individual and team networks is that inter-organizational networks are harder to detect. Identifying the

network can be a hard job even for a firm that is a member of that network. Accordingly, "to detect overarching structure, one has to rise above the individual firm and analyze the system as a whole" (Bowler et al., 1992: 312). The proliferation of inter-organizational network research has been fueled by the increasing adaptation of the strategic network approach. This approach maintains that the value creating activities rest at the network level rather than firm level; therefore, we need to extend the limits of strategic enquiry to include the networks in which firms are embedded (Dagnino, Levanti & Li Destri, 2008).

Below, I discuss two main streams of research that occupy the study of networks at the organizational level - namely network formation and network consequences. I follow this with a detailed exploration of the third stream of network structure.

1.2.1. Inter-organizational network formation

In the literature, the emphasize has been placed on alliance formations rather than network formations, but since alliances are the building blocks of networks, the arguments for alliances formation can be extended to discuss network formation. There are many classifications for network formations throughout the literature. For instance, Eisenhardt and Schoonhoven (1996) divide the factors that affect network formation, by establishing alliances, into 'strategic' and 'social' explanations. Strategic explanations highlight the need for strategic alliances, while social explanations suggest the opportunity to form new alliances. I will present the four most common factors provided in the literature for explaining network formation. They are: a firm's resource procurement and the level of uncertainty, social capital, the institutional environment, and the status of a firm's embeddedness.

1.2.1.1. Resource procurement and uncertainty

Pfeffer and Salancik (1978) argue that the survival of an organization is contingent upon its ability to effectively manage the internal demands of the groups upon which it is dependent and its ability to acquire and maintain resources from the external environment. They maintain that since the environment is uncertain, organizations can arrange contracts with other firms to guarantee the required resources; in other words, they can establish interfirm networks.

Building on resource dependence theory, managing interdependence has been the most common explanation for the emergence of interfirm networks (Baum et al., 2003). External interdependence focuses on two considerations: resource procurement and uncertainty reduction (Pfeffer & Salancik, 1978).

Resource procurement is a major factor that encourages firms to establish networks. Oliver (1990) argues that a firm enters into an alliance to exercise power and control over another organization's resources. Firms usually seek three types of resources from their network partners. First, firms establish networks to have access to capital (Lee et al., 2001; Uzzi, 1999). Second, firms participate in networks to have access to partners' tacit knowledge (Hansen, 1999; Kale et al., 2000; Oxley & Sampson, 2004) and to learn from their partners (Anand & Khanna, 2000; Baum et al., 2000; Kogut, 1988; Powell et al., 1996). Finally, firms join networks to have access to technological resources (Baum et al., 2003).

Reducing uncertainty is the second factor that affects network structure according to resource dependence theory. In situations of high level of uncertainty, organizations seek stability by establishing alliances to avoid facing an unstable environment (Oliver,

1990). This idea of coping with environmental uncertainty is derived from Thompson (1967) and is supported by Baum and Oliver (1991) who argue that organizations with institutional linkages exhibit a significant survival advantage.

1.2.1.2. Institutional factors

The recognition of institutional factors as key determinants in the formation of alliances networks was first introduced theoretically by Oliver (1990), and this has been developed further by other scholars (e.g. Dacin et al., 2007; Peng & Zhou, 2005). However, very few studies have shown this relationship empirically. Oliver (1990) suggests two institutional determinants of alliance formation: necessity and legitimacy. The former explains that a firm establishes a linkage with other organizations to meet legal or regulatory requirements. The latter emphasizes that a firm participates in alliances to gain legitimacy by improving its reputation, image, or exhibiting congruence with prevailing norms in its institutional environment.

1.2.1.3. Social capital

A firm that has good social capital is more able to choose its alliances and, eventually, its optimal network structure. As Gulati notes, "firms with more social capital will not only have access to information about a larger number of alliances, but they may also be able to attract better partners who want to ally with them" (1998: 298). Social capital is defined as "the goodwill available to individuals or groups. Its source lies in the structure and content of the actor's social relations. Its effects flow from the information, influence, and solidarity it makes available to the actor" (Adler & Kown, 2002: 23). Thus, social capital is the accumulated experience of a firm with other current or

potential partners that is developed as a result of the previous ties among these firms (Gulati, 1995). The social networks in which most firms are embedded become important sources of information about the reliability and capabilities of their partners (Gulati, 1995).

Not only does social capital arise from the previous relationships between organizations, but it can also be generated by the personal social capital of the management team. For instance, Larson (1992) points out that prior personal relationships and known reputations reduce uncertainty and establish expectations that enhance early cooperation between organizations. After many interviews with several entrepreneurs, she argues that personal relations have a great role in strategic alliances. This is not to say that economic incentives were absent but that a social context provides the environment within which economic exchange can be established. She concludes that concrete personal relations provide a base frame for economic exchange in strategic alliances.

On the same line, Eisenhardt and Schoonhoven (1996) argue that extensive personal relationships and the social capital of the top management team create an awareness of opportunities for networking as well as knowledge and trust among potential partners. More specifically, they find that firms with large, experienced, and well-connected top management teams will have greater rates of strategic alliances. The experience is measured by the number of previous employers of the team or by the number of previous management positions held by members of the team.

Gulati and Westphal (1999) examine the influence of the social network of board interlocks on the formation of strategic alliances. Since the board members of a firm have

advisory and controlling roles for the decision-making of the firm, their influence on the formation of strategic alliances will vary as a result of the differences between these two roles. Consequently, a CEO-board relationship that is characterized by independent board control reduces the likelihood of alliance formation by encouraging distrust between the board and the CEO. By contrast, CEO-board cooperation in strategic decision-making promotes alliance formation by enhancing trust between the CEO and the board.

Rosenkopf, Metiu, and George (2001) examine the effects of mid-level management connections among firms on the subsequent alliance formation among these firms. They found that interfirm relations are enhanced by the interpersonal bonds that are built among managers in technical committees. They also find that the activities of technical committees facilitate the entry of less established firms into alliance networks by increasing the social capital of these firms. Finally, investigating U.S. investment banking firms' syndication in underwriting corporate stock offerings, Chung et al. (2000) finds that the likelihood that an investment bank will engage in alliance formation is positively related to the bank's social capital, which arises from direct and indirect collaborative experiences.

1.2.1.4. Embeddedness

Granovetter's (1985) seminal work on economic action and social structure is considered to be the primary catalyst behind the modern research on embeddedness. He argues that economic actions are directly affected by the ongoing patterns of social relations. Zukin and DiMaggio (1990) provide more specific arguments and propose that economic activities are contingent on four types of embeddedness, namely cognitive, cultural, structural, and political. Cognitive embeddedness refers to the limitations that

are exerted on economic rationalities by the "structured regularities of mental processes." Cultural embeddedness is concerned with how "shared collective understandings" affect economic activities. Patterns of ongoing interpersonal relationships create the context for economic exchange, which they call structural embeddedness. Political embeddedness explains how the struggle for power and the role of non-market institutions such as state and social classes shape economic institutions.

In the context of inter-organizational networks, however, the major contribution of embeddedness is that the current pattern of relationship will affect the future partnerships between firms (Gulati & Gagiulo, 1999). Firms use cues from previous alliances to establish new ones (Gulati, 1995). Gulati and Gagiulo (1999) identify three types of embeddedness: i) relational embeddedness that emphasizes the role of cohesive ties between firms on the subsequent relationships between them; ii) structural embeddedness that captures the influence of the structure of the relationships around the firms on their cooperative activities; and iii) positional embeddedness that explains how the current position of a firm in its network affects its future tendencies toward cooperation.

Hagedoorn (2006) argues that inter-organizational embeddedness can be recognized on three levels of analysis. The first is dyadic embeddedness, which concentrates on repeated ties within pairs of companies. The second level is inter-organizational embeddedness, which emphasizes the history of a firm's different networks. These two levels are close to those of Gulati and Gagiulo (1999). However, the last level of environmental embeddedness provides a deeper understanding of the phenomenon of embeddedness. Environmental embeddedness emphasizes the macro-

level factors such as country differences and industry advancement and their effect on network formation.

1.2.2. Consequences of inter-organizational networks

Throughout the literature, many benefits have been proposed as a result of firm alliances and networks. Since strategic alliances constitute the most dominant type of inter-organizational networks (Hitt et al., 2007), the emphasis has been specially placed on the results of strategic alliances. According to resource dependence theory, alliances can help firms in creating the needed and complementary resources (Ahuja, 2000; Eisenhardt & Schoonhoven, 1996; Gulati, 1998). Moreover, alliances can facilitate access to resources in faster ways than developing them in house (Rosenkopf & Schilling, 2007). Alliances can also help firms reach economies of scale (Jarillo, 1988).

Not only do networks serve as a viable conduit to transfer tangible assets, but they can also be a great source of learning through the transfer and creation of knowledge (Ahuja, 2000; Baum et al., 2000; Powell et al., 1996). Moreover, alliances can play a significant role in accelerating the learning process of participating firms (Kale et al., 2000) and improving the innovative activities of firms (Dhanaraj & Parkhe, 2006).

The formation of alliances and networks can be an important tool in the competitive strategy of firms (Jarillo, 1998; Eisenhardt & Schoonhoven, 1996). They can be a response to competitors' alliances (Gimeno, 2004) and facilitate the sharing of risks and costs of new projects (Das & Teng, 1996; Powell, 1990). Alliances also help firms to have access to new markets (Powell, 1990). Powell (1990) argues that alliances can help firms to achieve vertical disaggregation (reducing the reliability of large-scale organizations that results from the large structural inertia of big companies).

Studies of networks' effect on performance have yielded mixed results in the literature. Peng and Luo (2000) investigate the effects of the interpersonal networks and the performance of firms in a Chinese sample. They find that the interpersonal networks between managers and top executives of other firms and government official influence the performance of firms. They conclude that these networks are necessary for performance but not sufficient. Lincoln et al. (1996) argue that membership in a keiretsu network has a positive effect for firms with previously negative results. However, negative performance figures are also reported for firms with previously good results.

As mentioned above, resource dependence theory indicates that alliances are important mechanisms to reduce uncertainty (Pfeffer & Salancik, 1978). Many scholars have confirmed this argument and present networks as a way to cope with uncertainty (Baum & Oliver, 1991; Hoffmann, 2007; Nohria & Garcia-Pont, 1991). In addition to environmental and market uncertainty, the network, as a hybrid mode between market and hierarchy, can help in reducing opportunistic behavior faced by firms through interaction in the open market (Williamson, 1991). Finally, alliances can enhance the legitimacy of a firm by connecting it with legitimate actors (Galaskiewicz, 1985). Alliances can also improve the reputation of firms by associating their image with well reputable firms (Larson, 1992).

Before moving on to a discussion of network structures, it is noteworthy to point out that there are many studies that have attempted to cross the line between the individual, group, and organizational levels of analysis. Multilevel network studies try to "zoom back and forth" between individuals and collective levels of analysis (Ibarra et al., 2005) to have a comprehensive view of the effect of social networks on economic actions

(Uzzi, 1999; Rosenkopf et al., 2001). For instance, Mehra et al. (2006) combine individual and group level networks in one framework and explain that both networks influence group performance. Oh et al. (2006) take the same approach to study group networks and emphasize the role of individual intragroup networks and intergroup networks to examine group effectiveness. Other studies measure the effect of individual networks on organizational networks (e.g. Eisenhardt & Schoonhoven, 1996; Gulati & Westphal, 1999; Larson, 1992; Rosenkopf et al., 2001).

1.3. Network Structure

> "Consider carbon atoms, which may be structured in different ways. One arrangement yields graphite, the soft, greasy, black substance used in pencils. Another yields diamonds, the hardest known substance found in nature." (Parkhe et al., 2006: 561)

Network structure refers to the presence of lasting patterns of relationships among actors (Wasserman & Faust, 1994). For the purposes of this research, I will focus on inter-organizational network structures which refer to "the overall pattern of relationships within which the industry is embedded" (Gulati et al., 2000: 205). There is no scholarly consensus about the dimensions of a network structure; different scholars present different dimensions. For instance, Gulati et al. (2000) argue that network structure can include network density, structural holes, structural equivalence, and core vs. peripheral firms. On the other hand, Provan et al., (2007) provide more detailed features of network structure such as in-degree and out-degree centrality, closeness centrality, betweenness centrality, multiplexity, broker relationships, and cliques.

One of the major dimensions of network structure that have been investigated in many studies is centrality. For example, Ahuja et al. (2009) connect the centrality of

firms with their resulting alliance formation. Human and Provan (1997) try to connect the centrality of a firm in its network and its performance. The other dimension of network structure that is widely used is small world property (Milgram, 1967). A network that has a small world property will consist of many dense clusters of actors, and these clusters are connected by a short path length (Kogut & Walker, 2001). Conyon and Muldoon (2008) provide a good summary for the use of small world property in management literature.

Throughout the literature, primary attention has been devoted to study the two opposite properties of network structure, structural holes and closure (Baum et al., 2010). What is common between the closure and structural holes arguments is that both emphasize the importance of social capital in creating a competitive advantage. In other words, both agree that better connected people have more social capital. However, each has a different view about the meaning of 'better' connected (Burt, 2000).

Structural holes occur in a network when an actor's partners do not maintain connections among each other (Burt, 1992). The logic behind the structural holes argument is that information circulates more within than between groups and the weak ties between groups are holes in the social structure of the market. Consequently, structural holes create a competitive advantage for an individual whose relationships span across the holes (Burt, 2000). Moreover, the structural holes argument indicates that structures exhibiting closure require redundant ties that post liabilities in terms of resources such as time and attention (Burt, 1992). Therefore, we can consider structural holes as an opportunity to broker and control the flow of information between people from opposite sides of the hole (Burt, 2000).

The other pole of the density dimension is the case of closure as presented by Coleman (1988). Closure can be obtained when actors in a network are all connected to each other. The logic behind the closure argument is that the closure of a network can be a good source of social capital for its members because it facilitates information diffusion. Furthermore, closure facilitates the creation and development of common routines and creates shared meaning which enhances trust and curbs the opportunistic behavior due to close monitoring (Coleman, 1988). In addition, the probability of unethical behavior is lower in dense networks due to the rapid diffusion of information about ethical wrongdoing from any member in a given network (Soda et al., 2004).

Both closure and bridging have been shown to be advantageous under a range of conditions, but each displays a distinct temporal dynamic (Baum et al., 2010). Some authors argue that closure and holes are not contradictories and they might complement each other (e.g. Reagans & McEvily, 2008). As mentioned above, network studies can be conducted on three levels of analysis: the individual, group, and organizational. I will attempt to track the structure studies in the literature on these three levels of analysis because the contingencies of the three levels are different from each other.

1.3.1. Structure of individual networks

The initial debate between Burt (1992) and Coleman (1988) about the superiority of closure vs. structural holes as a source of social capital was originally focused on the individual level of analysis. Burt (1992) conducted his study on individual managers while Coleman (1988) investigated individual students. Burt (1992) finds that managers who have a network that is rich with structural holes will have better results in terms of their promotions and power. On the other hand, Coleman (1988) studies the role of the

social structure around students and their probability of dropping out of school before graduation. He concludes that students with more closure in their social structure (family, school) will enjoy more social capital and a lower probability of dropping out of school.

Support for Burt's theory is mounting on the individual level. In their study of two high-technology electronics firms, Podolny and Baron (1997) find that senior managers with networks richer in structural holes are more likely to have early promotions. Mizruchi and Sterns (2001) point out that the probability of closing deals will be more for loan officers whose networks span many structural holes in the bank. Burt, Hogarth, and Michaud (2000) take their experiment to France and find that the probability of receiving a salary raise increases for managers who have many structural holes in their networks. Burt (2000) finds that the social capital of networks that span structural holes matters for managers' performance, improving evaluations of the managers' work, the probability of early promotion, and managers' compensation relative to their peers.

The closure argument has received support in the literature as well. For instance, Krackhardt (1999) shows a preference for closure and argues that individual networks with triadic or Simmelian ties (i.e. if a strong tie exists between A-B and A-C, there is a strong tie between B-C), are more enduring and stronger than networks that do not maintain such ties.

In the literature, the support of one of the theories over the other is not conclusive. Therefore, Burt (2000) proposes a contingency approach to settle down the debate between the two theories. "A contingency factor is any variable that affects the strength of association between social capital and performance" (Burt 2000: 37). Consequently, he proposes three factors on the individual level that might affect the preference of one

structure against the other, namely culture and personality, content, and peers.

Actors who have certain personality traits like "need for achievement" will have different network structure preferences than other individuals. In supporting this argument, Burt et al. (1998) conclude that the network structure varies systematically with the personality traits of the relevant actors. More specifically, he finds that actors with entrepreneurial attitudes tend to occupy hole-rich networks. Regarding the content, Burt (2000) differentiates between three types of relationships (friendship, business, and authority). Each type of relationship will create a different network structure preference. The influence of structural holes will be minimized when a manager has many peers in a position to undercut or denigrate the manager's proposals. In support of the contingency approach, Moran (2005) indicates that the implications of closure are task dependent in such a way that closure improves the performance of managers at routine, execution-oriented tasks but closure has less effect on new, innovation-oriented tasks.

1.3.2. Structure of group networks

The debate between closure and structural holes has a different nature on the group level of analysis. Intragroup structures can be analyzed as to whether closure is more beneficial or holes. However, this comparison is hard to establish at the intergroup level because it is hard to achieve closure of intergroup relationships. Closure will mean that all the members of a group should have extensive relationships with all members of the other groups in the firm which is hard to attain. Since the existence of intergroup closure is hard to achieve, the question will not be if closure is more beneficial than structural holes among groups; the relevant question focuses, rather, on whether structural holes are beneficial or not.

Gargiulo and Benassi (2000) use data from a newly created special unit within the Italian subsidiary of a multinational computer manufacturer to support the structural holes argument. They find that managers with cohesive communication networks are less likely to succeed in transforming their networks to meet new requirements. Zaheer and Soda (2009) find that teams in the Italian TV production industry that span many structural holes have better performance in terms of viewership. On the other hand, Ancona and Caldwell (1992) support the closure argument by investigating teams in five high-technology companies. They conclude that teams that have more diversity (intragroup structural holes) have fewer evaluations of firm performance. They attribute the low performance to some problems in communication among team members.

There are many contingencies that have been proposed at the group level. Reagan and Zuckerman (1999) study the performance of 223 corporate R&D units within 29 major American firms in eight industries. They report that R&D teams that have denser networks of interaction achieve a higher level of productivity than those with sparse networks. However, they find that teams which are characterized by links between members who entered the organization at different points in time have more productivity than teams that include members who have the same tenure (differences in tenure imply that they have diverse reach and, consequently, structural holes outside the team). If we borrow the terminology of Soda et al. (2004), the results of Reagan and Zuckerman (1999) can be clarified by indicating that previous structural holes (due to variation in tenure) and current density among group members are good predictors of group productivity.

In a study of the Italian television production industry, Soda et al. (2004) propose

the contingency of time. They argue that current structural holes within project teams, as opposed to past ones, and past closure rather, than current closure, help current team performance. Therefore, they conclude that structural holes are beneficial at different points in time. Burt (2000) proposes another type of contingency which can be regarded as a compromise with the closure argument. He argues for the necessity of structural holes in intergroup networks, but he also admits that closure is necessary within the group. In a study of the sales division of a financial services firm, Mehra et al. (2006) confirm that local density and external structural holes are related to group performance.

1.4. Structure of Inter-organizational Networks

Throughout the literature, many studies have emphasized the benefits of strong and dense networks which support the closure argument. For instance, Nohria and Garcia-Pont (1991) claim that in the global automotive industry, strategic blocks (dense networks) have a positive effect on firms' performance. In their study of biotechnology startups, Walker, Kogut, and Shan (1997) argue that the greater the number of relations formed by a firm (dense networks), the more social capital the firm gains and the greater its probability of further alliances. Ahuja (2000) concludes that the positive effects of dense networks outweigh their negative effects. He also finds that an increase in the structural holes will have a negative effect on innovation. Dyer and Nobeoka (2000) point out that Toyota's dense network increases its ability to efficiently create and manage network-level knowledge-sharing processes. Within the Canadian banking industry, Rowley et al. (2004) find that this industry enjoys many stable cliques and that the membership of these cliques has a positive effect on firm-level benefits.

The structural holes camp has already received a good support in the literature.

For example, in a study on Canadian mutual fund companies, Zaheer and Bell (2005) observe a positive relationship between focal firm performance and structural holes between its alliances. Along the same line, Baum et al. (2000) find that a startup in the Canadian biotech industry benefits from positioning itself among disconnected partners. Firms in geographical clusters that maintain networks characterized by many structural holes are well positioned to access new information, ideas, and opportunities (McEvily & Zaheer, 1999).

The contingency approach for the preference of holes vs. closure has received much support from the scholarship on organizational networks. Some scholars advocate that the benefits of structural holes are contingent on external factors. For instance, Ahuja (2000) argues that the benefits of structural holes could be affected by the industry context. Rowley et al. (2000) indicate that the type of the industry affects structure preference. More specifically, they find that structural holes are optimal for the semiconductors industry and closure is optimal for the steel industry. Koka and Prescott (2008) point out that the performance indications of the two alternative structures are subject to environmental change and strategy, which means that the choice of structure is time dependent.

In addition to external factors, many researchers indicated that the benefit of structural holes is contingent on network factors. For instance, Bae and Gargiulo (2004) connect the benefit of structural holes to the substitutability of partners in a network. They argue that organizations whose alliances with non-substitutable partners are embedded in dense networks obtain better returns than firms occupying brokering positions between non-substitutable partners.

Moreover, Baum et al. (2010) conclude that the benefits of closure, bridging, and hybrid network positions are contingent on the ages of ties constituting them. They found that the benefits associated with closure take time to develop, whereas those associated with bridging are often short lived. For hybrid positions, which combine elements of bridging and closure, a mix of established and new ties will be most advantageous.

The benefits of structural holes vs. closure can also be affected by firms' specific characteristics. For instance, Shiplov (2006) connects the benefit of structural holes to the specialization level of firms. More specifically, he finds that generalist and specialist banks can benefit more from structural holes than moderate specialization banks. Shipilov (2009) emphasizes another aspect of firms' characteristics in relation to structural holes. He argues that firms with a wide scope of experience and a high level of historic multimarket contact with their partners are able to extract the highest benefit from structural holes.

Hite and Hesterly (2001) propose another contingency factor which is the age of the firm. They point out that a firm in its early stages will take advantage of more identity based (denser) ego networks. However, when the firm moves toward the next growth stage, the ego network becomes increasingly based on calculation (less dense).

Hoffman (2007) argues that the benefits of closure vs. hole are contingent upon the pursued strategy of a firm. More specifically, when a firm needs to follow a shaping strategy (e.g. developing and introducing new technologies), dense networks will be more effective. On the other hand, if the firm wants to follow an adopting strategy (e.g. overcome high technological uncertainty), structural holes can provide better chances of success.

Capaldo (2007) reaches a compromise position and proposes that the integration of a large periphery of heterogeneous weak ties and a core of strong ties will lead to optimal results. Schilling and Phelps (2007) emphasize the same argument, holding that both holes and closure should exist together in order for a firm to take advantage of its network position. Firms embedded in alliance networks that exhibit both high clustering and high reach (short average path lengths to a wide range of firms) will have more innovative output than firms in networks that do not exhibit these characteristics (Schilling & Phelps, 2007).

Provan and Sebastian (1998) also propose a compromise argument while studying the networks of mental health agencies in three US cities. They take a global view and measure the effectiveness of the networks as a whole. They note that networks with denser cliques tend to be more effective and that these cliques are connected through structural holes. They also suggest, however, that the density of the network as a whole is a poor predictor of network effectiveness. A summary for the researchers who participated in the closure vs. holes debate is presented in table (1).

This review of contingency studies indicates that most studies are mainly concerned about contingencies related to firms' specific characteristics and there is less emphasize on external factors. In this research, I contribute to the contingency approach by proposing an external factor that might affect the prevalence of one structure over another. I argue that the country in which the network structure is materialized will have an influence on the preference of holes over density or vice versa.

1.4.1. The importance of studying structure

The strategic network perspective maintains that the embeddedness of firms in

networks of external relationships has significant implications for firm performance (Gulati et al., 2000). From the RBV perspective, the structural pattern of a firm's relationships is unique and has the potential to result in competitive advantage (Gulati et al., 2000). Nohria and Garcia-Pont (1991) emphasize that the position of a firm in its

Table 1: Summary for the closure vs. holes debate

	Closure	Structural holes	Contingency approach
Individual level	Coleman (1988) Krackhardt (1999)	Burt (1992) Podolny & Baron (1997) Mizruchi & Sterns (2000) Burt et al. (2000)	Burt et al. (1998) Burt (2000) Moran (2005)
Group level	Ancona & Caldwell (1992)	Gargiulo & Benassi (2000) Zaheer & Soda (2009)	Reagan & Zuckerman (1999) Soda et al. (2004) Mehra et al. (2006)
Firm level	Nohria & Garcia-Pont (1991) Walker, Kogut & Shan (1997) Ahuja (2000) Dyer & Nobeoka (2000) Rowley et al. (2004)	McEvily & Zaheer (1999) Baum et al. (2000) Zaheer & Bell (2005)	**External factors:** Rowley et al. (2000) Koka & Prescott (2008) **Network factors:** Baum et al. (2010) Bae & Gargiulo (2004) **Firm factors:** Hite & Hesterly (2001) Bae & Gargiulo (2004) Shipilov (2006, 2009) Hoffman (2007) Capaldo (2007) Schilling & Phelps (2007)

network is an important part of its competitive tools. Therefore, I argue that the network structure is a major factor in determining the strategies of firms inside a network, and we have to fully understand such structures if we want to effectively influence the strategy of

firms. As Koka et al. lucidly explain, "Just as the architect needs to understand what makes buildings stay up rather than fall down, the network strategist needs to understand the elementary processes through which network structure comes about" (2006: 721).

The literature provides a mounting evidence for the effect of network structure on many outcomes related to their members. For instance, Zaheer and Bell (2005) find that among Canadian mutual fund companies, firms with superior network structures are better able to exploit their internal innovative capability which consequently enhances their overall performance. Baum, McEvily and Rowley (2010) argue that when the appropriate relational building blocks are in place, the structural features of network positions yield the predicted benefits of the structure.

McEvily and Zaheer (1999) argue that network structure is an important source of variation in the acquisition of competitive capabilities for job shop manufacturers (e.g. screw machining, stamping, sheet metal fabrication, and machining) in the US Midwest. More specifically, they find that geographical clusters that contain many structural holes and maintain ties to regional institutions provide their members with greater chances of accessing new information, ideas, and opportunities.

Uzzi (1996) points out that the embeddedness of a firm in a network and the configurations of these networks (in terms of density and strength) will improve the survival chances of "better dress apparel" firms in the New York apparel economy. He also emphasizes that the positive effect of embeddedness reaches a threshold, after which the positive effect reverses itself.

Rowley et al. (2000) find that steel industry networks that are denser will have a positive effect on firms' performance in terms of Return on Assets (ROA), while sparser

networks in the semiconductor industry will have a greater effect on performance. In a study of mental health delivery networks in four U.S. cities, Provan and Milward (1995) indicate that the effectiveness of a network is determined by many structural variables, especially integration and centrality. Humman and Provan (1997) find that the network structure of small to medium enterprises (SME) has a significant influence on the firm outcomes, specifically transformational ones (changing the way that managers think and act due to participation in the network).

It has been explained that networks play a significant role in the survival of startups (Powell et al., 1996). Baum et al. (2000) add to this argument by emphasizing that not only do networks affect the survival of startups, but the network structure also plays a key role in affecting the probability that startups will survive. Thus, they point out that the startups in the Canadian biomedical industry which are able to configure their networks to provide access to more diverse information and capabilities exhibit a stronger initial performances and greater chances for future survival.

Another important influence of network structure is its effect on the future alliance formations. Nohria (1992) argues that the options available to network strategists are strongly influenced by current network structures. The current structure affects dynamic of network ties which will consequently affect that structure (Gulati, 1998). Gulati and Gargiulo (1999) indicate that the structural embeddedness of a firm has a significant effect on the future cooperative activities of that firm. Ahuja et al. (2009) conclude that a preexisting network structure constrains the formation of new alliances. More specifically, they note that firms that are poorly embedded in a network structure (occupying a peripheral position) are less likely to form alliances than firms that are well

embedded in their networks (occupying a central position).

Kogut (2000) explains that the structure of the Toyota network has facilitated the diffusion of innovation and norms which allow it to successfully transfer its operations to North America. Moreover, he argues that this structure has helped in creating and maintaining a specific network identity. Brass et al. (2004) also emphasize this point and argue that network structure helps to enforce norms and roles. Powell and Smith-Doerr (1994) argue that members of densely formed networks possess a shared normative foundation.

From the previous review, we can conclude that structural position that a firm occupies in its network will not only influence its performance, which has received the highest coverage, but also its ability to obtain resources as well as its future relational behavior. It has been found that network structure has a direct influence on many performance measures of firms such as innovation, growth, survival, and effectiveness. Structure also affects the ability of firms to access capital, information, and opportunities. Finally, structure affects the future relational behavior of a firm by affecting its probabilities of future alliances and affecting the identity of the network in which the firm is embedded in.

Almost all studies in this literature deal with network structure as an independent variable. Very few attempts have tried to present network structure as a dependent variable. Madhavan et al. state that "managerial action can potentially shape networks so as to provide a favorable context for future action. In order to understand how managers may do this, research needs to move beyond asking how networks constrain and shape action, to examining what factors constrain and shape networks" (1998: 440). This study

proposes the same argument regarding the structure of networks and explores how networks and their structures are shaped.

1.5. Country Effects on Networks

The increasing use of networks in management science has not been accompanied by an effort to explain the difference in networking tendencies among countries. As Parkhe et al. suggest, "Surprisingly little attention has been paid, however, to the crucial cross-national, cross-cultural aspects of networks" (2006: 563). Some studies have been conducted outside the U.S., such as Canada (e.g. Baum et al., 2003; Shipilov, 2006), England (e.g. Shipilov, 2009), Japan (e.g. Gerlach & Lincoln, 1992), and Italy (e.g. Gargiulo & Benassi, 2000; Soda et al., 2004; Zaheer & Soda, 2009). By combing the results of these studies together, we can obtain sufficient indications to suggest that inter-organizational networks vary among countries. To obtain robust evidence regarding the variation in inter-organizational network structures among countries, we need to perform a systematic comparison in one study.

Few studies have attempted to compare individual managers' networks among countries. In one noteworthy study, Burt et al. (2000) compare the social-capital patterns between American and French managers and detect the effect of social capital on managers' performance. They find that successful American and French managers tend to have structural holes in their networks. However, they notice that French managers build their relationships in a different way than their American counterparts. French mangers have a narrower range of contacts. Also, Americans attach positive emotions to bridging relationships, while French managers associate negative emotions with them. Brass et al., (2004) propose that Japanese employees have group orientation toward decision making

and US employees have individualistic decision making style, which may affect the density and interconnectedness of their interpersonal networks.

There are some cross-country studies that concentrate on other aspects of inter-organizational networks besides structure. For instance Sakakibara and Dodgson (2003) conduct a cross-country study in which they compare Strategic Research Partnership (SRPs) networks among three Asian countries: Japan, South Korea, and Taiwan. They concentrate on the different purposes that these networks serve and observe that SRPs in Japan, for example, compensate for the limited opportunities for mergers and for weak university research. In Korea, SRPs networks are established to promote large-scale research projects. In Taiwan, on the other hand, SRPs are formed to facilitate technological diffusion.

Lam (2003) compares the networking activities of US and Japanese MNEs in the UK. The results indicate that the US R&D laboratories are able to embed themselves in the UK's local innovation networks more than the Japanese laboratories. In conclusion, the differences between the three countries' national patterns of organization and innovation affect their networking activities and their benefits from these networks.

In another study, Spencer (2003) conducts a structure comparison and investigates the establishment of knowledge-diffusion networks for developing the FPD (Flat Panel Display) industry. The strength of this study is that it deals with the same industry for a specific period of time, and the only difference between networks is their geographical location. Interestingly, she finds that Japanese knowledge-diffusion networks have more density and centrality than their North American counterparts and she notices no conclusive pattern for European networks. The difference between Spencer's study and

my research is that Spencer (2003) concentrates on knowledge-diffusion network (citation patterns among industrial researchers' publications), while in my study, I choose to focus on inter-organizational networks (alliances, R&D, licensing, etc).

In his book, Gerlach (1992a) tries to make a contrast between the networks in Japan and those in the US. He argues that strategic alliances in the US differ from the Japanese keiretsu in that the former alliances include a set of specific business activities (e.g. developing a new technology), while in Japan, alliances include a multiplex array of direct and indirect ties among banks, industrial firms, and commercial enterprises that create a complex web of interests among firms. This multiplicity norm regarding alliances in Japan creates denser networks. Gerlach (1992b) maintains that the existence of highly visible clique-like patterns based on inter-organizational alliances, or keiretsu, is one of the major characteristics of the Japanese economy.

Japan is not the only country that has a keiretsu-like cooperation arrangement; many countries in the Asia Pacific region exhibit such norms of cooperation, in the form of Chaebol in South Korea and business groups in other countries (Dacin & Delios, 2005), which vary from the norms of networking in the western world (Hamilton & Biggart, 1988). Ouchi (1981) admires Japan for its between-firm cooperation and argues that firms in the US rarely trust each other enough to form such inter-firm relationships. Lincoln et al. (1996) argue that American firms exhibit fewer grouping patterns around elites and major banks than their Japanese counterparts do. We can conclude that the general structure for the inter-firm networks in US tends to have moderate density and less centrality.

In general, Hagedoorn (2006) argues that there are international differences

regarding the propensity to engage in alliances and build networks. These differences in cooperative tendencies lead to different inter-organizational network structures around the world. In the following sections, I propose the factors that I believe to affect the network structure of firms. I also explain the logic behind the model that I proposed earlier.

CHAPTER 2: CONCEPTUAL FRAMEWORK

2.1. Factors Affecting Network Structure

Inter-organizational relationships are "inherently" and "inescapably" multilevel phenomena because organizations are nested within dyadic relationships that are nested within networks of organizations, which in turn are nested within industries, national economies, and cultures (Klein et al., 2000b). As such, this study adopts a multilevel model that uses broad societal characteristics to explain the variation of network structures as a firm-level construct. The variables of the study will span two levels of analysis: i) country-level variables that include institutional profiles as the independent variables and resource availability as the mediating variables and ii) firm-level variables that include ego network density as the dependent variable.

The major challenge for this study is to determine the factors that affect network structure. Since there is no clear model concerning these factors in the literature, we will attempt to explore the forces affecting changes in structure. Network structure represents regular patterns of interaction between actors (Anderson et al., 1999). The most dominant regular pattern of interaction between organizations is the formation of strategic alliances (Hitt et al., 2007), indicating that alliances are the building blocks of networks. Thus, many of the structural measures of a network can be changed by simply adding new ties and alliances. For instance, adding a new alliance to a central firm might increase its centrality measure. Also, having new alliances between a firm's partners might significantly reduce the value of the firm's measure of structural holes. We can therefore conclude that factors affecting alliance formations would significantly influence their overall configurations and network structures.

As the literature suggests, alliance formation can be explained under two broad classifications: social and strategic (Eisenhardt & Schoonhoven, 1996). The strategic explanation emphasizes why firms form alliances, while the social explanation concentrates on general factors that affect the opportunities for establishing alliances (Eisenhardt & Schoonhoven, 1996).

This research utilizes the strategic and social explanations to understand the formation of alliances that affect network structure. This view is supported by Koka et al. (2006) who emphasize that network structure is shaped by both the strategic action of organizations and other environmental influences. In particular, this study argues that organizational action in terms of alliance activities is best explained by the resource procurements that are presented by resource dependence theory and the environmental effects that are presented by institutional theory.

Resource dependence theory has been one of the major theories advancing the strategic explanation of alliance formation (Baum et al., 2003). From a resource dependence perspective, firms enter into alliances to secure resource procurements and to reduce uncertainty (Pfeffer & Salancik, 1978). On the other hand, the social explanation of alliances revolves around the institutional view of alliances. From the perspective of institutional theory, alliances are formed to obtain legitimacy in order for firms to have greater access to needed resources and support from the environment (Oliver, 1990). Dacin et al. (2007) provide five types of legitimacy that firms try to acquire through alliances. These types are market, relational, social, investment and alliances legitimacy, and firms enter into alliances to satisfy one or more of these types of legitimacy.

Since the main purpose of this research is to compare the structure of networks

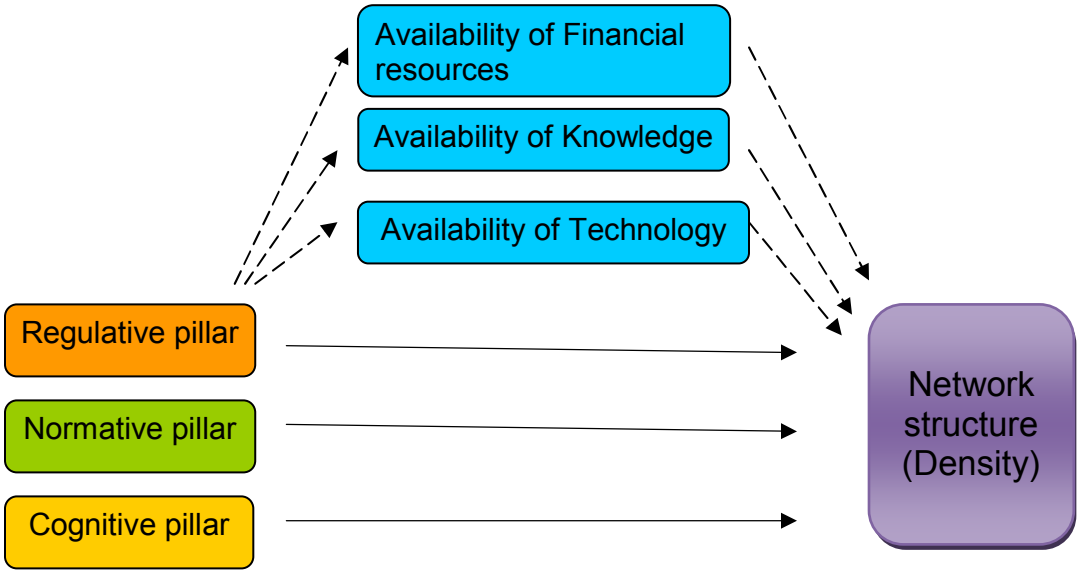
among countries and explain the factors that affect these structures, it is important to use constructs that are comparable across countries. Resource dependence theory can provide such constructs like the availability of resources, which varies among countries. By contrast, all other strategic explanations of alliance formation, such as transaction cost economies (e.g. Ireland, Hitt & Vaidyanath, 2002) or the resource based view (e.g. Chung et al., 2000), provide firm-level constructs that render it difficult to compare country-level factors affecting network structure. Institutional theory can also provide the institutional profile (Kostova, 1999) as a comparable construct that varies across countries.

Combining the institutional theory and resource dependence theory in a single study is a common feature in the literature. Greening and Gray (1994) argue that the variability in intra-organizational structures can be explained by using institutional and resource dependence theories. Oliver (1990) presents a framework that is considered as a standard reference for the causes of alliance formation in which she indirectly explains how institutional and resource dependence theories help to identify a range of strategic and tactical responses to the institutional environment. She suggests six comprehensive determinants that can be subsumed in one of the two theories; for institutional theory, these are: i) necessity and ii) legitimacy, and for resource dependence theory they consist of: iii) asymmetry, iv) reciprocity, v) efficiency, and vi) stability.

In conclusion, institutional theory and resource dependence theory can work together in serving as a sufficient basis for explaining network structure. Accordingly, the following is a quick review of the two theories, focusing in particular on their relationships with inter-organizational networks. The general model of this study is

presented in figure (1)

Figure 1: The general model of the research



2.2. Institutional Theory

In his review of institutional theory, Scott (2005) argues that institutional theory emphasizes the process by which structures, rules, norms, and routines become established as authoritative guidelines for social behaviour. It investigates how these norms and routines have been created, diffused, and adopted over space and time. He also points out that institutional theory is concerned with how norms and rules fade away and their authoritative power declines through the process of institutional change. Institutional theorists try to explain actions that cannot be explained by economic and strategic tools, and they "emphasize the extent to which firm behavior is compliant, habitual, unreflective, and socially defined" (Oliver, 1997: 699).

A more specific definition of institutional theory highlights how the social framework in which a firm operates shapes its economic choices (Oliver 1997). Firms

comply with industry norms in order to gain legitimacy, which is defined as "a generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions" (Suchman, 1995:574). Legitimacy is considered vital because it can be a resource for gaining other resources **(**Zimmerman & Zeitz, 2002**).** To gain legitimacy, firms are under pressure to act alike (DiMaggio & Powell, 1983) and to conform to the environment (Suchman, 1995), which eventually leads to "isomorphic" behavior among firms and creates homogeneity in the field (DiMaggio & Powell, 1983).

Many applications for institutional theory have been proposed in the literature. Thus, some scholars advocate for the introduction of an institutional based view to the domain of strategy to complement the already existing industry and resource-based views (Peng, 2002; Peng et al., 2008). The institution-based view is a response to the criticism of ignoring the importance of context (Peng et al., 2009). The view considers the strategic choice of an organization as a result of its dynamic interactions with institutional environments (Peng, 2002). The two core propositions of the institutional based view are that: i) strategic choices are taken within the formal and informal constraints of an institutional environment and that ii) informal institutions can reduce uncertainty and provide guidance and legitimacy where formal institutions are missing (Peng et al., 2009).

Drawing on institutional theory, the construct of a "country's institutional profile" captures the institutional characteristics of a national environment (Kostova, 1999). "A country's institutional profile reflects the institutional environment in that country defined as the set of all relevant institutions that have been established over time, operate

in that country, and get transmitted into organizations through individuals" (Kostova, 1997: 180). An institutional environment is composed of three pillars: i) the regulative, ii) the normative, and iii) the cognitive (Scott, 1995). The regulative pillar emphasizes the laws and rules that constrain and regulate behaviors. The normative pillar includes values and norms that specify how things ought to be done by defining goals and objectives and the appropriate ways to pursue them, what North (1990) calls the "rules of the game." Finally, the cognitive pillar represents the widely shared social knowledge and cognitive categories (e.g. schemas and stereotypes) that people hold regarding specific phenomenon (Scott, 2005).

Based on the institutional profile argument, the construct of "institutional distance" has been introduced to overcome the problems stemming from the construct of "cultural distance" (Kostova, 1999). "Institutional distance is the extent of similarity or dissimilarity between the regulatory, cognitive, and normative institutions of two countries" (Xu & Shenkar, 2002: 608). Institutional distance has been used to explain many factors related to MNCs, such as their implementation and internalization of strategic practices (Kostova, 1999; Kostova & Roth, 2002) and FDI decisions (Chan V Makino, 2007; Xu & Shenkar, 2002).

The relationship between institutional theory and inter-organizational networks has received a good support in the literature. For instance, institutional factors are portrayed as the main determinants of alliances and network formations (Dacin et al., 2007; Oliver, 1990; Peng and Zhou, 2005). Oliver (1990) suggests two institutional determinants of alliance formation: i) necessity and ii) legitimacy. The former explains that a firm establishes linkages with other organizations to meet legal or regulatory

requirements (Oliver, 1990), while the latter emphasizes that a firm participates in alliances to gain legitimacy by improving its reputation, image, or exhibiting congruence with the prevailing norms of its institutional environment (Oliver, 1990).

Another connection between institutional theory and networks has been proposed by Dacin et al. (2007) who connect legitimacy and alliances in a single framework, proposing that there are many types of legitimacy objectives in alliance formation and that these play an important role in yielding significant technical benefits for firms and their alliances. Peng and Zhou (2005) present a different angle on the relationship between institutional theory and network structure and argue that institutional transition affects the network structure of firms in emerging economies. They suggest that business networks in Asia do not only differ in strength but also in content, highlighting how their evolution is driven by the impact of different dimensions of institutional transitions.

The problem with the literature combining institutional theory and networks, however, is that there are few empirical attempts to clearly support this relationship. There are few noteworthy exceptions, nonetheless. For instance, Neuman, Davis and Mizruchi (2008) have conducted an empirical investigation on the board interlock networks of the US banking industry and found that institutional factors play a significant role in shaping network dynamics. They argue that the diminishing centrality of banks is partially a result of institutional pressure to reduce the size of boards.

In this research, I connect institutional theory and networks by arguing that the institutional profile of a country can be considered as a major factor affecting network structure. I use the institutional profile of a country because it captures all three dimensions of the institutional environment that affect firms. Many institutional studies

concentrate solely on the regulative aspects of institutions, especially those that are based on neo-institutionalism in economics (North, 1990). However, consideration needs to also be given to the normative and cognitive pillars of a country because they have a great influence on networks, as relationships within networks reflect the norms and knowledge of cooperation in that country.

Accordingly, my study argues that network structures not only vary because of the differences in the regulative aspects of national institutions but also because of their normative and cognitive aspects. As a hypothetical example, I expect that the network structure in China will still differ from that of the UK, even if regulations in China become similar to those in the UK. In the Global Competitive Report (2007-2008) (Porter et al., 2007), UK scored 5.8 on the "efficiency of legal system" measure and ranked 14 among the 131 countries listed, while China scored 3.6 on the same measure and ranked 71. There is a clear difference in the strength of the regulative systems of these two countries, which might explain the differences in their network structures. I thus argue that even if China has a regulative system as strong as that of UK, both countries would continue to have different network structures. This is because, aside from strength of regulation, the knowledge base and norms that have been institutionalized in the Chinese environment favor obtaining resources through networking rather than through mergers and acquisitions.

The study of institutional profiles in the literature can be practice specific (e.g. practices of quality management in Kostova and Roth, 2002), or domain specific (e.g. the domain of entrepreneurship in Busenitz et al., 2000). I will consider the institutional profile to be domain specific, and the domain will be inter-organizational cooperation

(regulatory rules about the cooperative activities of firms and distribution of resources, the social norms and values about cooperative activities of firms and how firms should obtain their needed resources, and the shared social knowledge that people hold regarding cooperative activities of firms and how firms should secure resources). Below, I explain the expected relationship between each pillar of the institutional profile and network structure with examples from the literature.

2.2.1. The regulative pillar

Factors related to government intervention, the type of rules, and the strength of the legal system will be relevant to the discussion about the regulative pillar because they clearly affect the domain of inter-organizational relationships. The literature suggests that government actions affect firms' strategies. In a review of the influence of government on organizations, Pearce et al. (2009) conclude that a government's stance with regards to organizational intervention has fundamental effects on organizational strategies, and the more attention governments devote to the strategies of independent organizations, the more likely government priorities are to shape managerial strategies. Since alliances and networking are an important part of firms' strategies, it is reasonable to propose that the regulations, laws, and rules of a country will affect the cooperative tendencies of firms.

There are many examples to illustrate how governments shape the structure of networks in their countries. Some governments directly impose policies that affect firms' networking activities. For instance, the US government interferes relatively little with the economic activities of firms (Spencer et al., 2005), and it does not deliberately impose cooperation between firms, meaning that this kind of government plays a minimal role in shaping firms' cooperative activities and the structure of their networks. On the other

hand, governments of countries like Japan show more involvement in firms' economic activities (Spencer et al., 2005), and they intentionally force firms to cooperate, eventually affecting the structure of their networks.

Governments can encourage collaboration by establishing research partnerships between firms and direct public funding for such partnerships. Sakakibara and Dodgson (2003) claim that the governments of Japan, South Korea, and Taiwan participate in and support the establishment of Strategic Research Partnerships. Similarly, Spencer (2003) provides the example of Japanese government policies that bring firms together in research consortia to accelerate the development of LCD, plasma displays, and other technologies.

The Helmholtz Association of German Research Center is an example of government support for collaborative activities among firms. This center is sponsored by the German government with an annual budget of approximately 3.3 billion Euros, and it consists of 17 scientific-technical and biological-medical research centers that collaborate with each other (Helmholtz Association, 2011). The creation of such partnerships and consortia influences network structures because it strengthens ties between firms and increases the density of their networks.

Some governments enforce cooperation between firms by awarding government contracts to consortia as opposed to single contractors. Such a policy encourages firms to cooperate and to become familiar with one another. The familiarity and trust that arise between partners will increase the probability of their future involvement in strategic alliances (Gulati, 1995). These new alliances increase the density of the networks because they add more ties.

The effect of governments on network structures is not restricted to promoting cooperation, but they are also involved in preserving the existing ties between firms. For example, Hamilton (1996) asserts that the states of Japan and South Korea play considerable roles in supporting the maintenance of their network-integrated economies.

In addition to direct intervention in the networking decisions of firms, governments can propose rules that have a significant influence on firms' cooperative tendencies. Ownership laws are a very important example of these rules because, as part of the institutional environment, they affect the entry mode of foreign MNCs (Davis et al., 2000). In many countries such as China, governments restrict the foreign ownership of local firms. These restrictions force foreign MNCs to choose alliances as their preferred entry mode into local markets. The waves of international partners, in turn, change the cooperation dynamics between local firms by adding new links to the existing network, consequently affecting the structure of networks in that country.

Arrighetti, Bachmann, and Deakin (1999) argue that the institutional framework for exchange, as constituted by the system of contract law, has a significant effect on the contractual agreements among firms. In a comparison between the UK, Germany, and Italy, Arrighetti et al. (1999) found that the contract law doctrine in Germany and Italy formally places greater stress on the value of cooperation than is the case with British common law.

Gerlach (1992) proposes a strong argument that American regulations encourage firms to perform fewer alliances and more acquisitions. He states that "since American law has taken a far more relaxed attitude toward transactions within vertically integrated firms, firms in the United States have sought to use full-scale acquisition to internalize

many strategic business operations that their Japanese counterparts manage through inter-firm transactions" (1992: 24). If the regulative environment in a country supports more cooperation between firms, the number of ties among firms will be higher, which means higher network density in that country. Furthermore, in response to his question, "Why are network arrangements so common in some nations and some actors and not others?" (327), Powell (1990) suggests that state policies dictate the easiness with which firms cooperate.

In addition to the type of regulative system and government interference, the strength of the legal system is also an additional factor affecting a country's network structure. As described in the Global Competitiveness Report (Porter et al., 2008), countries with strong legal systems have stronger intellectual and property right protections, more efficient legal frameworks, more transparency in government policymaking, and stronger auditing and reporting standards. On the other hand, countries that have weak legal systems are characterized by inefficient formal conflict resolution, a lack of adequate disclosure, and erratic law enforcement.

Khanna and Palepu (2000) argue that business groups, as dense networks, can compensate for institutional voids in emerging economies. Close relationships within dense networks create and develop common routines and shared meanings, which enhances trust and curbs the opportunistic behavior of firms (Coleman, 1988). In dense networks, any deviation from the shared norms of trust is highly punished by the group. Moreover, dense networks reduce the probability of unethical behavior because information about ethical wrongdoing is easily circulated within the network (Soda et al., 2004). Coleman (1988) emphasizes this point by arguing that dense networks provide

close monitoring opportunities for the behavior of an individual firm by group members. The combined effect of the trust norms and close monitoring may compensate for the need for strong legal systems to resolve business conflicts.

Weak regulative environments increase the level of uncertainty, which can be defined as the lack of information in an environment, given a specific decision-making scenario (Dess & Beard, 1984). When an organizational environment, or a particular component of that environment, is perceived to be unpredictable, we experience what Milliken (1987) calls "state uncertainty." He asserts that state uncertainty means one does not understand how an environment's components might be changing, and actors are unable to predict the future behavior of key competitors or the government (such as the inability of firms to predict whether Congress will deregulate their industry).

McKelvie et al. (2008) propose that uncertainty can emerge from a lack of information about a particular environment. The regulative environment of a country directly affects the availability of information about the different industries. To summarize, countries with more articulated and stronger legal systems have less environmental uncertainty for many reasons. Chief among these are that: i) the actions of government are more predictable, ii) the availability of information is high, iii) government is expected to ease any external causes of uncertainty, and finally, iv) firms have more formal mechanisms to cope with uncertainty.

As the foregoing discussion suggests, firms participate in denser networks in the case of unstable environments by seeking to build more alliances, the building blocks of networks, to cope with greater uncertainty (Baum & Oliver, 1991). For example, joint ventures were the preferred mechanism used to cope with environmental uncertainty in

Hong Kong from the 1976 to 1986 period (Gilbert, 1996). Thus, under conditions of general uncertainty, firms tend to reinforce their existing affiliations (Beckman et al., 2004), leading to denser networks. Moreover, Nohria and Garcia-Pont (1991) emphasize that strategic blocks act similarly in the case of shocks; the denser the ties, the less the effect of uncertainty is. Schilling and Phelps (2008) argue that when the industry environment is characterized by uncertainty, firms are encouraged to form more alliances, leading to a majority of firms in the industry being actively engaged in alliances and to a higher rate of alliance activity per firm. In summary, weak legal systems (low score on the regulative pillar) encourage firms to build denser networks in order to offset the lack of legal order and to make the environment more predictable by reducing uncertainty.

In conclusion, a country that has an efficient and more articulated regulative system is more likely to have a high score on the regulative pillar of its institutional profile. In general, such countries are characterized by less environmental uncertainty and greater economic freedom. In addition, networks in these countries will tend to have less density.

> ***Hypothesis 1****: The lower the score on the regulative pillar of a country's institutional profile, the greater the density of the network structure in its biomedical industry.*

2.2.2. The normative pillar

In addition to the effect of the regulative institutional environment on inter-organizational relationships, the normative and cognitive institutional environments are expected to play a similar role in affecting relationships between firms (Arrighetti et al.,

1999). Dei Ottati (1994) argues that formal and informal institutions complement each other in creating an economic and social environment in which constructive forms of cooperation can be created among firms.

This study argues that the values and social norms that people hold regarding cooperation among firms (networks) will affect how firms cooperate and the number of alliances they initiate. This tendency toward more alliances will consequently affect the network structure of the industries in that country. Dacin et al., (2007) highlight how some industries lack a history of using alliances as a strategic choice and how many of the firms in such industries have tended to limit their business activity to pure competition, acquisition, or diversification. In these industries, alliances are not a legitimate strategic option (Dacin et al., 2007), which means far fewer alliances and looser network structures.

In comparison to other industries, the biomedical industry is characterized by norms of cooperation. Powell et al. explain the networking tendencies in that industry by stating that "when the knowledge base of an industry is both complex and expanding and the sources of expertise are widely dispersed, the locus of innovation will be found in networks of learning, rather than in individual firms" (1996: 116). Even though the norms of cooperation are prevalent in the biomedical industry in general, it is expected that the strength of these norms will vary among countries.

A country's collaboration norms are usually a result of its historical path, an important example being the economic system for recovery after World War II. For instance, with regards to the norms of alliance formation in Japan following the war, Keiretsu groups reflect the prewar period's alliance patterns, i.e. Zaibatsu groups

(Gerlach, 1992b). Keiretsu groups continue to dominate the Japanese economy today (Gerlach, 1992b). The domination of Keiretsu groups has even more intensified because they are considered to be a defensive mechanism against new comers to the Japanese market (Gerlach, 1992a).

One important norm that affects network structure is the prevailing views on competition. Spencer (2003) advocates that the ideology of business practices in some countries supports competition among firms, leading to less density in the networks of knowledge sharing. In general, if the norms of an industry are concentrated around partnerships, the number of alliances and ties among firms will increase, which magnifies the density of networks within that industry.

Not only do competition norms vary among industries, but they also differ among countries. Ingram and Yue (2008) argue that different countries have different views of cooperation vs. competition. These norms establish the optimal path for firms to follow for securing needed resources. The propensity toward competition in a country encourages firms to obtain their needed resources by either arm-length contracts or through acquisitions, which in turn reduces the country's network density. On the other hand, the tendency toward cooperation increases the social trust and encourages firms to obtain their resources through networking, leading to higher network density.

Powell (1990) indicates that U.S. firms were historically more hesitant to engage in collective industrial research than the Japanese and Europeans. He asserts that Americans view collective research as a "form of collusion and as seedbed for anticompetitive practices" (1990: 317). He also emphasizes that U.S. firms have been reluctant to share their best scientists and most attractive projects even though they have a

shared view about the importance of collaborative R&D in adapting to the changing nature of technology development. Similarly, Garud and Karnoe (2003) point out that in the wind turbine industry, actors in Denmark show greater commitment to their interactions with one another, while their American counterparts exhibit a lower quality of interaction due to the antagonistic attitudes between competitors. Spencer (2003) explains these differences between the tendencies of Danish and US firms to share information by suggesting that the corporatist norms in Denmark support more cooperation and knowledge exchange between competitors than the associational norms of the US.

Spencer (2003) advocates the existence of two conflicting national political institutional structures, namely pluralist and corporatist. In corporatist countries like the Scandinavian countries and Japan, national interest groups participate in the decision-making structure of the state, while in pluralist countries, like the US, UK, and Australia, independent interest groups that target specific issues are the norm (Wiarda, 1997). Spencer et al. (2005) argue that countries with pluralist norms tend to have more competition between firms and less cooperation between competitors. Societies with corporatist norms, on the other hand, tend to have more collaboration and mutual adaptation among competitors while they compete for market share. More collaboration among firms in corporatist societies means more ties and greater network structure density.

Another collaboration norm that can affect a country's network structure concerns industry-university collaboration. The collaborations between universities and firms bring complementary resources to both parties. University research centers have access to

intellectual resources and advanced infrastructure; industrial firms, on the other hand, have practical expertise, financial resources, internship opportunities for students, and employment opportunities for graduates and students (Santoro & Gopalakrishnan, 2000). Thune (2007) argues that in some technology intensive industries such as biotech, there is a greater tendency for industry-university collaboration.

Santoro and Gopalakrishnan (2000) argue that the knowledge transfer activities between industrial firms and universities can be institutionalized within firms. I argue that this norm can be institutionalized at the country level as well. In support of this argument, van Beers, Berghall, and Poot (2007) indicate that Finland's norms exhibit a greater tendency for networking and the integration of firms and universities into a national innovation system than the Netherlands. The norms of industry-university collaboration in a country will increase the number of collaborative activities and, consequently, the density of its networks.

Another example of industry-university collaboration is the establishment of scientific parks. These types of parks contain many types of companies in addition to university spinouts. Many of these parks function under university supervision. One such park is Nottingham's BioCity, which is one of Europe's largest bioscience incubators that hosts over 70 companies. BioCity is the result of an effective collaboration between Nottingham Trent University, The University of Nottingham, and the East Midlands Development Agency. It includes many new startups, established SMEs, international companies, and university spinouts (BioCity Nottingham, 2011). Such scientific parks foster greater collaboration between industry and universities and between the companies within them, increasing a country's network density.

The normative pillar of inter-organizational relationships emphasizes that the norms of cooperation prevail in specific countries. At the individual level, some countries will have individuals who are integrated into strong cohesive groups; these individuals have longer and more intimate social interactions (Gelfand, Bhawuk, Nishii & Bechtold, 2004). The tendency toward greater collective action is well documented in the cross-cultural literature as collectivism (e.g. Hofstede, 1984; Kim et al., 1994; Triandis, 1995). Hofstede (2001) explains that collectivistic societies are characterized by strong and cohesive ties, while individualistic societies are characterized by looser ties among individuals.

Culture can be defined as "the collective programming of the mind that distinguishes the member of one group or category of people from another" (Hofstede, 2001:9). How societal culture can affect the strategy of firms, particularly in terms of alliances for the purposes of our research, can be justified by many theoretical explanations, notable of which is cultural immersion theory which suggests that people from the same culture share the same schemas that are reflected in their organizations (Dickson et al., 2004).

While there remains a heated debate over the use of culture as a component for measuring countries' institutional profiles, this practice is being increasingly adopted (e.g. Ang & Michailova, 2008; Parboteeah et al., 2008). For instance, Scott (2001) provides three institutional pillars, of which the third is the "culture-cognitive pillar." He argues that the internal interpretive processes that constitute the frames through which meaning is made are shaped by external cultural frameworks. This supports the argument that the attitude of managers and the strategic orientation of their firms are shaped by a

society's collectivistic culture. Thus, in support for their utilization of culture as a main component of the normative pillar, Parboteeah et al. (2008) argue that Busenitz et al.'s (2000) conceptualization of the normative aspect of a country's institutional profile is similar to the concept of national culture.

In order to consider the normative/cultural dimension, Parboteeah et al. (2008) follow Kostova's (1997) recommendation to use only those elements that the theory considers most relevant to the issue under investigation. In this research, the dimension of collectivism is strongly relevant to the cooperative orientation of organizations. Kumar and Das (2011) choose to use the construct of collectivism vs. individualism to the exclusion of any other cultural constructs in explaining the link between culture and legitimacy management in international alliances. They argue that collectivism has direct implications for how partnering firms embedded in different cultures view partnerships.

There are a few works that attempt to connect network research to culture. For instance, Rowley and Baum (2008) have compared the findings of Conyon and Muldoonof (2008) regarding the mechanisms of tie formation and termination in the UK with previous research about these interlock networks in the US and Germany. They noticed real differences between these networks and suggest that these differences could be attributed to cultural variations.

In this research, culture can be a major component of the normative pillar as well as the cognitive pillar. For the normative pillar, the "practiced" collectivism as presented in the GLOBE study (Gelfand et al., 2004) will be used since it represents the actual norms of collectivism, while the "value" collectivism will be used in the cognitive pillar because it represents the knowledge about collectivism. The collectivistic attitudes of

individuals in these countries will be reflected in their decisions to establish greater ties and alliances.

The construct of collectivism (as an opposite dimension to individualism) has received much attention in the literature, with about 1400 studies using this construct over a 25 year period (Gelfand et al., 2004). Collectivism explains the nature of the relationship between the individual and the group (Gelfand et al., 2004). The GLOBE study differentiates between two types of collectivism. The first type is institutional collectivism, which is defined as "the degree to which organizational and societal institutional practices encourage and reward collective distribution of resources and collective action" (Javidan, House, & Dorfman, 2004: 30). The second type is the in-group collectivism or "family collectivism" (Brewer & Venaik, 2011); this is defined as "the degree to which individuals express pride, loyalty, and cohesiveness in their organizations or families" (Javidan et al., 2004: 30).

Hofstede (1980) describes individualistic societies as societies in which the ties between individuals are loose and an individual is expected to look after himself and his direct family. Collectivistic societies, on the other hand, are characterized by strong and cohesive ties among individuals. The distinction between in-group and out-group is a major characteristic of collectivistic individuals (Triandis, 1995). Therefore, it can be argued that collectivistic societies tend to have individuals who are integrated into strong cohesive groups, and individuals in such societies are more likely to have longer and more intimate social interactions (Gelfand et al., 2004). While the construct of collectivism has been studied on three levels of analysis, namely societal, organizational, and individual (Gelfand et al., 2004), this study concentrates on societal level

collectivism because it is an attempt to detect the effect of country level factors on the network structure.

In summary, countries that have a high score on the normative pillar tend to value collaboration more than competition, have higher university-industry collaboration, and have a high score on practiced collectivism. Firms in countries that have a high score on the normative pillar will have greater collaboration, which increases the number of ties in their networks and, consequently, the density of these networks.

> ***Hypothesis 2****: The higher the score on the normative pillar of a country's institutional profile, the more the density of the network structure of its biomedical industry.*

2.2.3. The cognitive pillar

In the literature, the cognitive pillar is presented either as a knowledge, from a value perspective, of a certain phenomenon (e.g. Kostova, 1997), or as the institutions that foster the creation and diffusion of knowledge (e.g. Parbooteah et al., 2008). In the former case, the cognitive pillar includes the elements of society that have a 'taken for granted' nature (Kostova, 1997). For instance, Parboteeah et al. (2009) adopt the value perspective of knowledge by identifying five items that reflect belief in religion as the component of the cognitive pillar. In contrast, Parbooteah et al. (2008) followed the latter definition of the cognitive pillar by including the educational system as a major component of the gender equality's cognitive pillar.

In this research, the cognitive pillar will reflect the knowledge of inter-organizational cooperation from a value perspective. This is due to the difficulties of identifying the institutions that create and transmit the knowledge of cooperation between

firms. Consequently, the cognitive pillar will be defined as the widely shared social knowledge and cognitive categories (e.g. schemas and stereotypes) that people hold (Scott, 2005) in regard to cooperation and alliances which affect the network structure in their country. The assumption here is that firms in some countries know how to cooperate, while in other countries, the knowledge of cooperation is not as widely available. In the former countries, we can recognize higher levels of social trust and lower levels of social loafing and opportunistic behavior. Social loafing refers to the reduced performance of individuals who act as part of a group rather than alone (Earley, 1989). In other words, firms in countries that score high on the cognitive pillar show more cooperation with other firms and exhibit less opportunistic behavior toward their partners.

As discussed concerning the normative pillar, culture is a component of the cognitive pillar. The valued collectivism construct will be the cultural variable, and it measures the "should be" form of collectivism. This construct concentrates on how respondents perceive and value personal relationships and family achievements. In countries with a high score on collectivism values, people learn more about how to cooperate at the individual and organizational levels. This knowledge of cooperation will encourage managers to perform more collaborative activities among their firms, which results in more alliances and denser network structures.

In addition to collectivism, views on friendship can be considered as a component of the cognitive pillar because valuing personal relationships would, most probably, result in placing greater emphasis on inter-organizational relationships. The analogy or the mutual effect of collectivism and personal friendships on inter-organizational

relationships can be explained by the notion of "macro organizational psychology" (Staw, 1991; Staw & Sutton, 1993). According to Straw and Sutton, "This area comprises theory and research that uses psychological constructs, especially constructs reflecting individual cognitions and emotions to explain the attribute and behavior of organizations" (1993: 370). In other words, "macro organizational psychology" explains how micro models can be used to explain macro actions. Accordingly, this study uses personal friendships to explain the macro action of inter-organizational relationships.

It is widely accepted that personal connections have a considerable influence on network formation. For instance, Larson (1992) indicates that the entrepreneurial personal relations of owners affect the tendency of their firms to establish networks. Eisenhardt and Schoonhoven (1996) also maintain that previous and current managerial connections are also shown to affect network formation. More specifically, Rosenkopf et al. (2001) found that middle management connections exhibit a considerable effect on network formation. In brief, societies that value collective actions and their residents value group achievements over individual ones are more likely to have greater collaboration between organizations as a reflection of the collaboration between individuals. In these societies, inter-organizational networks are typically characterized by density, which reflects the density of their individual networks.

Trust is also a major component of the cognitive pillar because it can be considered as a cognitive construct (Johnson & Grayson, 2005) and significantly affects the formation of organizational alliances (Gulati, 1995) and alliance performance (Zaheer et al., 1998). Inter-organizational trust can be defined as an organization's assumption that another firm will not act opportunistically (Bradach & Eccles, 1989).

The role of trust in alliances is explained according to different rationales in the literature. Gulati and Nickerson (2008) argue that trust between partners reduces transaction costs along with greater information exchange between partners; trust also facilitates problem solving and joint commitments, which enhance exchange performance (Gulati & Nickerson, 2008). Arrighetti et al. (1999) conclude that trust plays an important role in offsetting asymmetries of power between contracting parties, promoting stability in trading relationships, which in turn increases the tendency for collaboration between firms. If we accept that trust affects the governance arrangement between partners (Gulati 1995), we can conclude that the level of trust in a country will affect the knowledge of cooperation between firms in that country.

Studies have shown that trust has a significant influence on network structures too. For instance, Baum et al. (2010) argue that trust is an antecedent and a consequence of network density. Gulati and Nicherson (2008) also argue that inter-organizational trust will affect the strength of ties (make, ally, or buy) between partners. Partners usually participate in stronger forms of collaboration after accumulating trust through incremental small exchanges (Larson, 1992). Trust is very important for inter-organizational relationships because it enhances exchange performance (Gulati & Nicherson, 2008) and is the mechanism by which the benefits of knowledge transfer are recognized (Levin & Cross, 2004).

The prevalence of trust norms in a country will encourage firms to have more collaborative agreements as a means of expanding or having access to resources as opposed to expanding through acquisitions. This is because trust is an initial condition for the establishment of alliances and networks (Gulati, 1995). In support of this argument,

Ouchi (1981) argues that the lack of trust among American firms discourages them from having many inter-firm relationships similar to those of Japan. Therefore, we argue that countries that have high levels of trust tend to have more alliances, which increases the density of networks in these countries.

In conclusion, countries that place greater emphasis on collectivism, personal relationships and friendships, and appreciate the value of trust are more likely to have a higher score on the cognitive pillar of their institutional profiles. A higher score on the cognitive pillar might result in more knowledge fostered on collaboration at the individual and organizational levels. Such countries are expected to see more alliances and inter-organizational relationships, increasing their network density.

> ***Hypothesis 3:*** *The higher the score on the cognitive pillar of a country's institutional profile, the greater the density of the network structure of its biomedical industry.*

2.3. Resource Dependence Theory

Relying on the models of power (Blau, 1964) and the argument of buffering the technical core (Thompson, 1967), Resource Dependence Theory (Pfeffer & Salancik, 1978) seeks to explore how power and dependence affect organizational choice and how organizations can buffer themselves from dependence and interdependence (Pfeffer, 2005). Pfeffer and Salancik (1978) argue that the survival of an organization is contingent upon its ability to effectively manage the internal demands of the groups upon which it depends and upon its ability to acquire and maintain resources from the external environment.

Pfeffer (2005) proposes three lines of inquiry that cover the resource dependence

literature: i) how resource dependence affects organizational decisions (e.g. how reliance on government funding affects a firm's adaptation to government policies); ii) how external interdependence affects the power mechanisms inside organizations (departments of an organization that help manage external constraints will have more power); and iii) how firms can manage interdependence (many techniques have been proposed such as manipulating regulative bodies, cooptation, mergers, and alliances).

Resource dependence theory helps to explain alliance formation by highlighting that the uncertainty concerning the environment encourages firms to arrange contracts with other firms to guarantee their needed resources, thus establishing inter-firm networks. In support of the resource dependence argument, Pfeffer and Nowak (1976) indicate that inter-organizational linkages have been used to manage the inter-organizational interdependence of American companies engaged in manufacturing and those in oil and gas extraction. Building on resource dependence theory, managing interdependence has been the most common explanation for the emergence of inter-firm networks (Baum et al., 2003). From the previous arguments, we can conclude that firms have to secure resource procurement in order to reduce uncertainty (Pfeffer & Salancik, 1978).

Resource procurement is a major factor that encourages firms to establish networks. Oliver (1990) argues that a firm enters into an alliance to exercise power and control over another organization’s resources. We can identify three types of resources that firms usually seek from their network partners: i) firms establish networks to have access to capital (Lee et al., 2001; Uzzi, 1999); ii) firms participate in networks to have access to partners’ tacit knowledge (Hansen, 1999; Kale et al., 2000; Oxley & Sampson,

2004) and to learn from their partners (Anand & Khanna, 2000; Baum et al., 2000; Kogut 1988; Powell et al., 1996); and iii) firms join networks to have access to technological resources (Baum et al., 2003).

As mentioned above, firms generally enter networks to overcome the uncertainty in their environment by arranging access to their shortage of assets (Nohria & Garcia-Pont, 1991). These assets can be technical assets (Baum et al., 2003), financial assets (Hoshi et al., 1990; Uzzi, 1999); or knowledge of practices and technologies (Baum et al., 2000; Kogut, 1988). Firms usually follow different alliance strategies to obtain these different resources. Using the word "conduit" to describe the function of network ties (e.g. Ahuja, 2000), we conclude that different types of conduits are necessary to properly transfer different resources between allies. Thus, different complementarities result in different types of linkages and, consequently, different network structures.

There is mounting evidence in the literature that firms' network structures affect their abilities to access network-specific resources. For instance, Gulati et al. (2000) indicate that the structure of the networks in which firms are embedded has a great influence on firms' ability to capitalize on their network resources. Hite and Hesterly (2001) also argue that network structure is conducive to firm performance when it is aligned with and addresses a firm's evolving resource challenges. Gulati (1999) proposed the concept of "network resources" to highlight the importance of the resources that a firm can obtain from its network. These resources, in addition to the structures of firms' networks which are unique, can serve as a source of sustainable competitive advantage (Gulati, 1999; Gulati et al., 2000).

2.3.1. Access to knowledge resources and network structure

One of the most cited motivations for strategic alliances is having access to the partner's tacit knowledge and learning new skills. Oxly and Wada (2009) emphasize that alliances are very useful for transferring knowledge, and the structure of alliances (equity JV vs. licensing) plays a big role in this knowledge transfer. Srivastava and Gnyawali (2011) indicate that alliance portfolios (ego network) play a significant role in knowledge transfer and that the quality and diversity of network technological resources contribute to knowledge transfer and the resulting innovation. Moreover, Dagnino et al. (2008) emphasize the influence of the shared context of interaction, i.e. the network structure, on the knowledge generating and disseminating processes.

Complex knowledge cannot be transferred easily; it needs strong cooperative activities to guarantee the efficiency of this transfer (Hansen, 1999) and to speed up the learning process (Kale et al., 2000). Therefore, we see firms enroll in some strong forms of alliance, such as joint ventures, to achieve learning objectives (Oxley & Sampson, 2004). In addition to the strength of ties, the density of networks should have impact on the creation and dissemination of knowledge among network members.

Srivastava & Gnyawali (2011) indicate that the benefit of an alliance network as a source of knowledge will be maximized for less endowed firms, while this benefit is reduced if a firm has high knowledge resource availability. I similarly argue that the need for networks to transfer knowledge will be minimized if knowledge is more readily available in the market or if there are some formal sources such as universities and research centers that can provide knowledge to firms.

In some contexts, knowledge is fairly available and transfer of knowledge is

formal. In certain countries, especially developed countries, there is a significant presence of research institutions that can provide access to scientific developments. The existence of such institutions in certain countries reduces the role of alliances in obtaining this type of knowledge. In those countries, networks will have less density due to the fewer needs for alliance formation.

> ***Hypothesis 4:*** *The greater the availability of knowledge in a country, the lower the density of the network structure of its biomedical industry.*

2.3.2. Access to technological resources and network structure

Related to the availability of knowledge, the availability of recent technologies in a country also affects its network structures. Previous research suggests that joint ventures are effective vehicles for accessing complex technology (Oxley & Wada, 2009). Baum et al. (2003) emphasize that access to technological resources is a main factor that determines the establishment of networks. Anand, Oriani, and Vassolo (2010) indicate that alliances could be the mechanism by which less-endowed firms have access to new technologies that would otherwise be beyond their reach. In the same vein, Stuart (2000) asserts that alliances with firms that possess leading-edge technological resources are the most valuable alliances and that they result in technological transfer and better performance.

More specific to the biomedical industry, Anand et al. (2010) argue that due to the apparent heterogeneity among pharmaceutical firms' biotech technological capabilities, pharmaceutical firms have often used alliances with biotech firms to build new technological competencies. Kogut and Chang (1991) note that joint ventures are the ways through which weaker Japanese' firms have been able to acquire technology.

Furthermore, Rothaermel and Boeker (2008) indicate that pharmaceutical firms initiate alliances with biomedical firms based on their complementarities and that they use alliances to transfer back new technologies. It is widely acceptable that strategic alliances mitigate technological uncertainties (Hagedoorn & Schakenraad, 1994). Alliances help these firms share resources and technological knowledge in order to create new products and technologies (Bessy & Brousseau, 1998).

In many hi-tech industries, knowledge is widely dispersed and it is hard for one firm to have all the knowledge required to achieve the competitive advantage. In these industries, firms are encouraged to establish cooperative ties to develop a knowledge-based advantage (Baum & Rowley, 2008). Baum and Rowley (2008) also argue that the major purpose of cooperative ties, among other things, is to have access to other firms' complementary expertise and novel technological development. They conclude that the establishment of such cooperative ties will result in inter-organizational networks that span and link the entire industry. Therefore, I argue that the role of alliances and networks as a conduit for the transfer of technology is very important in the biomedical industry because it is characterized by innovation and technological change. In this industry, it is hard for any firm to possess the full range of resources, expertise, and knowledge needed to develop new technologies (Teece, 1992).

In conclusion, if certain countries do not have up-to-date technologies available on a large scale, firms are forced to form more alliances to have access to such developed technologies. More alliances lead to denser networks, which lead us to the following hypothesis.

Hypothesis 5. *The greater the availability of technological resources in a*

country, the lower the density of the network structure of its biomedical industry

2.3.3. Access to financial resources and network structure

Another strategic reason for companies to enter into networks is gaining access to financial resources (Uzzi, 1999). Gopalakrishnan, Scillitoe, and Santoro (2008) explain that biotech firms use alliances with pharmaceutical firms to have access to financial capital. They indicate that biotech firms can gain financial capital from alliances with pharmaceutical firms through debt or equity arrangements. Receiving money through alliances with pharmaceuticals not only helps biotech firms to finance their operations but also improves the valuation of small biotech firms (Janney & Folta, 2003).

If capital can be raised from open markets, fewer relational alliances will be required, and, consequently, the networks will be less dense. On the other hand, if the capital is concentrated in the hands of controlling banks or business groups, strong relational alliances are required. In the latter case, networks will be denser with close relationships to capital sources. The relationships with financial institutions are not the only solution to raise capital; firms can have alliances to share the financial burden of new projects. In this case, networks play a substitute role for the less advanced financial market. This role is similar to the role of business groups in developing economies (Khanna & Palepu, 2000).

Hypothesis 6: *The more available the financial capital in a country, the lower the density of the network structure of its biomedical industry.*

2.4. Resource Dependence and Institutional Theory in One Framework

The integration of institutional theory and resource dependence theory essentially

means that organizations exercise strategic choice, but do so within constraints imposed by their institutional environments (Greening & Gray, 1994). In the international business literature, many theorists have argued for more integration between institutional theory and resource dependency theory (Meyer & Peng, 2005; Peng, 2001; Wright et al., 2005; Yamakawa et al., 2008). Meyer et al. (2009) combine the two views to analyze the strategies of foreign investors for entering emerging economies.

To better integrate institutional and resource dependence theories in one framework, we have to understand how each theory describes the environment. Scholars of resource dependence theory concentrate on the "task environment," with less emphasis on the effect of social and state pressures (Oliver, 1991). Moreover, the environment is mainly considered as a source of uncertainty. In a review of resource dependence research, Nienhüser (2008) has found that the major emphasis of that research is on the consequence of power and uncertainty reduction. There is less attention paid to the factors that create power imbalances and to the variation of environmental uncertainty. On the other hand, institutional theory has a broader view of the environment. We can see that the notion of the environment in institutional theory is much broader than that of resource dependence theory. However, there is less emphasis on the micro mechanisms of how institutional theory functions at the organizational level. Therefore, I believe that combining the two theories in one framework will help to reconcile the argument for the conformity of institutional theory and the strategic choice of resource dependence theory (Oliver, 1991), and will give us a better understanding of the structural differences among inter-organizational networks.

Institutions not only present the optimal intra- and inter-organizational structure

that firms should comply with, but they also affect the task environment and limit firm choices. In general, firms can obtain the required resources for their survival by one of three means: i) by buying them from the open market, ii) by acquiring or merging with other firms that possess these resources, and finally, iii) by establishing a network of inter-organizational relations to secure the flow of resources. The institutional environment shapes the distribution of resources in a way that makes some strategic actions, like networking, more rational than other strategic options, such as mergers and acquisitions. If this is the case, the network structure of organizations will be characterized by denser networks with stronger ties among organizations.

The model of this study shows that the relationship between the institutional profile and the network structure is partially mediated by resource availability. Mathieu and Taylor (2006) provide three means to justify the sequence of effects in meditational models: i) experimental design feature, ii) temporal precedence, and iii) theoretical rationale. They argue that the theoretical rationale is the only basis for advancing a particular causal order in non-experimental studies with simultaneous measurements of the antecedents, which is the case for this study.

According to Baron and Kenny (1986), partial mediation can be clarified by showing that all the relationships in a model are significant. More specifically, to exhibit partial mediation, the model of this study should exhibit a significant relationship between the institutional profile and the network structure in addition to a significant relationship between resource availability and network structure. Below, I provide a theoretical argument to explain the order of the mediation relationship.

Aside from the direct effect on network structures, the institutional profile of a

country can have an indirect effect by shaping the availability of resources for the firms operating within it. In other words, we can argue that the institutional environment (especially its regulative pillar) affects the strategies of firms (represented by their network strategies) by affecting the resource availability.

For instance, the strength of property rights directly affects knowledge transfer and the alliances required for that transfer. The networks of knowledge transfer in countries with strong property rights will be less dense because there are formal mechanisms for knowledge transfer, creating weaker ties and more dispersed networks in these countries. On the other hand, transferring knowledge in countries with weak property rights requires strong connections to allow the informal channels to facilitate the transfer of knowledge.

In countries with a deregulated banking sector, the financial capital will be distributed among many actors and extensive alliances are not required. If the banking industry is highly centralized, the economic system will consist of financial institutions taking center stage and all other economic activities evolving around them. Banks will represent central nodes that encourage denser and more intense networks, which is the case in Japan and Germany (Kogut et al., 2003). The existence of financial institutions at the apex of business groups creates certain network structures characterized by density and strong ties. Kogut et al. (2003) argue that there is a relationship between the centrality of banks in Japan and Germany and the establishment of business groups in both countries; they also emphasize the correlation between corporate and non-financial centrality in the US and UK and their weak network structure. Unlike US banks, which are restricted by the Glass-Steagall Act, Japanese banks typically maintain a holding of a

certain percentage of most of their main client companies' stocks; the ability to hold equity and lend capital increases the centrality of banks in Japan (Gerlach, 1992).

Moreover, the strength and the reliability of the regulative system have an influence on the knowledge outcomes in a country. For instance, Allred and Park (2007) observe that in developed economies, the strength of the regulations that organize patents positively affects R&D and domestic patent filings in that country.

Since the institutional profile is domain specific (i.e. inter-organizational cooperation) in this study, I do not expect to see a great influence for the normative and cognitive pillars of collaboration on the availability of resources in a country. Therefore, the mediation effect will be restricted to the regulative pillar of the institutional profile.

Hypothesis 7*: The effect of the regulative pillar of a country on the network structures of its biomedical industry will be partially mediated by the availability of strategic resources in that country.*

Hypothesis 7a*. The effect of the regulative pillar of a country on the network structures of its biomedical industry will be partially mediated by the availability of knowledge resources in that country.*

Hypothesis 7b*. The effect of the regulative pillar of a country on the network structures of its biomedical industry will be partially mediated by the availability of technological resources in that country.*

Hypothesis 7c*. The effect of the regulative pillar of a country on the network structures of its biomedical industry will be partially mediated by the availability of financial resources in that country.*

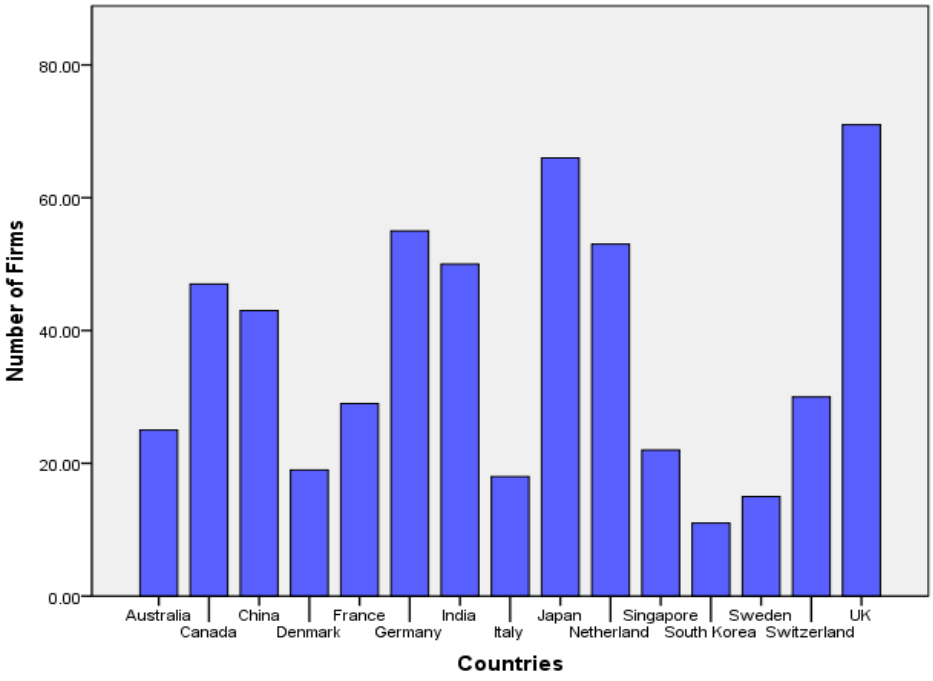
CHAPTER 3: PILOT STUDY

Before executing the actual study, a pilot study was conducted to test the research design and various aspect of the research methodology for the proposed model. Another purpose of the pilot study was to find out more about the validity of measures for each variable as well as if there is a cross country variation among the networks of the biomedical industry, which can support the first research question.

The network data for the pilot study was collected from the SDC Platinum database, which lists all joint ventures and strategic alliances worldwide for many sectors that include many biotechnology industries. The network in the pilot study included the alliances between biomedical firms in 38 countries during the period of 2005-2007 (three years). Constructing the network for a timeframe of three years is a common practice in inter-organizational network research (e.g. Schilling & Phelps, 2007).

After establishing the global network, it turned out that some countries were represented by just one or two firms (e.g. Brazil, UAE, and South Africa); which means that there is no real network of the biomedical industry in these countries. We, therefore, excluded these countries from the final dataset. USA is also excluded because there is a high coverage for firms from US which posts a problem of bias toward US firms' characteristics. After excluding the countries with low coverage and USA, we ended up with 15 countries. These countries are: Australia, Belgium, Canada, China, India, Italy, Germany, France, Japan, Netherlands, Singapore, South Korea, Sweden, Switzerland, and UK. The network measure was calculated for 554 firms from these 15 countries. Figure (2) summarizes the number of firms that have been included in the pilot study.

Figure (2): Number of firms in each country that are used in the pilot study



3.1. Pilot Study Methodology

The dependent variable in the pilot study is network structure, more specifically global network density. To calculate structural measures, symmetric (non-directional) matrix was constructed (Wasserman & Faust, 1994). The measures then calculated by using the UCINET software (Borgatti et al., 2002). First, the global networks of the biomedical industry were constructed and then by using the extracting command in the software, the network for each country was isolated. The individual network for each country was used to calculate the network density of that country.

Two different measures of network density were used in the pilot and actual studies because of the significant difference between their sample sizes. In the pilot study, the density is a country level measure that indicates the density of the overall biomedical network in a country. This density is measured by the number of actual ties

between all organizations in an industry divided by the number of possible ties in a network (Gulati & Gargiulo, 1999; Shipilov, 2006). In the actual study, however, the density is a firm level variable, which measures the density of the ego network of each firm in a country.

In the pilot study, the original attempt was to use the ego network density; however, after collecting the data and obtaining the ego network measures, we calculated the intra-class correlation of the unconditional HLM model. The ICC was just .03 which means that only 3% of the ego density variation resides between countries. ICC of just .03 is too low and does not justify the use of HLM (Bliese, 2000). As a consequence, the decision was to use the global network density instead of ego density to execute the pilot study.

The differences in the dependent variables between the pilot and actual studies forced us to change the modeling techniques. Since all the variables in the pilot study are at the country level, using multiple regression analysis was the proper method to test the hypotheses. On the other hand, since there are two levels of analysis in the actual study (country and firm levels), Hierarchical Linear Modeling (HLM) was used to test for the hypotheses.

The measures of independent and mediating variables are also different between the pilot and actual studies. In the former, the variables were measured by single-item measures, while in the latter, multi-item measures have been adopted. Since the exact measures have not been used previously in the literature, the choice of items in the pilot study was based on finding the most relevant items that represent the variables in question. For instance, the regulative pillar is measured by the institutional strength in the

Global Competitiveness Report (GCR). This measure is a combination of 18 items that range from property right protection and efficiency of the legal framework to the strength of auditing and reporting standards. This measure in general evaluates the overall rigor of the regulative institutions in a country. Xu et al. (2004) use this measure as a component of their regulative pillar variable.

The normative pillar was measured by the ratio between the alliance cases and the acquisition cases in a country. This measure is also used in the actual study as a component to construct the normative pillar. The rationale behind this measure is that the higher this ratio in a country, the more the norms of cooperation in that country. The number of alliances and acquisitions were obtained from the SDC database. This measure is on the country level; therefore, it included the number of acquisitions and alliances for all industries and not just for the biomedical.

The cognitive pillar is measuring the social knowledge shared by the people in a given country regarding the cooperative activities. This knowledge is represented by the collectivistic attitudes of individuals in the chosen countries. I used the Hofstede's (2001) construct of individualism/collectivism as a measure of cognitive pillar. Parboteeah et al. (2008) use cultural dimensions from Hofstede (2001) in his measure of the country institutional profile.

The three mediator variables are i) availability of knowledge, ii) availability of technological resources, and iii) availability of financial resources. Availability of knowledge is measured by the item of "local availability of research and training services" in the Global Competitiveness Report (GCR). Availability of technological resources is measured by the item of "availability of latest technologies" in the GCR.

Availability of capital is measured by the item of "venture capital availability" in the GCR. As can be seen, the independent and mediating variables were each measured by a single item. To improve the validity of the measures in the actual study, I generated many items to construct each variable.

3.2. Results of the Pilot Study

To test the hypotheses, the regression analysis has been used. Tables 2, 3, 4, and 5 provide full summary for all regression models that have been utilized in the analysis. The argument of hypothesis (1) is that the lower the score on the regulative pillar, the greater the density of the network structure of its biomedical industry. The result of the regression analysis in model (1) shows that there is a significant and negative relationship between the score of a country on the regulative pillar and its global network density. This result gives a good support for hypothesis (1).

Table 2: The direct effect of institutional pillars on network density (pilot study)

	Model 1	Model 2	Model 3	Model 4	Model 5
Constant	.127**	.09	.061**	.152**	.134**
Regulative pillar	-.019**			.019**	-.016**
Normative pillar		.309**		.003	
Cognitive pillar			-.001**	.00*	.00**

p < .1 p** <.05 p*** <.01*

Hypothesis (2) claims that the higher the score on the normative pillar, the more the density of the network structure of its biomedical industry. The regression of the network density on the score of a country on the normative pillar (model 2) indicates that

there is significant and positive relationship between the normative pillar and network density, which support hypothesis (2).

Hypothesis (3) emphasizes that the higher the score on the cognitive pillar, the greater the density of the network structure of its biomedical industry. The cognitive pillar is measured by the individualism construct of Hofstede (2001), which means that the low score of individualism (high collectivism) will be accompanied by high network density. The result in model (3) shows that there is a significant and negative relationship between individualism and network density which supports hypothesis (3).

Model (4) combines the three pillars together and the results hold for regulative and partially for the cognitive pillars but not for the normative pillar (not significant). In model (5), the normative pillar has been eliminated and the results are significant for the regulative and the cognitive pillars which provide more support for the hypotheses (1) and (3).

Hypothesis (4) claims that the more knowledge is available within a country, the lower the density of the network structure of its biomedical industry. Model (6) tests this hypothesis and the result show that there is negative and significant relationship between availability of knowledge resources and network density which gives strong support to hypothesis 4.

Hypothesis (5) states that the more available the technological resources in a country, the lower the density of the network structure of its biomedical industry. The results of model (7) indicate significant and negative relationship between network density and availability of technological resources. These results support hypothesis (5)

Hypothesis (6) indicates that the more available the financial resources in a

country, the lower the density of the network structure of its biomedical industry. The results of model (8) show that there is a negative and significant relationship between the availability of financial resources and network density, which support hypothesis (6).

Table 3: The direct effect of resource availability on network density (pilot study)

	Model 6	Model 7	Model 8
Constant	.127**	.208**	.158**
Availability of financial resources	-.023**		
Availability of knowledge		-.033**	
Availability of technology			-.023**

p < .1 p** <.05 p*** <.01*

To test that a variable (M) mediates the relationship between the independent variable (I) and the dependent variable (D), Baron and Kenny (1986) propose three-step procedures. First, test the direct relationship between the independent and the dependent variable. Second, test for the relationship between the independent variable and the mediator. Finally, regress the dependent variable on the independent and mediator variables, and if all the relationships are significant, that means there is a partial mediation. If the significance of the relationship between the independent and dependent variables disappeared, that means there is a full mediation.

We have already tested the first step which is the relationships between the dependent and independent variables and they were significant (models 1 & 5). Step 2 can be tested by regressing the mediator variables on the independent variables. Models (9, 10, & 11) show the effect of the regulative pillar on the three mediators (availability

of financial, knowledge and technological resources).

The results of model (9) indicate that there is a positive and significant relationship between the score of the regulative pillar and the availability of financial resources. This is an interesting finding since it indicates that in countries with stronger and more rigorous legal system, we expect to see more availability of financial resources to economic actors.

Model (10) indicates that the relationship between the regulative pillar and resource availability is positive and significant. We can explain this result by arguing that the strong regulative system in a country creates the foundation for crating and disseminating knowledge resources in that country.

Model (11) shows the same results as those of models (9 & 10) which support the main argument of the three models: the stronger the regulative system, the more available the resources. The results of model (11) indicate that there is a positive and significant relationship between the regulative pillar and the availability of technological resources.

Table 4: The effect of independent variables on the mediators (pilot study)

	Model 9	**Model 10**	**Model 11**
Constant	.509	2.855**	1.315**
Availability of financial resources	.729**		
Availability of knowledge		.496**	
Availability of technology			.849**

p < .1 p** <.05 p*** <.01*

The last stage in testing the mediation effect is including the independent,

dependent and mediator variables in the same equation. Model (12) tests for the relationships between regulative pillar, availability of financial resources, and network density. The model indicates that all the relationships are significant which supports the partial mediation hypothesis. This result means that the regulative pillar is affecting network structure by two means. First, there is a direct influence of regulations on network structure. Second, there is an indirect influence through affecting the availability of financial resources which in turn affect the network structure.

Model (13) tests for the relationship between regulative pillar, availability of knowledge, and network density. All the relationships are significant which support the partial mediation hypothesis. Again, the regulative pillar has both direct and indirect effect on network density by influencing the availability of knowledge resources in a country.

Finally, Model 14 tests for the relationship between regulative pillar, availability of technology and network density. We can notice that the significance disappear for the relationship between the mediator and the dependent variable which means that the mediation effect is not supported in this case. This result indicates that there is no indirect effect between the regulative pillar and network density through the availability of technological resources.

To summarize the results of the pilot study, we can say that two of the direct effect hypotheses (1 & 3) are strongly supported and there are strong relationships between regulative and cognitive pillars and the network density in a country. Hypothesis (2) that explains the relationship between the normative pillar and density of network is partially supported. Hypotheses (4, 5, and 6) that explain the relationship between

availability of financial, knowledge, and technological resources and network density

Table 5: Testing the mediating effect of resource availability (pilot study)

	Model 12	Model 13	Model 14
Constant	.135**	.201**	.0158**
Regulative pillar	-.008**	-.006**	-.024
Availability of financial resources	-.015**		
Availability of knowledge		-.026**	
Availability of technology			.001

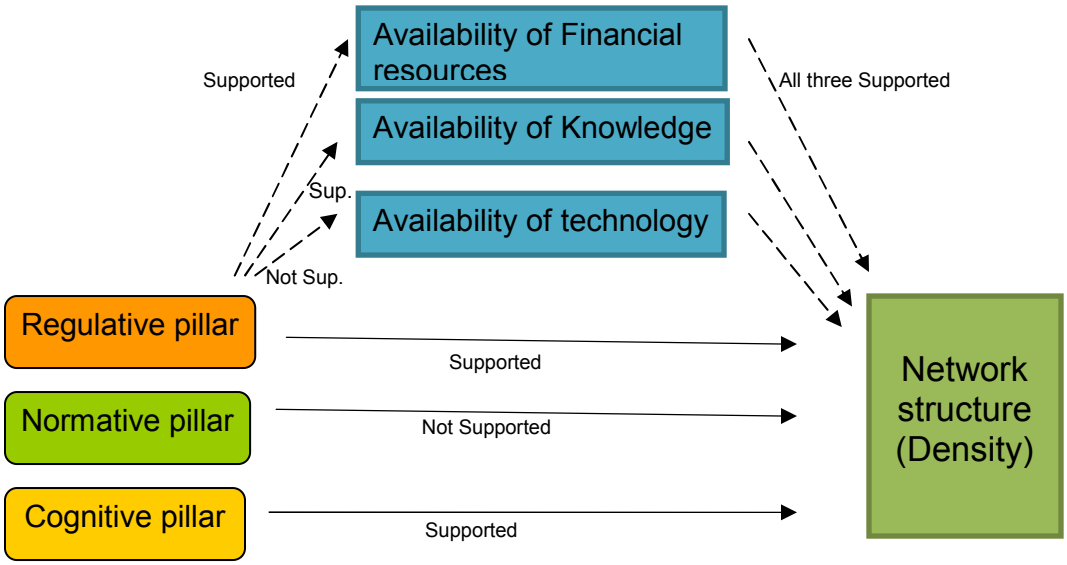
p < .1 p** <.05 p*** <.01*

have been all supported. There are strong relationships between availability of resources and the network density of each country. Finally, the mediator effect of the availability of resources between the regulative pillar and network density has been supported for the financial and knowledge resources but not for the technological resources. Figure (3) provides a summary for the findings of the pilot study.

3.3 Lessons learned from the pilot study

The results of the pilot study awarded a strong support for the general model of the study. All the direct effect hypotheses were supported except one and the partial mediation effect is also supported. A variation in the network structure among countries has also been identified. The comparison between the scores of the global network density among the selected 15 countries shows that there is enough variation among countries to justify conducting the actual study. All of these results encouraged the committee members to give the green light to continue the research and conduct the actual study.

Figure 3: Summary findings of the pilot study



The lack of variability in the ego network density that was experienced in the pilot study encouraged us to attempt to increase the network data (adding more ties to the network). The increase of ties has been achieved by increasing the timeframe of establishing the network from 3 years to 5 years. We also added another database (RECAP) which significantly increased the number of ties among biomedical firms. More specifically, the number of ties has increased from 554 to 2150 ties.

In addition to the extension of the time-frame and adding another database, we were able to add three more countries to the final sample for the actual study since the number of firms in these three countries passed the cut- off point of 10 firms per country (the cut-off point is based on the HLM specifications). These three countries are Belgium, Malaysia, and Spain. Therefore, the number of countries in the actual study is 18 instead of 15.

Another outcome of the pilot study is using multi-items to measure for the independent and mediating variables. The problems of multi-collinearity and common method variance were evident in the pilot study; therefore, multi-items measures have been adopted in the actual study to prevent these problems.

Common method variance is the "variance that is attributable to the measurement method rather than to the constructs the measures represent" (Podsakoff, MacKenzie & Podsakoff, 2003: 879). Podsakoff et al. (2003) indicate that common method variance can arise from having a common rater, a common measurement context, a common item context, or from the characteristics of the items themselves. Since the majority of the variables in the pilot study (the regulative pillars in addition to the three resource availability variables) are measured by items from the Global Competitiveness Report, the results of the study are prone to common method bias because these items are completed by the same rater, under the same context.

Podsakoff et al. (2003) propose a solution to this problem by arguing that researchers could obtain the measures of the predictor and mediating variables from different sources. Therefore, in the actual study, we introduced other sources beside GCR such as the International Monetary Fund and the World Value Survey to construct the independent and mediating variables.

Table (6) summarized various aspects of the pilot study and the actual study. It shows how the pilot study helped to improve sampling, measures, and statistical analysis in order to have more reliable results in the actual study. It is clear that there are at least 7 major differences between the pilot and actual studies. These major differences between the two studies (especially the dependent variables and number of ties) make it very hard

to interpret the differences in findings between the two studies. However, we can argue that the regulative pillar in addition to the availability of resources, in both studies, have significant relationships with network density (either global or ego). The combined findings of the two studies give more support to the main argument of this research which is networks vary among countries and the variation can be explained by both institutional and strategic factors.

Table 6: Major differences between the pilot and actual studies

Differences	Pilot study	Actual study
Dependent variable	overall country network density	Ego network density
Independent and mediating variables	Single item measures	Multi items measures
Sources of regulative and mediating variables	GCR	GCR, WBI, IMF, WVS, and Heritage Foundation.
Databases of network measures	SDC	SDC and RECAP
Time frame	Three years (2005-2007)	Five years (2005-2009)
Number of countries	15	18
Modeling	Regression analysis	HLM

CHAPTER 4: METHODOLOGY

4.1. Data Sources

As it has been explained in the pilot study, the independent variables (pillars of countries' institutional profiles) and meditating variables (availability of resources) should be obtained from different sources to eliminate the risk of common method variance and multi-collinearity. Therefore, the dependent, independent, and mediating variables have been collected from different data sources. Moreover, following the advice of Podsakoff et al. (2003), the databases that have been used to obtain the dependent variable are totally different from those used to obtain the independent and mediating variables. All the data was obtained from secondary sources.

4.1.1. Sources of the dependent variable

To collect network data (inter-organizational relationships), two databases were used: SDC Platinum and Recombinant Capital (RECAP). SDC (Securities Data Corporation) platinum is a division of Thomson Reuters. It provides information about global new issues, M&A, syndicated loans, private equity, project finance, and more. Alliances data are under the merger & acquisition section of the database. SDC Platinum covers approximately 672,000 global M&As from 1985 to the present including many alliance agreements. SDC tracks a vast array of agreement types, including joint ventures, strategic alliances, research and development (R&D), sales and marketing, manufacturing, supply, and licensing and distribution agreements. Agreements data is not restricted to companies; it is also collected for research institutions, universities, government agencies, international agencies and many other entities.

In a recent review of the databases that are used in network studies, Schilling (2009) indicates that SDC has the widest range of sectors among industries and it has a wide international coverage. Many researchers have used SDC to collect alliances data (e.g. Lin et al., 2009; Oxley & Sampson, 2004; Reuer & Ragoozzino, 2006; Rosenkopf et al., 2001; Rosenkopf & Schilling, 2007). According to Schilling (2009), SDC is a legitimate source for alliance data.

Since there is no alliance database with complete or exhaustive coverage (Shilling, 2009) and, as explained in the pilot study, this research needs to have valid and comprehensive data about relationships between biomedical firms around the world, I decided to use another database, RECAP, in addition to SDC. Using multiple sources of network data is a common practice in network research (e.g. Rowley et al., 2000). RECAP is a specialized database for the biotechnology industry. It is a division of Deloitte and provides consulting services to the biotech industries.

RECAP allows search by company names or by timeframe. It provides data about several types of agreements such as co-development, R&D, co-marketing, licensing, joint ventures, manufacturing, and distribution. This database provides information about different types of organizations that participate in the value chain of the biotechnology industries such as biomedical firms, pharmaceutical firms, universities, government agencies, and international agencies. RECAP has been used extensively to conduct various researches on alliances in the biotech industry (e.g. Gopalakrishnan et al., 2008; Rothaermel & Boeker, 2008; Santoro & McGill, 2005).

A five-year window, 2005-2009, has been used to construct the global network of the biomedical industry. There are various perspectives in the literature about the time

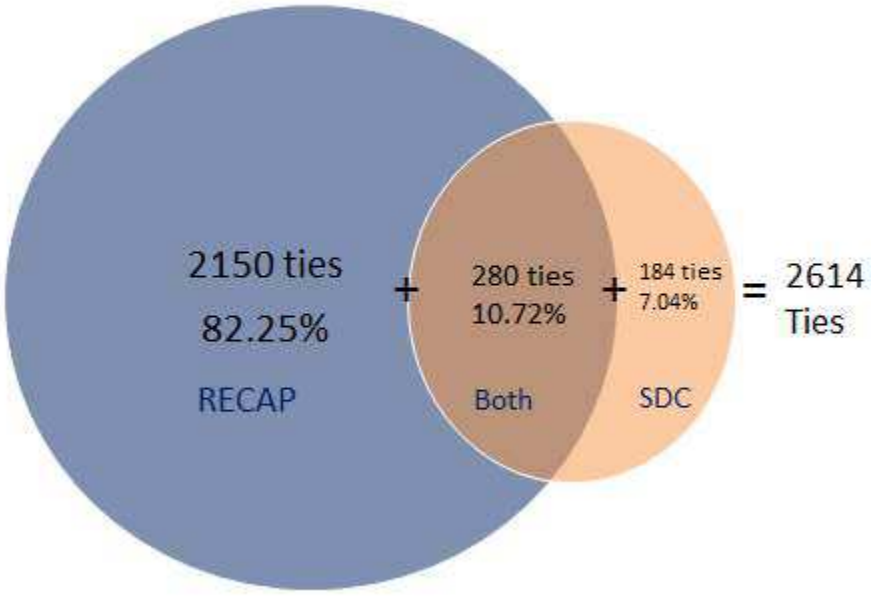
window that is required to construct the inter-organizational networks. For instance, some researchers adopt a three-year time window (e.g. Schilling & Phelps, 2007); others use the four-year window (e.g. Bae & Gargiulo, 2004); finally, some have adopted the five-year window (e.g. Baum et al., 2003; Gulati & Gargiulo, 1999). After a review of several alliances research, Gulati (1995) supports the choice of a five-year window because he found that the lifespan for the majority of alliances is usually no more than five years. In addition to the previous reason, we found in the pilot study that for a three-year window the variation of ego network density among countries was very small. Therefore, a five-year window is adopted in the actual study to give a longer time for the countries' networks and experience more variability.

After collecting the required data from both databases, it was clear that the RECAP database has more coverage for the industry than SDC. To clarify that, I calculated the differences in reported alliances between firms for the three years: 2005, 2006, and 2007. The overall number of alliances is 2614 out of which 82.25% (or 2150 ties) have been reported exclusively in the RECAP and only 7.04% (or 184 ties) are reported exclusively in the SDC. The overlap between the two databases is just 10.72% (or 280 ties). Figure (4) provides an overview of the relationships between the findings of the two databases. My findings for the coverage of databases are consistent with the findings of Schilling (2009). She conducted a comparison between three databases (SDC, RECAP, and MERIT-CATI), and found that RECAP performed the best, identifying an average of 22.2 % of the biotech alliances reported in SDC and MERIT-CATI.

Since coverage varies between databases, I used both RECAP and SDC databases to construct countries' networks. Alliances that are included in both databases have been

used directly in constructing the networks. Alliances that are reported exclusively in either SDC or RECAP were subject to a validity test. Following Srivastava and Gnyawali (2011), I have used news reported on Factiva to trace alliances that are not reported in the both databases. I followed the systematic random sampling procedure in which every K^{th} element in the sampling frame is selected (Black, 2008) to be checked against the data available through sources other than the two databases of the study. More specifically,

Figure 4: The breakdown for the sources of the networks data



I selected each 21^{st} alliance to be checked by Factiva news or by direct on-line sources (searching the name on the Google search engine). All alliances that are reported exclusively in one of the two databases have matched a news piece on either Factiva or some other news websites. The rate is 100% which means that the reliability of the reported alliances is very high, however, the problem is in the not reported alliances.

The problem of the not reported alliances is more severe in countries where

English is not the first language. All the databases that deal with alliances have a bias toward English sources (Schilling, 2009). Jung-Youn (2006) advocates that Korean firms should make more disclosures in English. He asserts that during the first eight months of 2006, only 49 English disclosures have been made among which 35 were done by one firm (KT&G Corp, a tobacco manufacturer). Therefore, I relied on my own search by using the native language for some countries in the language field on the Factiva search engine then using Google translation to translate the news into English. This method was especially used for some of the Asian countries such as China, South Korea, and Malaysia. However, it did not significantly improve the coverage for these countries (3 alliances for China, 0 for South Korea, and 1 for Malaysia). More details are provided in appendix (A). The low improvement in coverage can be explained by arguing that the biomedical industry is a global one and usually alliances with big players demonstrate the competency of the biotech firms (Janney & Folta, 2003); therefore, firms try to disclose their alliances in English in order to show that they are legitimate partners among international players.

4.1.2. Sources of the independent variables

The three independent variables of this study are the three pillars of the institutional profile, namely regulative, normative and cognitive pillars. Secondary sources of data will be used to calculate these measures. The practice of measuring institutional profile by secondary data has received increasing support in the literature. For instance, Xu, Pan and Beamish (2004) have used many variables from the Global Competitiveness Report (GCR) to measure the regulative and normative distances among different countries. Also Parboteeah et al. (2008) and Parboteeah et al. (2009) have used

the World Value Survey to measure a country's institutional profile. Furthermore, Ang and Michailova (2008) have used the World Bank's composite measure of governance and cultural scores to measure the institutional profile and then detect its influence on the adoption of equity alliance mode by firms from emerging countries.

To eliminate common method variance and collinearity, I will use many different secondary sources to measure the institutional profile of a country for the domain of inter-organizational network. The GCR is published annually by the Geneva-based World Economic Forum. Increasing number of studies have used this source of data (Delios & Beamish, 1999; Wan & Hoskisson 2003; Xu , Pan & Beamish, 2004).

The World Value Survey (WVS) is a worldwide investigation of sociocultural and political change. It is conducted by a network of social scientists at leading universities all around the world. Interviews have been carried out with nationally representative samples of the population of more than 80 societies on all six inhabited continents. The data is collected by either survey questionnaires or direct interviews questionnaires (World Values Study Group, 2000). I will be using the results of the 2005-2008 waves because they better fit with the timeframe of my study.

Following Meyer et al. (2009) and Gubbi et al. (2010), I proxy the regulative pillar of every country's institutional profile by the compound index of economic freedom. The index is developed by the Wall Street Journal and the Heritage Foundation. The index covers 10 freedom factors, from property rights to entrepreneurship, in 183 countries. I will use the data for year 2005, as the starting year of the timeframe of my study, to be able to measure the effect of this index on firms' behavior in the coming years.

The GLOBE study will also be used as a source for four items in the normative and cognitive pillars. The GLOBE study (House et al., 2004) was conducted in the mid-1990s and involved more than 170 investigators in 62 countries or regions. The study aims to test various hypotheses that had been developed, in particular, on leadership topics. Survey questionnaires were developed and collected from more than 17,000 middle managers in 951 organizations. The GLOBE study is widely used in international business and cross-cultural studies (e.g. Parboteeah et al., 2008; Tung, 2008).

4.1.3. Sources of the moderating variables

The moderating variables represent the availability of resources (i.e. availability of knowledge, technological, and financial resources). In addition to the Global Competitiveness Report, I will use the World Bank Indicators, the International Monetary Fund, and the US Patent and Trademark Office databases for these variables. The World Development Indicators (WDI) of the World Bank include data from 209 countries spanning from 1960 to 2010. The World Bank indicators are widely used in international business (e.g. Berry et al., 2010; Cuervo-cazurra, 2008; Kali & Reyes, 2007).

For the financial availability variable, I will consider indictors from the International Monetary Fund. The IMF publishes a range of time series data on IMF lending, exchange rates and other economic and financial indicators covering more than 200 countries around the world (IMF, 2011). Researchers rely heavily on IMF measures for differences among countries regarding their financial outcomes (e.g. Kali & Reyes, 2007).

Finally, the US Patent and Trademark Office (USPTO) database is also used for moderating variables. The USPTO is an agency in the United States Department of

Commerce issuing patents to inventors and businesses for their inventions and trademark registration for products and intellectual property identifications. USPTO gives the total number of patents granted to the top innovator of each country. Patent numbers from the USPTO are commonly used to differentiate between innovative outcomes of countries (e.g. Allred & Park, 2007; Berry et al., 2010; Lederman, 2010). Appendix (B) summarizes the different items that will be used in measuring the dependent, moderator, and independent variables.

4.2. Sample Size

Since this study attempts to compare the network structure between many countries, we need to control for the industry effect. Rosenkopf and Shcilling (2007) compared the network structure of various industries. They found that different industries show varying network structures. Therefore, it is unreasonable to conduct the comparison between countries for many different industries because it will be very difficult to isolate the country and industry effects. Consequently, the comparison among countries will be only for the biomedical industry as the focused industry of this study. The choice of the industry was based on many factors especially its reliance on alliances (Powell et al., 1996). Many network studies have used biomedical as the focal industry (e.g. Barley et al., 1992; Baum et al., 2000; Gulati, 1995; Oliver, 2001; Rothaermel, 2001; Rothaermel & Deeds, 2004).

Biomedical research industry is a branch of the biotechnology industry. The United Nations Convention on Biological Diversity defines biotechnology as "Any technological application that uses biological systems, living organisms, or derivatives thereof, to make or modify products or processes for specific use" (CBD, 2011). The

biomedical industry is comprised of all the evaluation and development of new treatments in the medical field. This industry includes different types of firms that can be grouped in four categories: biotechnology firms, pharmaceuticals, test labs, and research institutes.

The biomedical firms follow business models that rely heavily on scientific and emerging specialized knowledge; therefore, they are under pressure to partner with non-profit organizations, such as government agencies and universities as well as pharmaceutical and chemical firms (Amburgey, Al-Laham, Tzabbar & Aharonson, 2008). The purpose of these partnerships is to have access to knowledge (Powell et al., 1996) capital (Gopalakrishnan et al., 2008) and commercial expertise (Amburgey et al., 2008). Powell and Smith-Doerr emphasize this point by stating that "[t]he dynamics of cooperation are endogenous to high technology fields where intellectual advances fuel new capabilities, which in turn require novel forms of collaboration" (1994: 388). The specific conditions of the industry encourage firms to perform more partnerships and alliances, creating visible inter-organizational networks that are comparable among countries.

In order to construct the network of the biomedical industry in each country, I started to code any relational agreements between firms from any country in the world during the five years from 2005-2009. I also coded the country of origin for each partner. There are two criteria to design the network of an industry in each country: i) membership in the target population (industry), and ii) at least one strategic alliance with another member of that industry (Bae & Garguilo, 2004; Rowley et al., 2000). The second condition is already achieved because I constructed the list of the biomedical

firms in each country from the alliances data of the biomedical firms. To ensure that all firms in my network satisfy the first condition, I manually checked if each firm included in the final dataset belongs to the value chain of the biomedical industry. To achieve that, I have consulted the firms' websites and looked into the field of operation or the products of the company. I also used the website of the Bloomberg Businessweek magazine to find more information about firms. The Businessweek's website provides a quick summary of many international firms working in the biomedical industry. The website usually presents the main information about firms including their fields of operation, the dates of establishment, and the dates of defunct, if applicable. I have also consulted the MediLexicon[1] directory of pharmaceutical and biomedical companies to ensure that firms used to construct the network are members in the biomedical value chain. For Canadian biomedical firms, I used the D&B (Dunn & Bradstreet) Million Dollar Database (MDDI) to check for a list of these firms.

In the final dataset, I included biotechnology firms that are specialized in medical research, pharmaceuticals, test labs, and research institutes. Many firms that are included in the original SDC and RECAP databases belong to the biotechnology industry, but they do not perform medical related activities (for instance, many of them perform agricultural related activities such as ABPL India and Monsanto of USA). Therefore, all biotechnology firms that do not perform medical-related activities were not included in constructing the biomedical network in each country.

The final dataset includes alliances data for 2666 firms around the world. These firms belong to 45 countries that span the six continents. The network in some countries

[1] MediLexicon is a UK based on-line data source that provides medical and pharmaceutical directories, among other things. It can be accessed at http://www.medilexicon.com/

consists of just two or three firms, which makes any study about network structure in such countries meaningless. A total of 26 countries were excluded since there is no meaningful network within their biomedical industry. In other words, those networks that have less than 10 firms and have no relationship between the member firms were excluded. Since Hierarchical Linear Modeling is used to analyze the collected data and 10 is the minimum number of members within each group that can yield meaningful results (Bryk & Raudenbush, 1992; Hofmann, 1997), I excluded countries with networks of less than 10 firms from the dataset. I also excluded the US from the final dataset because keeping it will skew the results toward the characteristics of the US market. Schilling (2009) indicates that databases have a bias toward covering data about US firms. Also, the US naturally has the highest number of biomedical firms in the world (1259 firms), which constitute 47.22% of the global number of firms. It is also unreasonable to compare the structure of an 18-firm network like the case of Singapore with the 1259-firm network of the US.

The final dataset includes 18 countries that can be grouped into two distinctive sets, emerging and developed countries. There are 13 developed countries and they are Australia, Belgium, Canada, Denmark, France, Germany, Italy, Japan, Netherland, Spain, Sweden, Switzerland, and the United Kingdom. The five emerging countries are China, India, Malaysia, Singapore, and South Korea. The total number of firms in these 18 countries is 1391. Table (7) provides a breakdown for the number of firms in each country.

Table 7: Number of firms in each country that are used in the actual study

Country	Number of firms
Australia	73
Belgium	31
Canada	141
China	78
Denmark	48
France	93
Germany	159
India	63
Italy	43
Japan	113
Malaysia	18
Netherlands	66
Singapore	19
South Korea	32
Spain	22
Sweden	51
Switzerland	66
United Kingdom	203
Total	1319

4.3. Variables

The model of this study includes one dependent variable (ego network density), three independent variables (regulative, normative, and cognitive institutions), and three mediating variables (availability of financial, knowledge, and technological resources).

4.3.1. Dependent variables

The dependent variable in this study is the ego network density, which can be measured by the number of ties for each ego firm divided by the number of pairs for this firm, times 100 (Hanneman & Riddle, 2005). The density of the network is used to

operationalize the construct of network closure (e.g. Soda et al., 2004). This variable gives us an indication about the degree to which firms within the network maintain extensive ties among each other. Density can be calculated at the firm level by measuring the density of the focal firm's network. It can also be calculated at the industry level by measuring the overall density of the industry.

We choose to use ego network rather than global measure of density for many reasons. First, the theories underlying the hypotheses are more closely connected to ego networks than to global density. It has been argued that the behavior of firms is more influenced by the structure of ties among its direct partners and the global density is less influential on firm behavior (Garcia-Pont & Nohria, 1999; Rowley et al., 2000). Since it is argued that organizations exercise strategic choice within restrictions imposed by their institutional environments, it is needed to see if each individual firm tries to build its alliances strategically under the different institutional environments and availability of resources, which can be achieved by studying ego network structure.

The second reason for using ego rather than global density is that we are measuring the density as an opposite pole of structural holes. Since structural holes are presented in the literature as ego network measures (Borgatti, 2001), we need to adopt ego network density. Finally, relying on global network density will force us to use multiple regression analysis which is not appropriate for a very small sample size (n=18 because each of the 18 countries will have just one figure for density).

An ego network includes the collection of the focal actor (the biomedical firm in this research) and all nodes to which ego has a connection at one-step path length (Hanneman & Riddle, 2005). In this study, the "neighborhood" includes only ego and

actors that are directly adjacent, and all of the ties among all of the actors to whom ego has a direct connection (Hanneman & Riddle, 2005).

UCINET software (Borgatti et al., 2002) is used to calculate the dependent variable. UCINET is a comprehensive program for the analysis of social networks and other proximity data. The program contains many network analytic routines (e.g. centrality measures, dyadic cohesion measures, etc.), in addition to general statistical and multivariate analysis tools such as multidimensional scaling, factor analysis, cluster analysis, multiple regression, etc. UCINET is widely used for social network analysis in management research (e.g. Baum et al., 2003; Schilling & Phelps, 2007; Zaheer & Bell, 2005).

4.3.2. Independent variables

As explained in the theoretical development, the institutional profiles that will be measured are domain specific and the domain is the inter-organizational relationships. The institutional profile consists of three pillars: regulative, normative and cognitive (Scott, 2005). Table (8) provides a summary of the items that have been used to measure these pillars of each country's institutional profile.

In the institutional profile literature, there is no identification for the domain of inter-organizational relationships. Therefore, to identify the components of each pillar, it is necessary to follow Kostova's (1999) assertion of identifying the specific regulative, normative, and cognitive elements that are relevant to the particular phenomenon of study, inter-organizational relationships in this research.

In their development for the institutional profile of gender equality, Parboteeah et al. (2008) reviewed the literature of the gender equality phenomenon and identified the

Table 8: Items selected to establish the measures of the institutional profile

Latent variable	Observed variables	Source
Regulative pillar	*1. Index of economic freedom*[*]	Heritage Foundation and Wall Street Journal
Normative pillar	*2. Ratio of acquisition to alliances in a country*[*]	SDC
	3. Extent of market dominance[*]	GCR
	4. Intensity of local competition	GCR
	5. University-industry research collaboration	GCR
	6. State of cluster development	GCR
	7. Collectivism institutional	GLOBE
	8. Collectivism in-group[*]	GLOBE
Cognitive pillar	9. Collectivism institutional value	GLOBE
	10. Collectivism in-group values	GLOBE
	11. Trust[*]	WVS
	12. Important in life: friends[*]	WVS
	13. *People try to take advantage of you*[*]	WVS

Items selected to measure the variables[*]

institutional factors that influence this gender equality. For the cognitive pillar they considered two factors (educational system and level of religiosity). For the normative pillar they used many cultural dimensions including power distance, uncertainty avoidance, masculinity, gender egalitarianism, and assertiveness. Finally, for the regulative pillar, they emphasized five government policies regarding gender equality.

Following the steps of Parboteeah et al. (2008), I reviewed the literature about the factors that affect inter-organizational relationships, which is presented in the theoretical framing of the hypotheses. Then I searched the literature to find reliable measures for these factors. The literature was helpful in identifying the measure of the regulative pillar, but since the domain of the inter-organizational relationships has not previously studied, I had to rely on measures that match the theoretical identifications of each pillar. The selected measures for each pillar will be explained in the following sections.

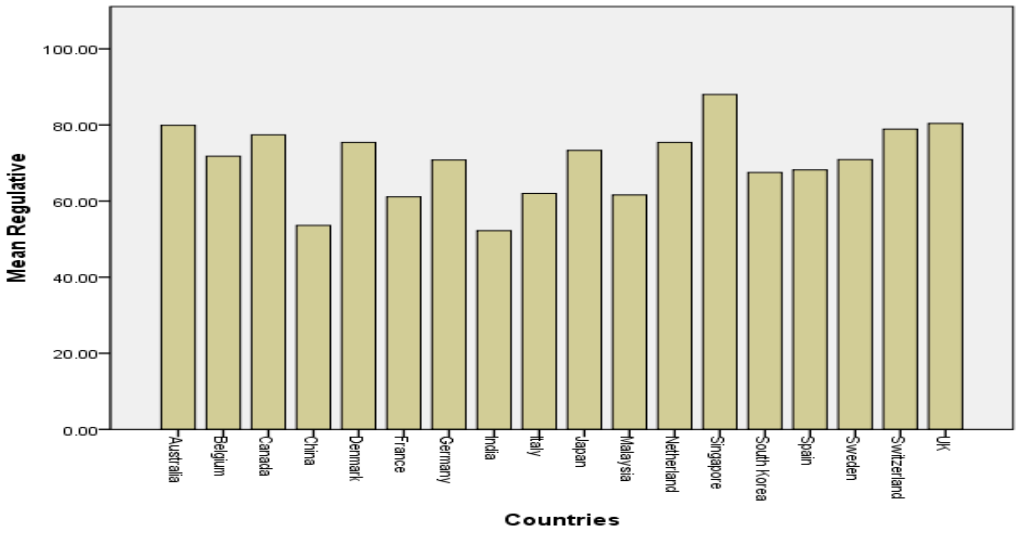
4.3.2.1. The regulative pillar

The regulative pillar is measured by the Index of Economic Freedom developed by the Heritage Foundation and the Wall Street Journal. The index consists of ten components of economic freedom. It assigns a grade to each component using a scale from 0 to 100, where 100 represent the maximum freedom. The ten component scores are then averaged to give an overall economic freedom score for each country. The ten components of economic freedom are: Business Freedom, Trade Freedom, Fiscal Freedom, Government Spending, Monetary Freedom, Investment Freedom, Financial Freedom, Property Rights, Freedom from Corruption, and Labor freedom.

The index fits with the previously explained conceptualization of the regulative pillar because it emphasizes the extent of government intervention and the state of property right protection in each country. Moreover, some researchers relied exclusively on the compound index of economic freedom to proxy the regulative pillar of the country institutional profile (e.g. Gubbi et al., 2010; Meyer et al., 2009).

Figure (5) presents the score on the regulative pillar of selected countries. It can be shown from the figure that the scores of countries range from around 50 up to almost 90 out of 100. The distribution of countries does not totally confirm the classification of developed vs. emerging country. Although the majority of the developed countries have scores that are above 60 while the emerging countries have scores that are between 50 and 60, there are notable exceptions for this classification such as the low score for France and the high score for Singapore and South Korea.

Figure 5: The score of countries on the regulative pillar



4.3.2.2. The Normative Pillar

The choice of items that construct the normative measure will be based on the conceptualization of this pillar in the literature. Normative elements are represented by values and norms held by individuals (Kostova, 1999; Scott, 2005) regarding the studied phenomenon. Therefore, normative pillar should measure the norms in the country toward cooperation vs. competition. If the norms of cooperation prevail, we expect to see denser networks in that country because people will use cooperation as a means to obtain resources. On the other hand, if the norms of competition are stronger, firms will perform more acquisitions than alliances to obtain required resources which bring down the density of networks. Seven items were subject to factor analysis to determine the measure of the normative pillar.

The seven items have been chosen because they cover different dimensions of the normative pillar as developed in the theoretical explanation of the pillar. In brief, the ratio of acquisition to alliances gives an indication about the norms of alliances vs. the norms of acquisition. The state of cluster development item also gives an indication about the

prevalence of collaboration through organizational clusters. Two items, the extent of market dominance and the intensity of local competition, are included to measure the level of competition in the country. The item of university-industry research collaboration is used to measure the norms of cooperation between universities and industries in a country. Finally, the two items of culture have been considered to be in the normative pillar because they measure the effect of practiced cultural norms on collaboration in a country. Following are details of each one of these seven items identified for measuring the normative pillar.

The first item in the normative pillar is the ratio between the alliance cases and the acquisition cases in a country. This ratio gives us a clear view of whether companies in a certain country prefer to expand by collaborating with other firms and establishing alliances or to expand by acquisition. The higher this ratio, the more the norms of cooperation prevail in that country. The number of alliances and acquisitions is obtained from the SDC database. This measure is at the country level; therefore, it will include the number of acquisitions and alliances for all industries and not just the biomedical.

The second item is the Extent of Market Dominance from the Global Competitiveness Report. This item is measured by asking respondents how they characterize corporate activity in their country (1 = dominated by a few business groups; 7 = spread among many firms). The final score is the weighted average of the responses. Countries that have a low score on this item tend to have more collaboration within its business groups while countries that have a high score tend to have more dispersed relationships between firms because the role of the market facilitates the economic activities in these countries. This item is reverse coded so that it fits with the direction of

the other items (high score means high norms of collaboration).

The third item will also be adopted from the GCR. This item is the "Intensity of local competition." Respondents are asked to rate if competition in the local market is high or low (1 = limited in most industries, 7 = intense in most industries). A high score on that measure for a country means that high competition is the norm in most industries in that country. This item was subject to reverse coding so low number reflects high competition in a country because, as it has been discussed before, acquisition prevail over collaboration in high competitive environments. I include this item because it shows how competition is valued in a specific country.

The fourth item measures the level of "university-industry research collaboration" from the GCR. Respondents are asked to answer this question: "In the area of R&D, collaboration between the business community and local universities is (1 = minimal or nonexistent, 7 = intensive and ongoing). This measure indicates that there are norms of collaboration between universities and industries' actors, specifically, in the R&D activities. That means norms of collaboration have strength in countries that score high on this item.

The fifth item measures the "state of cluster development" from the GCR. Respondents are asked to answer this question: "In your country's economy, well-developed and deep clusters are (1 = rare or absent, 7 = widespread in many fields)." This item indicates that the norms of business in a country is more centralized around clustering and collaboration between firms than around isolated firms with less collaboration.

Culture has been used in the literature empirically and conceptually as a

component for either the normative (Parboteeah et al., 2008; Xu et al., 2004) or the cognitive pillar (Kostova, 1999; Kostova & Roth, 2002). I will use culture as a component for the normative and cognitive measure. For the normative pillar, I will use the scores of the "institutional" and "in-group" collectivism (*As Is*) as reported in the GLOBE study. These items measure the actual practice of collectivism, which represents the norm of collaboration. On the other hand, I will use the scores of valued collectivism (*Should Be*) in the cognitive pillar because it is closer to the knowledge of collaboration than to practice.

The sixth item is adopted from the GLOBE study and it measures the practiced institutional collectivism. This measure is constructed by four questions that focus on the degree to which institutional practice at the societal level encourage and reward collectivistic actions (Gelfand et al., 2004). The questions assessed "whether group loyalty is emphasized at the expense of individual goals, whether the economic system emphasizes individual or collective interests, whether being accepted by other group members is important, and whether individualism or group cohesion is valued more in the society" (Gelfand et al., 2004: 463). To be differentiated from the (*Should be*) version, this statement is referred to as the *(As Is)* version of the scale: "in this society, people are in general . . ." Study participants responded to the question on a 7-point scale in which 1 indicates low collectivism (or high individualism) and 7 indicates high collectivism (or low individualism).

Finally, the seventh item is also adopted from the GLOBE study and it measures the in-group collectivism. This item measures how individuals express pride, loyalty, and interdependence on their families (Gelfand et al., 2004). Even though the measure itself

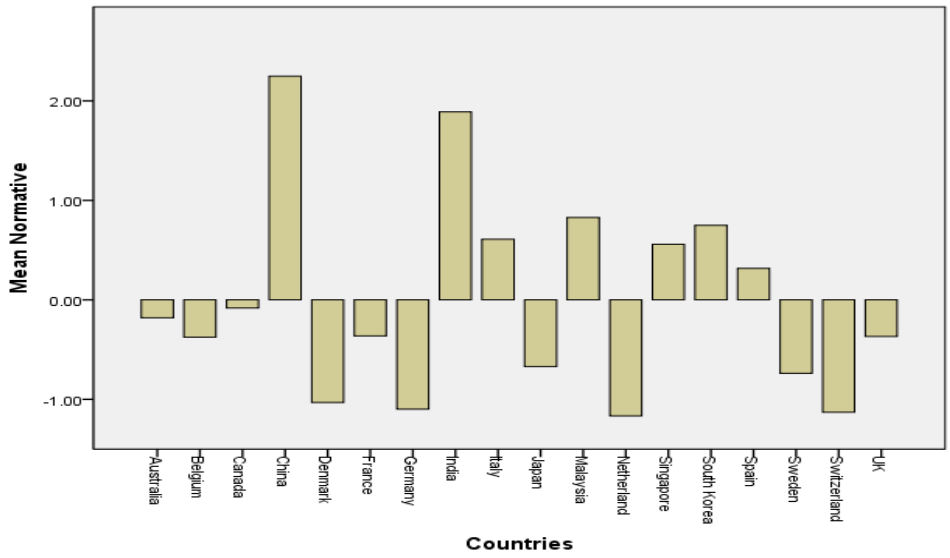
does not have a direct relationship with organizational collaboration, I decided to include it. Thus I do not exclude any collectivism measure from the GLOBE study. This item is constructed by four questions of "whether children take pride in the individual accomplishments of their parents and vice versa, whether aging parents live at home with their children, and whether children live at home with their parents until they get married" (Gelfand et al., 2004: 463).

Principle component analysis is very effective in capturing the highest amount of information from the data while reducing the dimensions of the measure (Lattin, Caroll, & Green, 2003). The factor analysis yields a three-item measure (ratio of acquisition to alliances, extent of market dominance, and in-group collectivism) with eigenvalue of 2.25. All the items have higher loading than .80, and 75.25% of the variance is explained by this factor. Table (10) provides the loading factors of these items.

Figure (6) presents the scores on the normative pillar of selected countries. Since the normative pillar is a combination of different factors, the total score for this pillar is standardized and centralized. We can see that many countries have way above the mean scores such as China and India which is consistent with the perception that firms in these two countries are relying heavily on cooperation rather than competition.

Since the corporatist countries such as Sweden, Denmark, and Japan prefer cooperation over competition (Spencer, 2005), we expect to have high scores on the normative pillar of these countries. However, these countries have low scores on this pillar. On the other hand, the scores of the pluralist countries such as Australia, UK and Canada are all low as expected by the theory (low density).

Figure 6: The scores of countries on the normative pillar.



4.3.2.3. The cognitive pillar

This pillar will measure the social knowledge shared by people in a given country (Kostova, 1999; Scott, 2005) regarding the cooperative activities of various entities (individuals or firms) in that country. This knowledge will be represented by many factors including culture, trust, and importance of relationships and friendships.

As mentioned before, the collectivistic items of cognitive pillar will be the (*Should Be*) variables of institutional and in-group collectivism. These two variables are measured by the same eight questions that are used to measure the (*As Is*) variables, the only difference being that these questions are introduced by this statement: "In this society, people should . . ."

Trust will be measured by an item that is adopted from the World Value Survey. Respondents were asked to answer this question: "generally speaking, would you say that most people can be trusted or that you need to be very careful in dealing with people?" The possible answers are 1) most people can be trusted and 2) can't, need to be very careful. Then the percentage of people who answered the first choice has been presented

for each country.

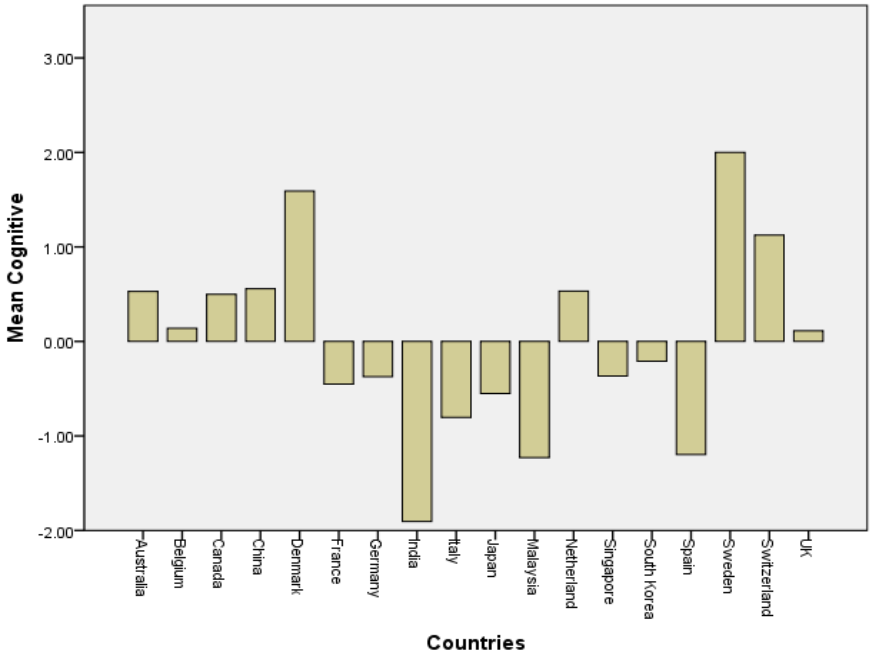
Another measure of trust will be the perception of individuals, whether the others tend to take advantage of him/her. The question is: "do you think most people would try to take advantage of you if they got a chance, or would they try to be fair?" the scale will be that 1) would take advantage and 10) try to be fair. Therefore, I consider that countries that have a high score on this item enjoy high level of trust between individuals.

The last item in the cognitive pillar measures the importance of relationships in life especially friends. In the WVS, respondents were asked to answer this question: "for each of the following aspects, indicate how important it is in your life. Would you say it is: Friends" the scale is (1: very important -4: not important at all). I use the percentage of respondents who answered that friends are very important.

The factor analysis yields a three-item measure (trust, people take advantage of you, and importance of friendship) with eigenvalue of 2.442. The loading factors for all the items are higher than .70, and 61.04% of the variance is explained by this factor. Table (10) presents the detailed loadings.

Figure (7) presents the scores on the cognitive pillar of selected countries. Similar to the process of calculating countries' scores on the normative pillar, the cognitive pillar scores are standardized and centralized. We can notice that Sweden and Denmark have the highest scores; consequently, we can claim that the norms of trust prevail in these countries. The low score of India is little surprising because we expect that people in India rely on their friendships and social relationships which increase their trust while the score of India implies the opposite. By investigating the scores of India on the items that construct the cognitive pillar, it can be noticed that India has the lowest score on the

Figure 7: The scores of countries on the cognitive pillar



"People try to take advantage of you" item, which explains the low score of India on the cognitive pillar.

4.3.3. Mediating variables

There are three variables that mediate the relationship between the regulative pillar and the network density. The three mediators are availability of knowledge, availability of technology, and availability of financial resources. It has been discussed before that the theoretical rationale is the only basis for advancing a particular causal order in non-experimental studies (Mathieu & Taylor, 2006) which is the case for this study. Since the institutional profile is domain specific (i.e. inter-organizational cooperation) in this study, there is no theoretical justification in the literature to connect the norms and knowledge of collaboration among firms in a country and the availability of resources in that country. Therefore, the mediation effect will be restricted to the

regulative pillar of the institutional profile.

To generate the items that construct the mediating variables, extensive literature review on country level measures was performed. All the data sources that are utilized in this research have already been used in the literature; however, the exact items might not be used since specific type of resource availability is of concern. The 21 reported items in table (9) is an exhaustive list of items related to the types of resources that I used in this research. These 21 items were then subject to factor analysis to determine the measures for each variable.

Table 9: Items selected to construct the resource availability variables

Latent variable	Observed variables	Source
Knowledge resource availability	*1. Quality of educational system*[*]	GCR
	2. Local availability of research & training	GCR
	3. Capacity for innovation	GCR
	4. Availability of scientists and engineers	GCR
	5. Quality of scientific research institutions	GCR
	6. Patent per capita	USPTO
	7. # of Scientific and technical journal articles[*]	WBI
	8. Researchers in R&D	WBI
	9. Expenses of R&D per capita	WBI
Technological resource availability	*10. Availability of latest technologies*[*]	GCR
	11. Firm-level technology absorption[*]	GCR
	12. Production process sophistication[*]	GCR
	13. High-technology exports	WBI
Financial resource availability	14. *Domestic credit provided by banking sector*[*]	World Bank Indicators
	15. Financial market sophistication	GCR
	16. Financing through local equity market	GCR
	17. Ease of access to loan	GCR
	18. Venture capital availability	GCR
	19. Restriction on capital flow	GCR
	20. Soundness of banks	GCR
	21. *Outstanding loans from commercial banks*[*]	IMF

Items selected to measure the mediating variables[*]

4.3.3.1 Availability of knowledge resource

This variable assesses the availability of knowledge in each of the studied countries. Many items can be associated with high knowledge availability in a country such as a high quality of education system. Furthermore, knowledge availability can be fostered by availability of more scientific institutions that can execute R&D activities and nurture the development of new patents and innovations. Human capital such as scientists and engineers who can conduct research play major role in increasing knowledge availability. Finally, scientific publications have a significant role in disseminating of knowledge.

In total, nine items have been collected from various sources indicating that certain countries have more available knowledge than others. After a factor analysis test, these items are grouped in two factors. The first one is based on items from GCR and the other factor included items from GCR and the World Bank Indicators (items 1 and 7). The second factor was selected to avoid a high correlation that the first factor has with the availability of technology variable. The correlation of the first factor with the availability of technology was .94, and the correlation was significant at .01 level using the GCR-based items. Under this condition of high correlation, it is hard to differentiate between the effect of availability of knowledge and availability of technology. The variance explained by chosen second factor is 77.6% and the loading factors are higher than 0.8 (table, 10).

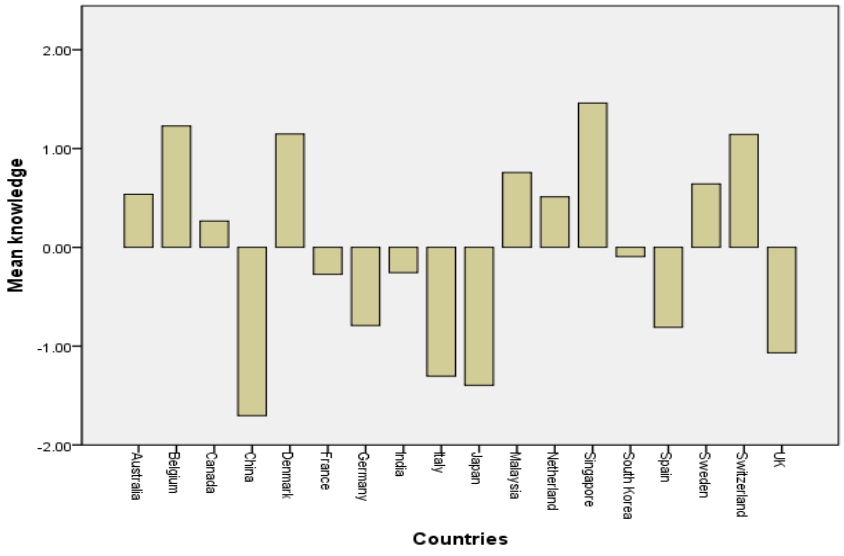
The first item included in the availability of knowledge variable is “quality of educational system” which is adopted from the GCR. Respondents were asked to answer this question: “The educational system in your country (1 = does not meet the needs of a

competitive economy, 7 = meets the needs of a competitive economy).” Countries that score high on this item tend to have better educational systems and, consequently, knowledge will be more available to be used by various economic actors.

The second item that indicates the availability of knowledge is the number of scientific and technical journal articles that are published by scholars in a specific country. This item is adopted from the World Bank Indicators and it includes scientific and technical journal articles published in the following fields: physics, biology, chemistry, mathematics, clinical medicine, biomedical research, engineering and technology, and earth and space sciences. Clearly, knowledge should be available in a country so that scholars in that country will be able to publish scientific and technical articles.

Figure (8) presents the scores for the availability of knowledge resources of the selected countries. Some countries have expected high score on this variable such as Sweden, Belgium, Denmark and Switzerland. Some other countries have expected low

Figure 8: The scores of countries on the availability of knowledge resources



score such as China and India. Surprisingly, Germany, Japan, and UK ended up with low scores on this measure, particularly, as a result of their low score on the quality of their educational systems.

4.3.3.2. The availability of technological resources

This variable measures whether new technologies are readily available for firms in each country. Four items were subject to factor analysis and one factor has emerged with eigenvalue of 2.65 which explains 86.7% of the variance. As shown in table (10) items 10, 11, and 12 have high loading on this factor.

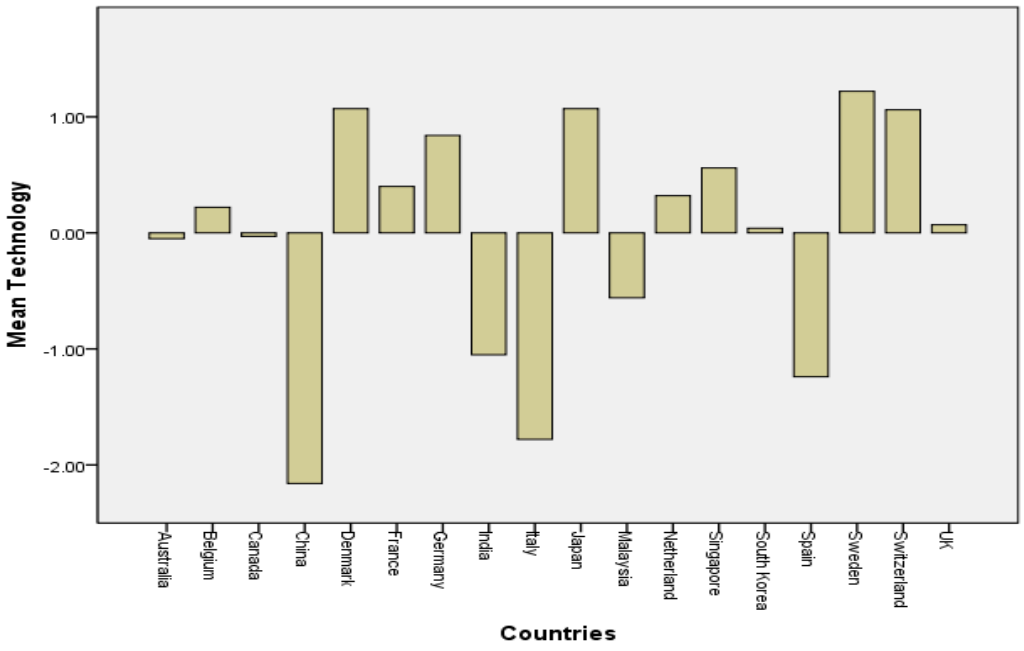
The first item that has high loadings is "Availability of latest technology" which is adopted from the GCR. The question of this item is: "In your country, the latest technologies are (1 = not widely available or used, 7 = widely available and used)." Countries that have high score on this item will have latest technologies available in their local environment.

The second item is "Firm level technology absorption". This variable indicates that not only technology is available but it also has been used properly by local firms. Respondents were asked to answer this question: "Companies in your country are (1 = not able to absorb new technology, 7 = aggressive in absorbing new technology)."

The final item for technological availability measure is the "Production process sophistication." "In your country, production processes use (1 = labor-intensive methods or previous generations of process technology, 7 = the world's best and most efficient process technology)." Clearly, this item measures whether firms use new technologies or outdated ones with high scores for using new technologies. The source of this item is also the GCR.

Figure (9) presents the scores on the availability of technology resources for the selected countries. The scores of countries are somewhat predictable with some countries have really high scores such as Sweden, Switzerland, Denmark, and Japan. On the other hand, China, India, and Malaysia have low scores on this measure. The low scores for Italy and Spain is somewhat odd, but by examining the scores of these two countries on the items that construct the technological availability variable it can be noticed that Italy

Figure 9: The scores of the countries on the availability of technology resources



has low scores on two items (the availability of latest technologies and firms-level technology absorption) while Spain has a low score on the third item (production process sophistication).

4.3.3.3. The availability of financial resources

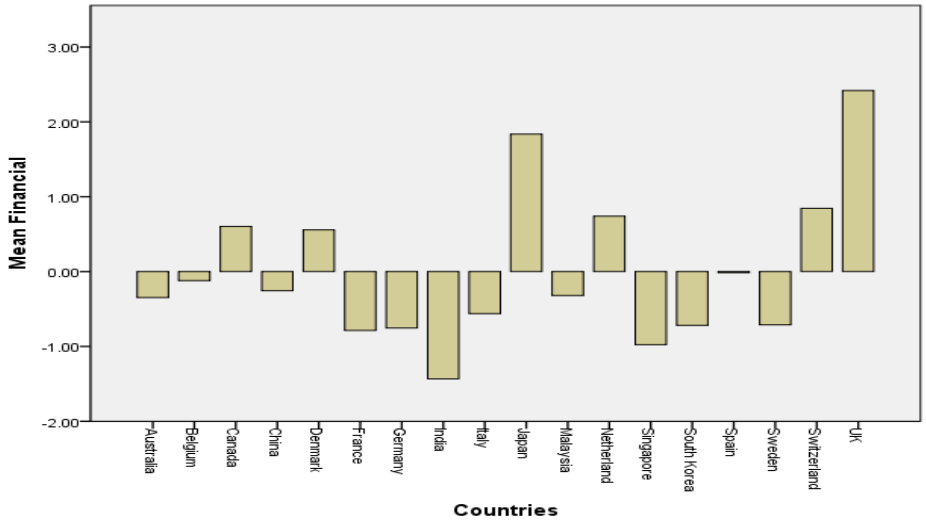
This variable measures the easiness of getting access to capital and the amount of capital available for economic activities within a country. In the literature, many variables have been used to measure the status of financial capital availability. I collected eight

such items from various sources (presented in table 3). The factor analysis for these eight items resulted in two strong factors with high eigenvalues. The first factor consists mainly of the items from the Global Competitiveness Report. The other factor consists of items 14 and 21. I choose to use the second factor because the first factor has high correlation with other types of resources (knowledge and technology) which can cause the problem of multicollinearity between the mediating variables. The correlation of the first factor with the availability of technology was 0.74 and it was 0.61 with the availability of knowledge. The correlations were significant at .01 level when I used the GCR-based items; therefore, the second factor has been chosen to represent the availability of financial resources.

Two items have high loading on the second chosen factor; 1) domestic credit provided by the banking sector, and 2) outstanding loans from commercial banks. This factor explains 65.72% of the variance and its loading is above 0.8 (table 10). The first item is a World Bank Indicator, which includes all the credits to various sectors on a gross basis, with the exception of the credits to the central governments, which are net values. The banking sector includes monetary authorities and deposit money banks, in addition to other banking institutions. The second item is adopted from the IMF, which represents the outstanding loans from commercial banks based on percentage of GDP. The score is calculated by using this equation: (Outstanding loan)* 100/GDP.

Figure (10) presents the scores on the availability of financial resources for selected countries. The distribution of scores is relatively predictable with some countries showing high scores such as Switzerland, UK, Japan, and Netherland. On other hand, other countries will show less availability of financial resources such as China, and India. The

Figure 10: The scores of the countries on the availability of financial resources.



unexpected results are the low score of France and Germany. That could be explained by the tight control of the financial systems in both countries.

Table 10: Results of the factor analysis for the independent and mediating variables

Variables	Variance explained	Items	Loading
Normative pillar	75.25%	Ratio of alliances/acquisition	.867
		Extent of market dominance	.814
		In-group collectivism (practice)	.918
Cognitive pillar	61.04%	Most people can be trusted	.700
		People try to take advantage of you	.851
		Important in life: friends	.827
Knowledge availability	77.60%	Quality of educational system	.881
		Number of scientific and technical journal articles	.881
Technological availability	86.70%	Availability of latest technologies	.961
		Firms-level technology absorption	.902
		Production process sophistication	.930
Financial availability	65.72%	Domestic credit provided by banking sector	.811
		Outstanding loans form commercial banks	.811

4.4. Analysis

This study is concerned with the variance in industry-level network structures that is explained by a number of country-level predictors. Therefore, it mandates a multilevel modeling technique in which the variances can be partitioned between the country-level and the industry-level variables. A variety of statistical procedures are available to analyze multilevel data such as Within-and-Between Analysis (WABA), Hierarchical Linear Modeling (HLM), Cross-Level Operator (CLOP) analyses in regression, and Analysis of Variance (ANOVA) (Klein et al., 2000).

Many authors suggest that the use of traditional statistical techniques in cross-level studies may prove inadequate (Bryk & Raudenbush, 1992; Hoegl et al., 2002; Rousseau, 1985). Hierarchical Linear Modeling (HLM) allows the estimation of random and fixed effects while Ordinary Least Square (OLS) regression includes only fixed effect (Beretvas, 2007). Moreover, HLM overcomes many problems intrinsic to regression methods of dealing with cross-level issues such as unit of analysis problems (Bryk & Raudenbush, 2002).

In this study we are trying to find out if there is a between country variation in their network structure at firm level and explain this variance by variables at country level. Since (HLM) captures "the influence of higher level units on lower level outcomes while maintaining the appropriate level of analysis" (Hofmann, 1997: 726), I am using HLM in this study. With HLM, we can test hypotheses between the two levels of analyses and partition the explained variances at each level (Hoegl et al., 2002).

In order to model both within level (in each country) and between level relationships (among countries), we need to estimate two models: 1) the level-1 model

which, in this case, estimates the variance of density among each of the level-1 units (the biomedical firms), and 2) the level-2 model which explains how variation among level-1 units is explained by level-2 variables (among countries) (Bryk & Raudenbush, 1992).

Level-1 Model

$$Y_{ij} = \beta_{0j} + r_{ij} \quad (1)$$

Where Y_{ij} is the density of firm i in country j, $\beta 0j$ is the intercept estimated for each country, and r_{ij} is the residual (the residual is normally distributed with a variance of σ^2). The level-2 analysis uses the intercept from the level-1 analysis as dependent variables (Bryk & Raudenbush, 1992). The intercept and slop parameters obtained from the level-1 model serve as the dependent variables in the level-2 model (Bryk & Raudenbush, 1992)

Level-2 Model

$$\beta_{0j} = \gamma_{00} + \gamma_{01} * (X_i) + u_{0j} \quad (2)$$

Where X_i is the country level variables (pillars of the institutional profile and the resource availability variables), γ_{00} is the second stage intercept term, γ_{01} is the slope relating Xi to the intercept term from the level-1 equation, and u_{0j} is the level-2 residual (Hofmann, 1997).

To justify the use of the HLM, we need to estimate the partitioning of the variability at each level (Beretvas, 2007). The unconditional model (including no predictors) is used to estimate the partitioning of variability at level-1 and level-2 (Hofmann, 1997). The unconditional model can estimate the variability of network

density among firms and the variability of density among countries.

At level-1, *DENSITY* (the independent variable) for firm *i* in the country *j* is modeled only as a function of country *j*'s intercept and the firm's residual (Beretvas, 2007).

Level-1 unconditional model

$$DENSITY_{ij} = \beta_{0j} + r_{ij} \quad (3)$$

At level-2, country *j*'s intercept is modeled to be a function of the average intercept (*DENSITY* score) across countries and a country residual (Beretvas, 2007).

Level-2 unconditional model

$$\beta_{0j} = \gamma_{00} + u_{0j} \quad (4)$$

Maximum Likelihood method of estimate will be used in this study because the number of firms vary considerably among countries (Max. number of firms is 203 in UK and Min. number of firms is 18 in Malaysia). Bryk and Raudenbush (1992) argue that when *n* is unbalanced between groups, iterative numerical procedures, Maximum Likelihood, must be used to obtain efficient estimates. The estimation of variance component of level-1 and level-2 are used to calculate the intra-class correlation (ICC) which measures the proportion of the variance in the outcome (density) that is between the level-2 units (countries) (Bryk & Raudenbush, 1992). In other words, the ICC represents a ratio of the between country variance in network density to the total variance in network density.

$$\rho = \tau_{00} / (\tau_{00+} \sigma^2) \quad (5)$$

Where τ_{00} is the level-2 residual variance and $\sigma 2$ is the level-1 residual variance. I use the HLM software version 7 (Raudenbush, Bryk, & Congdon, 2010) to calculate the parameters of the unconditional model. The results show that $\sigma 2 = 0.06352$ (variance of firms' density scores within countries assuming homogeneity across countries). $\tau_{00} = 0.00831$ (the variability of density among countries). By using equation (5), the ICC will be:

$$ICC = .00831/ (.00831 + .06352) = .11569$$

That means 11.6% of the variation in network density resides between countries and 88.4% resides within countries. Since in most social science research ICC ranges between 0 and .4 (Snijders & Bosker, 1999), any ICC above .1 is deemed acceptable (Bliese, 2000). The reliability estimate is .803, which is fairly high. The fixed effect estimated in this model is the intercept (the average density value across countries) the $\gamma_{00} = .13$ with a standard error of .02. This coefficient differs significantly from zero (t (17) = 5.69, $p < .001$). The results also indicate a statistically significant amount of variability in network density score between countries ($\sigma 2$ (17) = 85.73, $p < .001$). Since a reasonable amount of variability was found both within and among countries, level-2 predictors can be added to the unconditional model (Beretvas, 2007).

Since we have only 18 countries on level-2 and taking into consideration the test power, we are restricted for the number of variables that we can include into the model in each run. The rule of thumb is that each variable needs at least 10 units on level-2 to maintain acceptable power (Bryk & Raudenbush, 1992; Hofmann, 1997). I will test the relationship between each independent variable and the dependent variable separately. I will use equation 2 and replace the X with the independent variables.

CHAPTER 5: RESULTS

Since the hypotheses of the study concerned only level-2 (country) effect, and following Parboteeah et al. (2008), I just report level two correlations. The correlation matrix is presented in table (11) and it clearly shows that there is no problem of multicollinearity among the variables.

Table 11: Correlations among the variables

	Regulative	Normative	Cognitive	Financial	Knowledge	Technology
Regulative	1					
Normative	-.642**	1				
Cognitive	-.036	-.279	1			
Financial	.454	-.459	.170	1		
Knowledge	.493*	-.342	-.045	-.179	1	
Technology	.644**	-.816**	.063	.276	.526*	1

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

The high and significant correlation between the normative pillar and the regulative pillar is very interesting because the sign is negative. The negative correlation indicates that countries with weak regulative systems will tend to have more norms of inter-organizational relationships, which support the main theme of the study. The correlation between the regulative and cognitive pillars is low and not significant which indicates that at least in the selected countries there is no significant relationship between countries' regulative systems and their cognitive knowledge of cooperation between firms.

The high and significant correlations between the regulative pillar and the availability of knowledge and technological resources are consistent with the predictions

of this study. The sign is positive which means that countries with strong regulative environment will tend to have more availability of knowledge and technological resources.

It can be noticed that there is a high and significant correlation between the normative pillar and availability of technology. This high correlation does not post any challenge of high collinearity because the two variables are not included together in any model in the study. The negative sign between the two variables is also consistent with the general theme of the study because it indicates that the norms of collaboration will prevail in countries that have less availability of technological resources.

The high and significant correlation between the availability of technology and availability of knowledge was expected. The positive sign emphasizes that the more available the knowledge in a country, the more available the latest technologies which is aligned with the main theme of this study. It is worth mentioning here that technologies as measured in this research represent industrial technologies rather than consumer technologies. This differentiation is necessary because many oil rich countries might have high availability of latest consumer technologies without having the availability of industrial technologies.

An interesting finding from this correlation matrix that worth further investigation is the low and not significant correlation between the availability of financial resources and the availability of both knowledge and technological resources. These findings go against the common perceptions that countries with more available financial resources should enjoy more availability of knowledge and technology. By investigating countries' scores on the availability of financial resources, we can notice that there are many

advanced countries that have high availability of technology and knowledge and at the same time have a below average availability of financial resources. These countries are Australia, Belgium, France, Germany, and Sweden. Therefore, it is too simplistic to associate the advancement of a country with its availability of financial resources.

5.1. Testing the Direct-Effect Hypotheses

We use equation (2) to test for the hypotheses 1 to 6. Hypothesis (1) speculates that countries with stronger regulative systems will tend to have less network density because there is less need for networks to arrange the economic activities of firms. Model (1) tests this hypothesis and as it appears on Table 12, the relationship between the regulative pillar and the density of network is negative and significant, which indicates that the higher the score of a country on a regulative pillar the lower the density of the biomedical network in that country. The standard error is also very low (.002). These results support hypothesis (1).

Hypothesis (2) claims that the higher the score on the normative pillar, the more the density of the network structure of its biomedical industry. The results from model (2) show that the coefficient is significant and positive which support hypothesis (2). Hypothesis (3) emphasizes that the higher the score on the cognitive pillar, the greater the

Table 12: Direct effect of institutional profile on network density

	Model 1		**Model 2**		**Model 3**	
	β	SE	β	SE	β	SE
Intercept	.49	.16	.14***	.01	.13***	.02
Regulative pillar	-.005**	.002				
Normative pillar			.06**	.02		
Cognitive pillar					.008	.03

$p^{*} < .1$ $p^{**} < .05$ $p^{***} < .01$

density of the network structure of its biomedical industry. The result in model (3) is positive which supports a positive relationship; however, it is not significant which does not yield a sufficient support for hypothesis (3).

Hypothesis (4) claims that the more available knowledge resources within a country, the lower the density of the network structure of its biomedical industry. Model (4) tests this hypothesis and the result is negative and significant which strongly supports hypothesis (4). Hypothesis (5) states that the more available the technological resources in a country, the lower the density of the network structure of its biomedical industry. The results of Model (5) indicate a significant and negative relationship between network density and availability of knowledge resources. Hypothesis (6) indicates that the more available the financial capital in a country, the lower the density of the network structure of its biomedical industry. Model (6) supports this hypothesis because the relationship is significant and negative. The results of models 4-6 are summarized in table (13).

Table 13: The direct effect of recourse availability on network density

	Model 4		**Model 5**		**Model 6**	
	β	SE	β	SE	β	SE
Intercept	.136***	.01	.14***	.01	.139***	.017
Knowledge resources	-.02**	.007				
Technology resources			-.07***	.018		
Financial resources					-.07***	.01

$p^{*} < .1$ $p^{**} < .05$ $p^{***} < .01$

5.2. Testing the Mediating-Effect Hypotheses

Hypothesis 7 claims that the effect of the regulative pillar on the network structures of the biomedical industry will be partially mediated by the availability of

strategic resources in that country. To test if a variable (M) mediates the relationship between the independent variable (I) and the dependent variable (D), Baron and Kenny (1986), propose a three-step procedure: i) first is testing the direct relationship between the independent and the dependent variable, ii) second is testing for the relationship between the independent variable and the mediator, and iii) third is regressing the dependent variable on the independent and mediator variables. If all the relationships are significant, this means that there is a partial mediation. If the significance of the relationship between the independent and the dependent variables disappear, that means we have a full mediation.

Testing multilevel mediation models by using HLM has received much support in the literature (Zhang, Zyphur & Preacher, 2009). Some scholars refer to this type of relationship as the meso-mediational relationships (Mathieu & Taylor, 2007). Since the model of this research is 2-2-1 (the antecedent and mediation variables are at level-2 and the outcome variable is at level-1), the three steps of Baron and Kenny (1986) can be used to test for mediation by using HLM to test for independent-dependent and independent-mediator-dependent relationships while regression analysis can be used to test for the independent-mediator relationship (Zhang et al., 2009).

The first stage of the mediating test is already executed in model (1) when we show a significant relationship between the regulative pillar and the network density. In stage (2) the relationships between the independent variable and the mediators are tested. Models 7, 8, and 9 test the relationships between the regulative pillar and the availability of resources (summarized in table 14). Since the two independent variables and the mediators are at the same level of analysis, regression models have been used to test for

the relationships. The results of these regression models presented in table (8) indicate that all coefficients are positive and significant which support the notion that the higher the score on the regulative pillar in a country, the more available the financial, knowledge, and technological resources.

Table 14: The effect of regulative pillar on the availability of resources

	Model 7	Model 8	Model 9
Intercept	-3.35**	12.54**	-4.761***
Technology resources	.068***		
Knowledge resources		.178**	
Financial resources			.48**

$p^{*} < .1$ $p^{**} < .05$ $p^{***} < .01$

Finally, we need to perform the last stage of the mediating test. We use HLM because these tests span two levels of analyses (i.e. country and firm levels). Equations (6 and 7) will be used to test the last stage of the mediating effect. Since the dependent variable is the same (i.e. the network density) the level-1 equation will be similar to equation (1). The level-2 equation will be

$$\beta_{0j} = \gamma_{00} + \gamma_{01} * (REGULATI_j) + \gamma_{02} * (Z_j) + u_{0j} \quad (6)$$

The mixed model will be

$$DENSITY_{ij} = \gamma_{00} + \gamma_{01} * (REGULATI_j) + \gamma_{02} * (Z_j) + u_{0j} + r_{ij} \quad (7)$$

Where Z_j is the availability of resource variables (financial, knowledge and technological), γ_{00} is the second stage intercept term, γ_{01} is the slope relating *regulative*

pillar to the intercept term from the level-1 equation, γ_{02} is the slope relating the availability of resource variables to the intercept from the level-1 equation, u_{0j} is the level-2 residual, and r_{ij} is the error term.

Models (10-12) test the mediating effect by utilizing equation (7). Table (15) summarizes the results of the three models. From model (10), we can see the significance has disappeared from the regulative pillar; however, the coefficient of the financial resources is still significant which yields support for the full mediation effect. Similarly, the results of model (11) show that the significance has disappeared from the regulative pillar while the coefficient of the knowledge resources stayed significant. This result provides more evidence for the full mediation effect. Finally, model (12) provides a strong support for the full mediation effect of the resource availability because, again, the regulative pillar is not significant while the coefficient of the technological resources is significant.

Hypotheses 7a, 7b, and 7c are considered as partially supported because the original hypothesized relationships between the regulative pillar and availability of

Table 15: Testing the mediating effect of resource availability

	Model 10		**Model 11**		**Model 12**	
	β	SE	β	SE	β	SE
Intercept	.28	.192	.207	.017	.166	.165
Regulative pillar	-.002	.002	-.000	.002	-.00	.002
Knowledge resources	-.02**	.009				
Technology resources			-.062**	.023		
Financial resources					-.065**	.025

$p^{*} < .1$ $p^{**} < .05$ $p^{***} < .01$

resources was partial mediation, while the findings of the study supported the full

mediation relationship. This deviation from the partial to full mediation is not very significant; therefore, we indicated that these hypotheses are partially supported (not rejected or fully supported)

It can be concluded from the theoretical discussion in chapters (2) that the availability of resources has a stronger influence on network structure than just affecting the relationship between the institutional profile and network density; therefore, the mediating argument is adopted in this study instead of the moderating argument. To test for a possible moderating effect, two-way interactions between the regulative pillar and the three resource variables are performed using equation (8).

$$DENSITYij = \gamma 00 + \gamma 01 * (REGULATIj) + \gamma 02 * (REGULATIj * Zj) + u0j + rij \qquad (8)$$

Where Zj is the availability of resource variables (financial, knowledge and technological), *γ00* is the second stage intercept term, *γ01* is the slope relating regulative pillar to the intercept term from the level-1 equation, *γ02* is the slope relating the two-way interactions between the availability of resource and the regulative pillar to the intercept from the level-1 equation, *u0j* is the level-2 residual, and *rij* is the error term.

The results for testing the moderating effect is provided in table (16). Model (13) tests the moderating effect of the availability of knowledge resources on the relationship between the regulative pillar and network density. The results are not significant which means that we are not able to detect any moderating affect for the knowledge resource availability. Models (14 & 15) that test for the moderating effect of the availability of technology and financial resources respectively, show the same non-significant results, which also indicates that the moderation argument of resource availability does not

explain the relationship between the three constructs (regulative pillar, availability of resources, and network density). As a result, the mediation argument is adopted in this research instead of the moderating argument.

Table 16: Testing the moderating effect of resource availability

	Model 13		Model 14		Model 15	
	β	SE	*β*	SE	*β*	SE
Intercept	.4	.2	.251	.018	.166	.165
Regulative pillar	-.002	.004	-.000	.002	-.00**	.002
Regulative * Knowledge	.0003	.001				
Regulative * Technology			-.002	.003		
Regulative * Financial					.000	.003

p < .1 p** <.05 p*** <.01*

A summary for the results of the hypotheses testing is provided in figure (11), and table (17).

Figure 11: The final results of testing the model

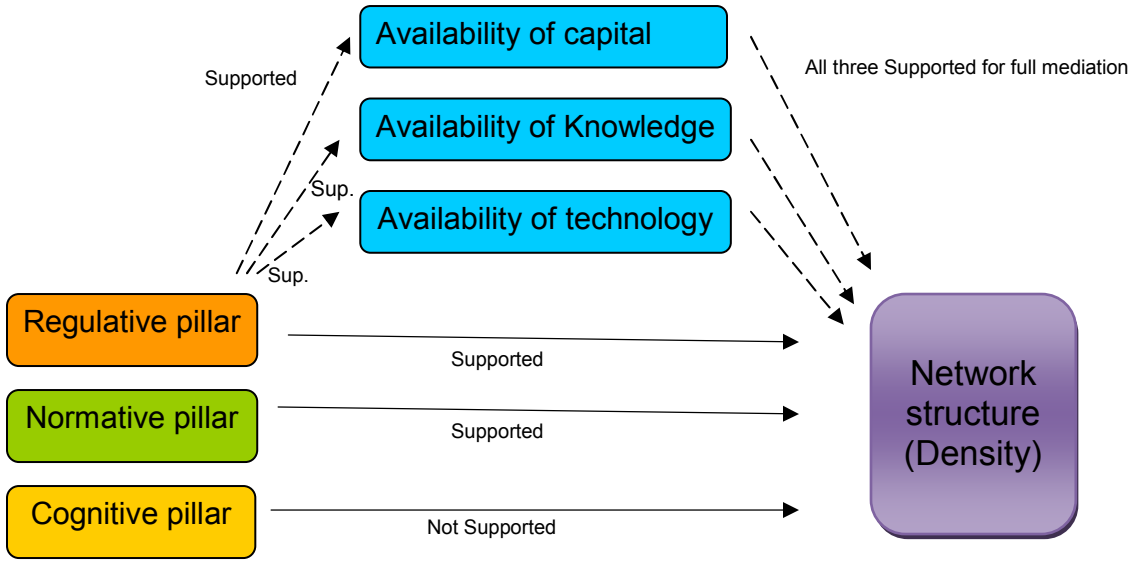


Table 17: Summary results of the hypothesis testing

Hypotheses	Result
H1: The higher the regulative score the less the density	Supported
H2: The higher the normative score the more the density	Supported
H3: The higher the cognitive score the more the density	Not Supported
H4: The more available the technological resources the less the density	Supported
H5: The more available the knowledge resources the less the density	Supported
H6: The more available the financial resources the less the density	Supported
H7a: Availability of technological capital partially mediates the relationship between the regulative pillar and the network density	Partially Supported
H7b: Availability of knowledge capital partially mediates the relationship between the regulative pillar and the network density	Partially Supported
H7c: Availability of financial capital partially mediates the relationship between the regulative pillar and the network density	Partially Supported

CHAPTER 6: DISCUSION AND CONCLUSION

6.1. Implications

The major aim of this research is to detect if there is a country effect on network structure, and explain the main factors behind this country effect. The results of the HLM show that there is a variation in network density among the 18 countries included in this study. The result of the interclass correlation indicates that there is a difference between countries though it is not that high. The ICC is (0.115) which implies that 11.5% of the density variation is among countries and 88.5% is within countries.

This result yields a good support for the argument that "countries do matter" in regard to network structures. Even though the biomedical industry is a relatively new global industry, this study shows that even in an industry which is mainly driven by global norms there is a considerable role for local norms in shaping firms' strategies and more specifically their networking strategies.

This research emphasizes that the density variation among countries is explained by local institutional and resource availability factors. More specifically, the regulative, normative, and cognitive institutions in addition to availability of three types of resources (knowledge, technology, and financial) can shape the networking strategies of firms.

As discussed in the introduction, connecting the institutional environment to the networking activities of firms (e.g. Dacin et al., 2007; Peng & Zhou, 2005) is not something new in the literature; however, very few studies have tried to empirically test the magnitude of the institutional effects on network structure. This research bridges this gap by providing an empirical demonstration of the institutional effects on network structure.

The results of the HLM indicate that there is a significant correlation between the regulative and normative pillars of a country and the density of its network. More specifically, it has been shown that a weak and less reliable regulative system in a country encourages firms to have more network density to compensate for the weak regulative system. The norms of collaboration either on the individual or organizational levels also encourage firms to have denser networks. The coefficients for the effects of regulative and normative institutional pillars are significant but low (table, 13) which indicates that the institutional effect is relatively low.

This is while no significant effect was found for the cognitive pillar on network structure. Failing to show a correlation between the cognitive pillar and the network structure can be explained either theoretically or empirically. From a theoretical point of view, we can argue that the view of personal trust and friendship have little effect on a firm's tendency to make alliances in the biomedical industry because the reliance is on formal relationships rather than personal trust in this industry.

From an empirical point of view, the result of no relationship can also be explained by arguing that the exact measures used to construct the cognitive pillar have no relationship, but if we try to change the component of the cognitive pillar, we might find a relationship with the network structure. For instance, strong attempts had been undertaken to include the number of business associations as a part of the cognitive pillar. However there is no database that provides the number of business associations in the 18 countries included in this study. I have tried to directly contact the specialized authority in many of the 18 countries (including China and India), but I have received no reliable answers about the number of associations in these countries. Therefore, the item on

"number of business associations" was not included as one of the components that construct the cognitive pillar.

Hypotheses 4, 5, and 6 connect the availability of resources to the density of networks. All of these hypotheses have received support from the HLM test. All the relationships were significant and their signs were negative. This implies that countries with less availability of knowledge, technological, and financial resources will have denser networks. The high density of networks will secure the flow of resources among the network members while there is less need for dense networks to transfer resources if those resources are already available from other sources.

The results of these hypotheses provide a good empirical support to the resource dependence theory's predictions regarding networking activities of firms. One of the dominant lines of enquiry in resource dependence literature is how dependence affects organizational decisions (Pfeffer, 2005). The argument is that the more availability of resources in a country, the less dependent are firms on each other. The low dependence encourages firms to establish fewer alliances, which consequently reduces the density of alliance networks.

The results of this research regarding the relationship between resource availability and network structure reinforce similar findings in the literature. For instance, Hite and Hesterly (2001) indicate that dense networks offer advantages for emerging firms in gaining access to needed resources. Other studies found that firms under conditions of high resource interdependence tend to establish small dense networks in which most partners connect to the other networks members (Baum et al., 2003; Gulati & Gargiulo, 1999). Uzzi (1999) argues that firms that are embedded in networks

characterized by a mix of dense and arm's-length ties receive better interest rate on loans.

The general theme in relationship between networks and resource procurements is that network density is a viable factor in acquiring needed resources. However, all of these studies are firm-level which connect the structure of a firm's network to its ability to acquire resources. Establishing the relationship between the availability of resources at the country level to the ego density at the firm level is a major contribution of this research because this relationship demonstrates the strategic nature of networks (Gulati, 1999; Hite & Hesterly, 2001).

Hypothesis 7 (a-c) proposes that the availability of resources partially mediates the relationship between the regulative pillar and the network density. The three steps to test mediation indicate that the relationship is a full mediation and not a partial mediation. This result implies that the institutional environment affects network structure through its influence on the availability of resources.

The full mediation can be justified in lieu of partial mediation because the regulative pillar as measured by the freedom index might have little direct effect on the density of a country's network. It can also be argued that the influence through the affecting mediator variables is much stronger than the direct effect.

Combining the institutional and resource considerations in one framework helps to reconcile the argument of conformity of the institutional theory and the strategic choice of the resource dependence theory (Oliver, 1991). The result of the study indicates that the institutional environment shapes the distribution of resources in a way that makes networking a more rational strategic option than other strategic options, such as merger and acquisition. The reconciliation of the economic and institutional factors in

determining the strategy of firms is a major contribution in this study.

This research provides many practical implications for managers especially for those who are interested in entering new international markets. For instance, recognizing the difference between countries in regards to the structure of networks can have significant implications for managing international operations. For instance, if a pharmaceutical firm wants to enter a foreign country, it is really important to know the local structure of relationships so the new entrant can position itself in the existing structure in the most appropriate way to achieve its objectives.

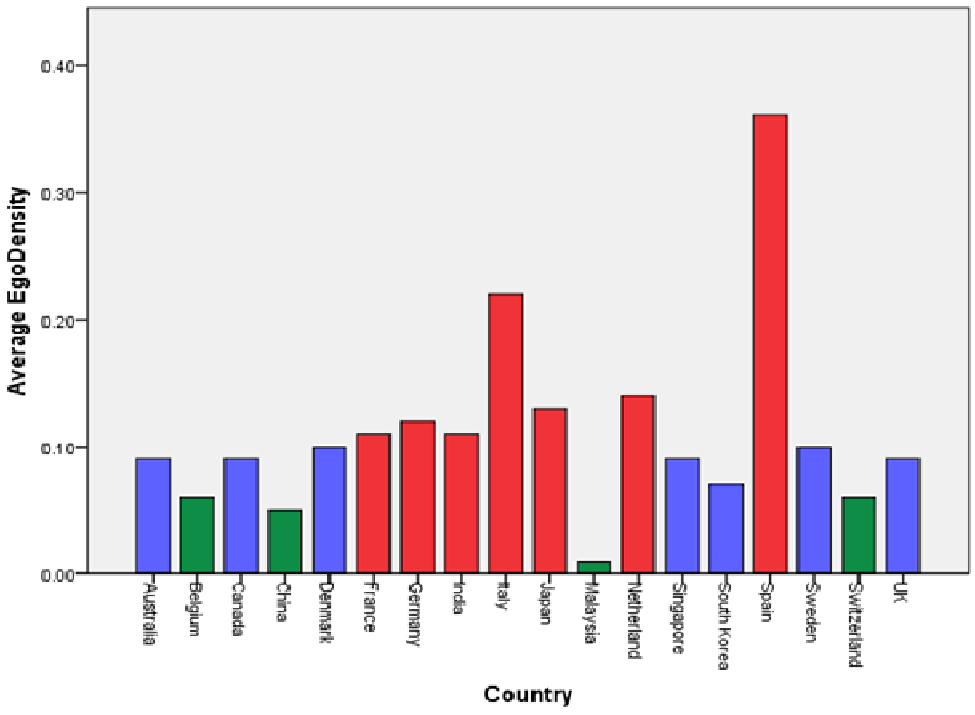
Moreover, by recognizing the institutional and resource factors, managers of firms can expect what to find in a foreign country in regard to the local web of relationships among firms by just identifying the regulative and normative pillars in addition to the availability of the three types of resources. For instance, a manager can expect to find a low density of networks in a host country if that country has strong regulative system and high availability of the three specified resources.

Organizations, in general, need the support of their environment to survive (Meyer & Rowan, 1977). Foreign subsidiaries must adapt to different institutional pressures that organize the markets in which they operate (Rosenzweig & Nohria, 1994) and reduce the liability of foreignness (Zaheer, 1999). The external legitimacy of a foreign subsidiary is its acceptance and approval by the host-country institutions (Kostova & Zaheer, 1999; Kostova & Roth, 2002). It is awarded by the institutional environment in which the subsidiary is embedded and is manifested by adopting practices institutionalized in that environment (Tempel, Edwards, Ferner, Muller-Camen, & Wächter, 2006). Identifying the local norms is the first step for conforming to those

norms. This research provides an overview for the norms of networking in 18 countries, which have very strong implications for practitioners.

Figure (12) presents the average score of firms on the ego network measures in the selected 18 countries that can be classified into three groups. We can notice that in red-labeled countries, the average density of firms is relatively high (above .1). On the other hands, the ego density is low in the green-labeled countries (below .05). Finally, firms in the blue-labeled countries have, on average, moderate ego network densities (.05 - .1). The average network density can give an overview for the norms of networking in a country. For instance, it is clear form figure (11) that biomedical firms in Italy have on average high ego densities, which means the norms for firms in Italy, is to have high density. Any new entrants to the Italian market should try to build high density network if it wants to conform to the local norms of networking.

Figure (12): The average countries' ego network densities



6.2. Limitations

One of the problems of the study is that it concentrates on formal networks and overlooks informal networks. Informal networks are indeed prevalent in developing countries. However, I do not think that overlooking the informal networks posts a big problem to the validity of the results of this study because informal networks have very limited role in the biomedical industry as a highly regulated industry. Many national regulatory authorities oversee and monitor medical research such as the development of new drugs. More specifically, in the USA the Food and Drug Administration oversees new drug development, while in Europe, there is the European Medicines Agency, and in Japan, the Ministry of Health, Labour and Welfare. The World Medical Association develops the ethical standards for the medical profession, involved in medical research. The International Conference on Harmonization of Technical Requirements for Registration of Pharmaceuticals for Human Use (ICH) works on the creation of rules and guidelines for the development of new medication, such as the guidelines for Good Clinical Practice (GCP).

One factor that encourages the formalization of the relationships between biomedical firms is the need to protect the property rights that are produced as a result of joint efforts. Stuart et al. (1999) indicate that biotech firms often have patents to protect their technological knowledge, which can be considered as a crucial resource for these technology intensive firms.

Formalizing and declaring the relationships between biomedical firms and pharmaceutical firms also helps biomedical companies to signal competencies. For a biomedical firm, the alliance with a legitimate pharmaceutical firm offers proof of its

ability to create potential revenue-generating inventions and signals the depth of its technological capabilities to external constituents in the marketplace (Stuart et al., 1999), which increases the value of the biomedical firm (Janney & Folta, 2003).

The highly regulated environment, the necessity of the property right protection, in addition to the benefit of partnership declaration all reduce the existence of informal networks in the biomedical industry. Therefore, we can safely rely on formal networks to detect the actual web of relationships in the biomedical industry.

Another limitation of the study is the reliance on secondary data to measure the countries' institutional profile. The majority of initial studies about institutional profile relied on primary sources of data to measure different pillars of the institutional profile (e.g. Busenitz et al., 2000; Kostova & Roth, 2002). Using secondary data to construct the measures of the independent and mediator variables reduces the reliability of these measures because they are collected from different sources. Since it is really difficult to collect primary data for each domain of countries' institutional profile, I opted to use secondary data just like many other researchers in this literature (e.g. Ang & Michailova, 2008; Parboteeah et al., 2008; Parboteeah et al., 2009; Xu et al., 2004).

In order to control for the industry effect, the comparison between countries has been conducted for just the biomedical industry. That might pose some challenges for generalizability of the results. However, we believe that if we were able to deduct a difference in structure among countries in such a globally integrated industry, we can expect to find more variation in traditional industries because they have been operating in their home countries for a long time, which increases their exposure to local norms.

Finally, the nature of the biomedical industry requires many advanced

technologies and other resources which can restrict our sample for just advanced or emerging countries. For instance, we were not able to construct a biomedical network for any African, South American, Eastern European, or Middle Eastern country. Consequently, the final sample included countries that have many institutional similarities especially regarding regulative pillar and availability of resources. This problem can be mitigated by comparing the networks of industries that have more diverse international coverage such as textile and retailing. We can also argue that if we were able to find institutional effects for such similar countries, we expect to find stronger results if we can include more institutionally diverse countries.

6.3. Future Research

Future research can look at other structural variables that might be affected by institutional factors. For instance, it is worthwhile to detect the relationship between centrality and the institutional profile of the country. The regulative system in a country might encourage the establishments of very big firms that occupy central positions in their networks. Normative and cognitive pillars might also show an effect on firms' centrality in their networks. For instance, it is reasonable to expect the existence of a relationship between the network centrality and cultural variable of power distance.

This study concentrates on the structural embeddedness of firms (the density of the structure). Future research can investigate the relationship between the relational embeddedness and the institutional environment. The relational embeddedness concentrates on the strength of ties among firms (Gulati & Gargiulo, 1999). Networks consist of strong and weak ties (Rowley et al., 2000). It is highly expected to see a cross-country variation in terms of the strength of ties among firms. That variation can be

explained by regulative as well as cognitive and normative factors.

Very interesting implications for the difference in network structure that has been established in this study can be comparing the different performance outcomes of the different structures. For instance, it is worth investigating whether density or structural holes have different performance implications in different countries. This argument will add to our understanding of the debate between Burt (1992) and Coleman (1988) about the superiority of closure or holes.

This research explains the establishment of alliance networks by institutional and resource dependence factors; however, there are other factors that might affect firms' propensities to participate in alliances such as market seeking objectives. Powell (1990) argues that alliances are very effective mechanisms to have access to new markets. Consequently, it would be interesting to see if there is any relationship between the size of the market in a country and the structure of ego networks in that country.

Related to the size of a market is the level of competition in that market. Gimeno (2004) indicates that firms participate in alliances as a strategic response to their competitors' establishments of alliances. Using a longitudinal alliances' data along with the competitive rivalry theory might allow us to see how the network structure will change as a results to the competitive actions and reactions.

Finally, this research connects the social capital that is available in a society to the density of organizational networks. It will be more accurate if we can measure the social capital of the individuals who are closely related to the economic activities of firms such as top management team, board of directors, managers, and employees. It has been established in the literature that the social capitals of the top management team

(Eisenhardt & Schoonhoven, 1996), board of directors (Gulati & Westphal, 1999), and middle managers (Rosenkop et al., 2001) have significant influences on firms' propensities to establish alliances and networks. Therefore, it is worth investigating to see if there is any relationship between the density of the board interlock network in a country and the density of inter-organizational network in that country.

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APPENDIXES

Appendix A: Measures taken to overcome non-English reporting problem

A news search by the native language was performed to detect alliance news that is not reported in English-speaking outlets. This process was performed for firms in these three countries: China, South Korea, and Malaysia. The main source of the news is the Factiva database. The procedures were as following:

1) Prepare the list of firms in each of these four countries.
2) Insert the names of each firms in the Factiva's search field (the name should be inserted in the native language because inserting the English name will most probably brings news that are reported in English outlets).
3) The resulted news in the native language then translated by Google Translate into English (a built-in feature at the Factiva website).
4) Searching for alliance news in the resulted English text.

This process did not significantly increase the number of alliances in these countries. For instance, the increase was just 3 alliances to the 156 already reported alliances in China. No alliances were added to the Korean firms, and one alliance was added to a Malaysian Firm.

Example

To detect the news in Chinese about the Beijing Sinovac Biotech Co. Ltd., the names first translated from English to Chinese: 北京科兴生物制品有限公司 Then the search for this firm at Factiva resulted in 148 piece of news. One piece of news, reported below, indicates on paragraph (5) that the Beijing Sinovac Biotech has a joint development agreement with another Chinese organization which is the Chinese Center of Disease Control to develop

a bird flu vaccine. This alliance is not reported in the SDC and RECAP databases, and I added it to the alliances performed by these two firms. The total of 3 alliances was added similarly to Chinese firms.

The original Chinese text

中关村奏响又好又快发展凯歌

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3 March 2008
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如果说中国企业正在积极搭乘的是一列"创新号"火车的话，那么中关村科技园区必定是这列火车的火车头，有力地拉动了我国企业创新和产业升级。回顾２００７年，这趟疾驰的列车掀起了一阵又一阵的高科技旋风，其自身也在不断提速的过程中越驶越勇，奏响了又好又快发展的凯歌。

自主创新 高新技术产业实现又好又快发展

中关村科技园区自建立以来，高新技术产业保持了２５％以上的年增长率。２００７年，中关村科技园区高新技术企业总收入超过８５００亿元，约是２００２年的３．６倍，占全国５４个国家高新区的１／７；国内生产总值１６００亿元，约是２００２年的3倍，占北京市的１８％；上缴税金３２０亿元，是２００２年的３．２倍；连续４年每年新增加年销售收入超亿元的企业１００家以上，目前，年超亿元的企业总数超过８００家。

此外，中关村科技园区芯片设计产业、软件产业的销售收入均占全国的１／３；科技与文化结合的创意产业增加值占北京市相应增加值的４０％。

重大科技创新成果不断涌现

２００７年，中关村科技园区重大技术、产业化创新成果不断涌现，在国家发展战略中的影响力迅速提升。中国航天科技集团、钢铁研究总院、有色金属研究总院等中关村科技园区企业院所积极参与了嫦娥探月工程有关项目研发，提供了相应的技术和服务，为嫦娥探月工程圆满成功做出了贡献。博奥生物有限公司承担的"生物芯片北京国家工程研究中心"项目在生物芯片技术的研究开发和产业化方面已达到国际先进水平。目前，该中心已研制出系列可供研究、诊断和药物开发等领域应用的生物芯片，其中多种芯片属国际首创，率先实现了我国生物芯片技术在国际专利领域零的突破。

北京科兴生物制品有限公司与中国疾病预防控制中心共同研制的人用禽流感疫苗顺利完成II期临床试验，疫苗对人体安全有效。同时，科兴公司通过承担国家发改委重大项目"２０００万支防治流感大流行疫苗的产业化"项目，初步具备了大流行流感疫苗的生产能力，从而为我国应对流感大流行、保障北京奥运会顺利举办提供了科技支撑。此外，中关村科技园区企业联合参与了中南海国办节约型办公区的建设。今年，闪联标准即将成为全球首个３C协同的国际标准，中关村科技园区企业主导创制的国际标准累计达到１４项，国家标准１３０项。

新兴科技企业脱颖而出

中关村科技园区管委会统计数据显示，２００７年，中关村科技园区高新技术企业研发投入占销售收入的比例达到４．５％，高出全国企业平均水平约４个百分点；企业专利申请和授权数同比分别增长１８％和４９％，均占北京地区企业的一半以上；软件著作权、集成电路布图设计登记量居全国领先地位。

在中关村科技园区，除了人们所熟悉的联想、方正、同方科兴、搜狐、百度等著名高科技企业在继续发展的同时，一批新的科技企业脱颖而出，成为新兴产业的领军企业。如在清洁技术领域，碧水源公司研发的生物膜污水处理技术占据了全国污水资源化利用市场的７０％；神雾热能公司研发的蓄热式烧嘴技术使工业窑炉分别节能和减排３０％以上。这些节能减排和资源循环利用技术都达到了国际领先水平。

在文化创意领域，创毅视讯公司研制成功第一个符合国家移动多媒体广播行业标准的手机电视芯片；文思创新公司是我国最大的也是我国首家在纽约交易所上市的离岸软件外包企业；完美时空公司研发的国内首个３D网游开发平台，其生产的具有中国民族文化特色的网游产品出口到１３个国家和地区。

The English-translated text

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Zhongguancun played the song of victory sound and rapid development

If Chinese companies are actively riding the train of an "innovation No. Zhongguancun Science Park must be the locomotive of the train, stimulating innovation and industrial upgrading of China's enterprises. Back in 2007, the train of the trip gallop off burst after burst of high-tech whirlwind itself are constantly speed up the process, the more Chi Yue Yong, played a sound and rapid development of triumph.

Innovation high-tech industries to achieve sound and rapid development

Zhongguancun Science Park since its establishment, the high-tech industry maintained an annual growth rate of more than 25%. In 2007, the total income of the high-tech enterprise of Zhongguancun Science Park, more than 850 billion yuan, about 3.6 times in 2002, accounting for 1/7 of the 54 high-tech zones; 160 billion yuan of gross domestic product (GDP), about 2002 three times, accounting for 18 percent of Beijing; taxes of 32 billion yuan, 3.2 times in 2002; for four consecutive years the annual increase in annual sales income of 100 million yuan more than 100 enterprises, at present, over a hundred million The total number of enterprises is more than 800.

In addition, the chip design industry of the Zhongguancun Science Park, the software industry's sales revenue account for 1/3 of the country; combination of technological and cultural creative industry accounts for 40% of the Beijing corresponding increase in the value of.

Major scientific and technological innovations continue to emerge

2007, the major technologies of Zhongguancun Science Park, industrialization innovations continue to emerge, the influence of the rapid increase in national development strategies. China Aerospace Science and Technology , Central Iron and Steel Research Institute, Institute for Nonferrous Metals, Zhongguancun Science Park enterprises institutes actively involved in the project research and development of the Chang'e lunar exploration project; the technologies and services, the success of the Chang'e lunar exploration project make a contribution. CapitalBio Corporation assume Biochip National Engineering Research Center in biochip technology research and development and industrialization has reached the international advanced level. Currently, the center has developed a series available for research, diagnostics and drug development applications in the field of bio-chip, multiple chips, an international initiative, the first to achieve a zero breakthrough of China's bio-chip technology in the field of international patent.

Beijing Sinovac Biotech Co., Ltd. and the Chinese Center for Disease Control jointly developed human bird flu vaccine successful completion of Phase II clinical trials, the vaccine is effective on human securnty. The same time, of Sinovac companies by taking on the major projects of the National Development and Reform Commission 20 million prevention and treatment of influenza pandemic vaccine industry "project, initially with a production capacity of pandemic influenza vaccine for an influenza pandemic, which for our country to protect Beijing Olympics successful organization that provides scientific and technological support. In addition, the Zhongguancun Science Park companies have jointly participated in Zhongnanhai, the Office of the State-saving office building. This year, the IGRS standard will soon become the world's first collaborative international standards 3C, Zhongguancun Science Park was created by business-led international standards has reached

Appendix B: Summary for the final variables used in the study

Variables		Measure	Data source
Dependent variable: (Network structure)			
Network density		The number of ties divided by the number of pairs, times 100	SDC and RECAP databases
Independent variables (Institutional profile)			
Regulative Pillar		*Index of economic freedom:* Business Freedom, Trade Freedom, Fiscal Freedom, Government Spending, Monetary Freedom, Investment Freedom, Financial Freedom, Property rights, Freedom from Corruption, and Labor freedom.	Heritage Foundation and Wall Street Journal
Normative Pillar	*the ratio of alliances cases to acquisition cases*	The total number of alliances in a country for the total number acquisition in that country	SDC
	Extent of market dominance	How would you characterize corporate activity in your country? (1 = dominated by a few business groups; 7 = spread among many firms)	GCR
	Collectivism in-group	1- whether children take pride in the individual accomplishments of their parents and vice versa 2- whether aging parents live at home with their children 3- whether children live at home with their parents until they get married	GLOBE
Cognitive pillar	*Trust*	Generally speaking, would you say that most people can be trusted or that you need to be very careful in dealing with people? Possible answers 1 Most people can be trusted 2 Can´t be too careful -1 Don´t know -2 No answer -3 Not applicable -4 Not asked in survey -5 Missing; Unknown	WVS
	People try to take advantage of you	Do you think most people try to take advantage of you (10 point scale) Possible answers o 1 Would take advantage o 2 2 o 3 3 o 4 4	WVS

		○ 5 5 ○ 6 6 ○ 7 7 ○ 8 8 ○ 9 9 ○ 10 Try to be fair ○ -1 Don´t know ○ -2 No answer ○ -3 Not applicable ○ -4 Not asked in survey ○ -5 Missing; Unknown	
	Important in life: friends	For each of the following aspects, indicate how important it is in your life. Would you say it is: Friends Possible answers 1 Very important 2 Rather important 3 Not very important 4 Not at all important -1 Don´t know -2 No answer -3 Not applicable -4 Not asked in survey -5 Missing; Unknown	WVS
Mediation variable (resource availability)			
Availability of knowledge	*Quality of educational system*	The educational system in your country (1 = does not meet the needs of a competitive economy, 7 = meets the needs of a competitive economy)	Global Competitiveness Report
	Number of Scientific and technical journal articles	Scientific and technical journal articles refer to the number of scientific and engineering articles published in the following fields: physics, biology, chemistry, mathematics, clinical medicine, biomedical research, engineering and technology, and earth and space sciences.	USPTO
Availability of technological resources	*Availability of latest technologies*	In your country, the latest technologies are (1 = not widely available or used, 7 = widely available and used)	GCR
	Firm-level technology absorption	Companies in your country are (1 = not able to absorb new technology, 7 = aggressive in absorbing new technology)	GCR
	Production process sophistication	In your country, production processes use (1 = labour-intensive methods or previous generations of process technology, 7 = the world's best and most efficient process technology)	GCR
Availability of financial resources	*Domestic credit provided by banking*	Domestic credit provided by the banking sector includes all credit to various sectors on a gross basis, with the exception of credit to the central	World Bank Indicators

	sector	government, which is net. The banking sector includes monetary authorities and deposit money banks, as well as other banking institutions where data are available (including institutions that do not accept transferable deposits but do incur such liabilities as time and savings deposits.	
	Outstanding loans from commercial banks	(Outstanding loan)* 100/GDP	IMF