Innovation Intermediation Activities and the Actors that Perform Them

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Abstract

While many organizational actors, including firms, governments, universities, and non-profit organizations may have an impact on the innovative capacity of the firms with which they engage, we have little knowledge of their relative importance. The literature on innovation intermediaries reports on the impact of specific types of organizations, but has not considered the relative importance of different types of organizations. While the studies using Community Innovation Survey (CIS) data are able to consider relative effects, data on the nature of those effects are limited. In the interests of a better understanding of the relative nature and degree of the innovation enabling contributions of a range of organizational actors, I conduct a comparative examination of the contributions of firms, governments, universities, industry associations, and research institutes. Using survey data from a sample of 499 firms, I identify the actors that are most strongly associated with each of ten innovation intermediation activities.

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1. Introduction

Innovation is facilitated by innovation intermediation activities that may involve a range of external organizational actors (Acworth, 2008; Bessant & Rush, 1995; Branstetter & Sakakibara, 2002; Debackere & Veugelers, 2005; Doloreux and Melancon, 2009; Hargadon & Sutton, 1997; Motohashi & Yun, 2007; Sapsed, Grantham, & DeFillippi, 2007). These include for-profit consulting or service firms (Bennett & Robson, 1999; Hargadon & Sutton, 1997; Zhang & Li, 2010), public organizations such as government agencies (Branstetter & Sakakibara, 2002), and private non-profit organizations such as university-based technology transfer organizations (Acworth, 2010; Debackere & Veugelers, 2005; Siegel, Waldman, & Link, 2003), non-profit research consortia (Aldrich & Sasaki, 1995; Grindley, Mowery, & Silverman, 1994), innovation networks (Human & Provan, 1997), and industry associations (Dalziel, 2006).

Innovation intermediation activities include activities that involve multiple-party interaction as well as activities that involve just the intermediary and the focal firm (Dalziel, 2009; Howells, 2006, p725). Multiple-party activities include, for example, providing business information to multiple entrepreneurs or connecting the entrepreneurs with other relevant partners (Sapsed et al., 2007), transferring expert knowledge and experiences from other fields (Bessant & Rush, 1995), and stimulating vertical collaborations that involve multiple organizations (Grindley et al., 1994). Activities that involve just the intermediary and the focal firm include managing patents (Debackere & Veugelers, 2005) and conducting research on behalf of member or client firms (Aldrich & Sasaki, 1995).

The innovation intermediaries literature[1] describes the impact of specific organizational actors or types of organizational actors, including for-profit firms and non-firm actors. For example, Bessant and Rush (1995) describe the contributions of consulting firms in bridging the managerial gap. Hargadon and Sutton (1997) describe how consulting firm IDEO facilitates innovation by transforming and combining ideas and resources. Zhang and Li (2010) examine the contributions of professional service intermediaries, such as technology service firms, accounting and financial service firms, law firms, and talent search firms, in contributing to product innovation by broadening the scope of external information search. Similarly, Lee, Park, Yoon, and Park (2009) examine how inter-firm collaborations facilitate the innovativeness of industrial firms. Other researchers describe the contributions of non-firm actors, such as universities, governments, and non-profit organizations. For example, Grindley et al. (1994) describe the process by which a non-profit research consortium SEMATECH facilitates vertical innovation collaborations, Branstetter and Sakakibara (2002) assess and prove the impact of research consortia in the US on patenting, Dalziel (2006) shows that industry associations have a strong impact on the ability of Canadian firms to innovate, and Acworth (2008) examines the impact of universities on enabling innovation.

The innovation intermediaries literature benefits from the full descriptions of specific organizations and a wide range of activities. But it exhibits a methodological limitation insofar as the samples used are typically not randomly selected. Samples are selected from a single intermediary or multiple intermediaries of the same type, typically including participating firms and possibly non-participating firms in paired sample studies. For example, they are chosen only from a research consortium (Grindley et. al.,

[1] Tables on the contributions and limitations of innovation intermediaries literature are presented in Appendix

1994), a consulting firm (Hargadon & Sutton, 1997), a technological knowledge exchange program (Acworth, 2008), or a university-based technology organization (Debackere & Veugelers, 2005). Under these circumstances, it is not possible to compare the relative importance of a range of organizations.

Community Innovation Surveys (CISs) help us gain insights into innovation: product innovation, process innovation, ongoing or abandoned innovation activities for process and product innovations, innovation expenditures for process and product innovations, the source of information and co-operation for innovation activities, factors hampering innovation activities, effects of innovation, and organizational innovation and marketing innovation (OECD, 2005). These surveys assess the impact of for-profit firms, such as consultancy firms, the impact of public agencies, such as government research institute, and the impact of non-profits, such as non-profit research institutes and universities.

Studies that use the data in Community Innovation Surveys benefit from a large random sample that can evaluate the impact of various organizational actors and their innovation intermediation activities. But CISs data only considers two innovation intermediation activities: Sources of information and cooperation for innovation activities. Although the CISs are not designed to consider innovation intermediation activities, two of the questions can be interpreted in this manner. The sources of information and innovation cooperation can both be interpreted as questions that pertain to the organizational actors from whom firms get information and the organizational actors with whom they cooperate. But these are high-level questions that provide limited information. Therefore, the data interpreters of CISs obtain the following results: “nearly a quarter of all innovative enterprises indicated that they engage in some cooperation activities when developing their innovation" (Central Statistical Office Ireland, 2009: p5). The results mention several times "some cooperation activities", and it is necessary for us to more deeply understand the nature of cooperation activities and the actors that perform them.

In addition, the list of sources for information in Community Innovation Surveys does not distinguish between the organizational actors and organizational roles (OECD, 2005, p81: Table 5.1). This further causes difficulty in interpreting data. For examples, the data interpreter would take it for granted that competitors, customers, and suppliers are for-profit firms because these three sources of information, along with consultancy firms are categorized together into external commercial sources (Ashby & Mahdon, 2009; Veugelers & Cassiman, 2005). Policy makers, managers, and researchers who use the survey data may overestimate the impact of for-profit firms, may consider for profits the most significant contributors to innovation. On the other hand, non-firm innovation intermediaries, such as industry associations, universities and research institutes that may also act as competitors, customers, and suppliers, may be underestimated (Dalziel, 2006; Department for Innovation, Universities & Skills, 2009). As a consequence, the innovation policies and strategies may be compromised. For example, when small and medium enterprises have difficulties in finding knowledgeable people and partner organizations, industry associations cannot legitimize themselves to be the strategic facilitator or inter-mediator to help these enterprises. This leads us to focus on the relative impact of a range of organizational actors that perform innovation intermediation activities.

In the interests of better understanding the relative contributions of a range of organizational actors, I conduct a comparative examination of the contributions of firms, governments, universities, industry associations, and research institutes. This study contributes to examining the impact of a wider range of innovation intermediation activities and a clearly designated range of organizational actors. In so doing, it attempts to better understand which innovation intermediation activities most benefit industrial firms and which organizations are most likely to be involved.

I draw on international survey data and use a subset of 499 respondent firms that answer the questions on the importance of innovation intermediation activities and the organizational actors that perform them. The results show that activities that help firms innovate are more important than activities that oblige firms to innovate. While for-profit firms, universities, and industry associations are the important to enable firms to innovate, government agencies are important only to force firms to innovate. Although it is mostly held that for-profit firms are the most important actors in enabling innovation, it is interesting to note that this is not so for all enabling activities. For example, Universities are the most important actors in helping firms learn about technology. Industry associations are the most important actors in facilitating multiple-party innovation collaborations.

In Chapter 2, I review the field of innovation intermediaries. In Chapter 3 I describe the concepts that are central to my study, and then derive hypotheses on the relative impact of innovation intermediation activities and organizational actors. In Chapter 4, I present my methodology. Following this, in Chapter 5 I report the results of the testing of hypotheses, and in Chapter 6 I conclude with a discussion of the results and suggestions for future research.

2. Literature Review

The first part of this section reviews the characteristics and definitions of innovation intermediaries, the second part reviews the users and activities of innovation intermediaries, and the final part discusses the impact of innovation intermediaries.

2.1 Definitions of Innovation Intermediaries

Many types of innovation have been studied including consultants (Bessant & Rush, 1995), university-based technology transfer organizations (Debackere & Veugelers, 2005), service firms (Zhang & Li, 2010), technology incubators (Rothaermel & Thursby, 2005), science parks (Löfsten & Lindelöf, 2002; Shearmur & Doloreux, 2000), and research consortia (Branstetter & Sakakibara, 2002; Grindley et. al., 1994). Researchers have characterized innovation intermediaries as technology brokers (Hargadon & Sutton, 1997), bridging organizations (Sapsed et al., 2007), innovation support organizations (Doloreux & Melancon, 2009), and facilitators of innovation networks (Human & Provan, 1997).

Howells (2006) characterizes innovation intermediaries as a single class of organizations that acts an agent or broker in any aspect of the innovation process between two or more parties" (Howells, 2006: p.720). He also distinguishes between the concept of innovation intermediaries and the concept of innovation intermediation activities. He identifies ten types of innovation intermediation activities: Foresight and diagnostics, scanning and information processing, knowledge processing, generation and combination, gate keeping and brokering, testing, validation and training, accreditation and standards, regulation and arbitration, intellectual property, commercialization, and assessment and evaluation.

While Howells (2006) defines innovation intermediaries on the basis of the activities they conduct, Dalziel (2009) proposes a purpose-based definition that aims at distinguishing dedicated innovation intermediaries from other organizations or firms that enable the innovation process. She defines innovation intermediaries as "organizations or groups within organizations that work to enable innovation, either by enabling the innovativeness of one or more firms, or indirectly by enhancing the innovative capacity of regions, nations, or sectors" (Dalziel, 2009: p.4). She also identifies three primary categories of innovation intermediation activities, namely, inter-organizational networking activities, technology development and related activities, and complementary business services.

But there is no agreement on the boundary of innovation intermediaries. Some studies consider for-profit firms as innovation intermediaries (Bessant & Rush, 1995; Hargadon & Sutton, 1997; Klerkx & Leeuwis, 2008a; Zhang & Li, 2010), while others do not (Dalziel, 2009; Howells, 2006). Some studies think of industry associations as innovation intermediaries (Dalziel, 2006; Lee et al., 2009), while others do not (Aldrich & Fiol, 1994; Human & Provan, 1997). By considering a comparative examination of a range of organizational actors, my study makes an empirical contribution to this discussion.

2.2 Activities of Innovation Intermediaries

In the following, I consider two types of activities of innovation intermediaries: Knowledge exchange and technology transfer. Knowledge exchange refers to the cooperative activities that support the use and sharing of information among two or more parties. Technology transfer refers to activities that facilitate the commercialization of scientific research. The technology transfer activities may involve financing the commercialization of scientific inventions, managing intellectual property, and developing and marketing technology-based products.

2.2.1 Knowledge Exchange

Knowledge exchange is difficult and resource-intensive activity. It is especially difficult for small and medium enterprises and new enterprises, between organizations across different industries, and between users and suppliers in vertical value chain.

The managerial weaknesses of firms cause difficulty in exchanging knowledge and searching information (Bessant & Rush, 1995). Small and medium enterprises and new enterprises commonly suffer from limited internal resources and narrow scope of networking and relationship with external actors. In order to mitigate the problems, for-profit consultants help the small and medium enterprises articulate and define needs in innovation, directly absorb specialized knowledge, provide a channel and selection aid to access a wide range of specialized knowledge, facilitate experience sharing, and carry ideas from one context into another (Bessant & Rush, 1995). For-profit service innovation intermediaries, such as financial service firms, law firms, technology service firms, and talent search firms, help new enterprises broaden the scope of their external innovation search by offering specialized financial or business services, providing the information on the sources of financial resources, identifying knowledge people, building social or innovation networking, accessing to the unknown technological knowledge, and commercializing innovation (Zhang & Li, 2010). The users of the abovementioned for-profit consultants or service firms are small and medium enterprises and new enterprises.

In addition, the boundaries among different industries cause difficulty in exchanging knowledge (Sapsed et al, 2007). Technological knowledge tends to be "local" and therefore difficult to transfer across industries (Garud & Rappa, 1994). Cohen and Levinthal (1990) propose the ideas of a "gatekeeper" which may mitigate the problem of knowledge exchange across industries. "Gatekeepers" are boundary-spanners that bridge the gap between the firms and external environment. Sapsed et al. (2007) suggest that bridging organizations can play the role of a gatekeeper to span the boundaries between industries. These are especially useful in sectors whose boundaries have undergone a major redefinition. Bridging organizations provide legal and business advice, offer a wide range of financial options, build community networking, and help firms refine business models. The users of the bridging organizations are firms that have managerial weaknesses. Hargadon and Sutton (1997) describe how IDEO help firms transform knowledge from different industries to create new product concepts and design, and business models. The users of IDEO are both large firms and start-ups that lack the expertise of product design.

Knowledge exchange between suppliers and users in vertical value chain is also difficult. In order to mitigate this difficulty, innovation intermediaries help firms articulate demand, search information, and establish networks. Research consortium SEMATECH focuses on facilitating vertical collaboration between suppliers and users by funding and providing advice on product development, improving the quality of production equipment, predicting the path of technological innovation in semiconductor industry, developing standards for equipment, testing equipment, and improving communication between suppliers and users (Grindley et. al., 1994). The users of SEMATECH are the firms in US semiconductor industry which depends on rapid product innovation. Innovation intermediaries facilitate vertical collaboration in the agricultural sector by enabling user firms to articulate demand, developing sources and absorptive capacity for innovation, broadening the scope of information search, and facilitating financial support (Klerkx & Leeuwis, 2008b).

2.2.2 Technology Transfer

Many researchers have observed difference in the goals, activities, and outcomes of the scientific and business communities (Etzkowiz & Leydesdorff, 2000). Dalziel (2009) refers to the gap between scientific community and business community as the innovation gap, and the gap between the scientific and business communities causes difficulty in technology transfer. The scientific community consists of researchers from universities, research institutes, public government agencies, and private firms that engage in R&D activities. In contrast, the business community consists of business people mainly from a wide range of private firms. While the scientific community emphasizes basic research, the business community emphasizes maximum profitability and high sales growth.

A potential model that reduces the gap between the two communities most likely involves four actors, namely, governments, universities, innovation intermediaries (enablers), and industrial firms (Dalziel, 2007). Governments provide regulatory and financial support; universities generate basic research and technological knowledge; and universities-based technology transfer organizations and technology incubators enable the commercialization of technological knowledge that benefits the innovation process of industrial firms. Thus, innovation intermediaries play an important role in transforming novel scientific results into commercially viable products and services. For example, university-based technology incubators reduce the probability of failure of high-technology start-ups by the means of technology licenses with the sponsoring research university (Rothaermel & Thursby, 2005). University-based technology transfer organizations facilitate the commercialization of basic research or scientific discovery by building faculty reward system, promoting staffing practices, and overcoming the culture barrier between industrial firms and universities (Siegel et al., 2003). Academic technology transfer organizations improve industry science links by funding and supporting contract research, managing intellectual property, and commercializing scientific inventions via spill-off firms (Debackere & Veugelers, 2005). The users of the technology (academic) transfer organizations or technology incubators are universities that focus on basic research and scientific discoveries.

Research consortia attempt to link scientific and business communities (Branstetter & Sakakibara, 2002). Research consortia in the US and Japan function differently. While Japanese research consortia link the scientific community to the business community by coordinating research in member firms, while the US research consortia link the technology community to business community by facilitating multiple-party innovation collaboration among universities, independent labs, and member firms (Aldrich and Sasaki, 1995). The users of research consortia are commonly the firms that have capacity of R&D.

2.3 Impact of Innovation Intermediaries

Researchers have described the activities of innovation intermediaries, but the question remains: What is the impact of innovation intermediaries? Thus, in the following, I review the studies of impact of innovation intermediaries.

Some studies on innovation intermediaries have focused on the impact of a single innovation intermediary. Grindley et al. (1994) examine the transformation of a research consortium SEMATECH in United States by the methods of semi-structured interviews and secondary data. They find SEMATECH has a positive impact on enabling vertical cooperation between the suppliers and user firms in US semiconductor industry which depends on rapid product innovations. They also hope that the successful model in SEMATECH can be transferred to other industries. Hargadon and Sutton (1997) conduct an ethnographic study on a consulting firm IDEO in UK by the means of tracking development projects, semi-structured interviews with managers, informal discussions or meetings, design team interviews, and secondary materials about the organizations. By doing so, this consultant has a positive impact on the production process of both the large client firms and start-up firms that lack the expertise or employees to design. Sapsed et al. (2007) conduct an elaborative case study on a series of “business clinics” initiated by a bridging organization called Wired Sussex in the UK electronic games sector. They find that Wired Sussex as an innovation intermediary has a positive impact on participating firms that have managerial weaknesses, and show that organizational design and management process act the most important role in attracting participating firms and producing positive impact for the firms. Debackere & Veugelers (2005) conduct a case study on a technology transfer organization of the K.U. Leuven (K.U. Leuven Research and Development) in Belgium, and this technology transfer organization plays an important role in commercializing the scientific research of universities and facilitating science-industry links.

Some studies have examined the impact of multiple innovation intermediaries of the same type. The studies involve the examination of consultants, research consortia, industry associations, and service firms. Bessant and Rush (1995) pay attention to consultants under the program of under the Advanced Manufacturing Technology support in UK, and they find that these consultants play a positive intermediary role in bridging managerial gap for the firms that lack managerial capabilities such as recognition of requirements for technology strategies, exploration of solutions to technological problems, selection of the best solution to problem, and management of technology. Sakakibara & Branstetter (2003) empirically evaluates the impacts of research consortia in the United States on the research outcomes of their member firms. The authors find that there is a positive relation between the participation in research consortia and the overall research outcomes of member firms, and they also suggest that large and R&D intensive firms benefit most from research consortia. Aldrich and Sasaki (1995) employ the same set of questionnaire on 39 US consortium managers and 54 Japanese consortium managers to conduct a comparative study on the R&D activities in the consortia in the two countries, and they find that the member firms of US research consortia are commonly at the pre-competitive stage, while the member firms of Japanese research consortia are large firms in high technology industries and could be nominal competitors. Dalziel (2006) presents that industry associations have a strong impact on enabling small firms to innovate, and she also find empirical evidence to prove that industry associations are the most frequently cited as the important source of ideas in the Canadian Innovation Survey. But the measurement guidelines of the Oslo Manual and the Frascati Manual make it hard to closely examine the impact of industry associations that perform as innovation enablers. Human and Provan (1997) conduct a qualitative study of two networks of small-to-medium-sized manufacturing enterprises in the US wood products industry, and they show that the two innovation networks add value to small firms. Bennett & Robson (1999) use a large-scale survey instrument to test the impact of 13 for-profit business advice providers on small and medium enterprises in UK, and the result shows that for-profit business advice providers, such as accountants, consultants, solicitors, and banks, are the most crucial sources of business advice. Zhang & Li (2010) use a survey data on 500 new manufacturing firms in China to examine the impact of Chinese service intermediaries. The result shows that there is a positive relationship between the use of service intermediaries and the product innovation of new firms.

Other studies have taken a novel approach and considered diverse types of innovation intermediaries in the same region. For example, Doloreux and Melancon (2009) conduct semi-structured interviews with directors and managers of three innovation-support organizations whose mandate is to promote the economic development in the marina science and technology industry of the coastal region of Quebec. They present that three innovation support organizations have positive impact both on the development of the whole industry and region, but they concern about the R&D capabilities of innovation support organizations due to a lack of sufficient researchers, engineers, and technicians, and a conflict between their financial autonomy and R&D activities. In addition, Smedlund (2006) conducts a case study in a medical technology cluster that is located in Finland, and he finds that regional innovation intermediaries play the most significant role in supporting innovation networking for the whole region.

On the other hand, some researchers show the evidence of no impact or even negative impact of innovation intermediaries. For example, Shearmur and Doloreux (2000) employ quantitative techniques to test the association between the opening of science parks and employment growth in Canadian high-technology sectors, and they find that there is no association between the two variables. King and Lenox (2000) examine the impact of Chemical Manufacturing Association in the United States. They provide empirical evidence that shows the firms in the Chemical Manufacturing Association improve the environment practices more slowly than non-member firms.

2.4 Summary

In summary, the impact of innovation intermediaries is considered positive in some studies, while other studies suggest that the impact of innovation intermediaries may be positive, little, or even negative. Although the extant studies examine the impact of a single innovation intermediary or multiple innovation intermediaries of same type, there are comparatively few studies that compare the relative impact of a range of innovation intermediaries and innovation intermediation activities. Thus, my study employs a large-scale sample to compare the relative impact of a range of innovation intermediary actors and innovation intermediation activities.

3. Conceptual Development

In this section, I consider a range of innovation intermediation activities and the organizational actors that perform them. I then derive hypotheses on the impact of organizational actors that perform innovation intermediation activities.

3.1 Concepts

In the following, I abstract a range of innovation intermediation activities and organizational actors from relevant literature, and this range of activities and actors will be used to be a framework for empirical analysis.

3.1.1 Innovation Intermediation Activities

I first describe ten specific innovation intermediation activities, shown in Table 3.1. The ten activities include identifying knowledgeable individuals, identifying partner firms and organizations, facilitating innovation involving multiple organizations, helping firms learn about new technology, helping firms learn about new markets, providing firms with business advice, undertaking innovative activities on behalf of firms, promoting enabling standards, forcing firms to innovate by changing regulations, and forcing firms to innovate through social pressure. These activities abstract from a diverse range of mechanisms (micro-activities) by referencing the outcomes. The mechanisms (micro-activities) may be too many to study, for example, a firm may learn about technology through multiple mechanisms such as seminars, reports, networks, and so on. Thus, I do not concentrate on the countless mechanisms.

A wide range of studies examines one type of innovation intermediation activity, namely, inter-organizational networking activities. These activities indirectly influence the creation of networks and markets for focal firms by identifying knowledgeable people. For example, Cambridge-MIT Institute (CMI) helps industrial firms identify knowledgeable individuals from universities, communities and government agencies in the UK (Acworth, 2008). University-industry linkages also stimulate new technology firms to recruit graduates and researchers (Gregorio & Shane, 2003). In addition to the identification of knowledgeable people, collaboration is another typical example of inter-organizational networking activities. The innovation process is facilitated by promoting vertical collaborations between suppliers and client firms (Grindley et al., 1994), by providing financial support for innovation collaborations (Inkinen & Suorsa, 2010), and by establishing cooperation for SMEs (Lee, et al., 2009) or research consortia (Sakakibara & Branstetter, 2003). When multiple firms participate in the same innovation collaboration, these firms are supposed to have similar interests and goals and to have awareness of participants as potential partners. Therefore, the identification of partner firm serves as a first step for subsequent decisions about multi-partner innovation collaborations (Rosenkopf, Metiu, & George, 2001). Other inter-organizational networking activities are linked to such metaphors as bridging, brokering, and cross pollination. This type of networking activities involves acquiring, storing, and retrieving knowledge from various unrelated sectors (Hargadon & Sutton, 1997), broadening networks for information arbitrage and cross pollination (Sapsed et al., 2007), and providing users with the access to various specialist services (Bessant & Rush, 1995). In so doing, the innovativeness, credibility and competencies of focal firms are greatly enhanced.

Table 3.1 Representative Studies on Innovation Intermediation Activities

Overarching innovation intermediation activities	Categories and representative studies
Inter-organizational networking activities	*Identifying Knowledgeable individuals* Löfsten and Lindelöf, 2002; Di Gregorio and Shane, 2003; Acworth, 2008
	Identifying partner firms and facilitating innovation collaborations Grindley et. al., 1994; Sapsed, et al., 2007; Lee, et al., 2009; Sakakibara and Branstetter, 2003; Inkinen and Suorsa, 2010
Direct enabling activities	*Learning about technology* Grindley et. al., 1994; Bessent andRush,1995; Gregorio and Shane, 2003; Debackere and Veugelers, 2005; Rothaermel and Thursy, 2005
	Learning about new markets von Hipple, 1986; Li and Atuahene-Gima, 2002
	Learning about business advice Bennett and Robson, 1999
	Undertaking innovation activities Aldrich and Sasaki, 1995; Löfsten and Lindelöf, 2002; Debackere and Veugelers, 2005; Motohashi and Yun, 2005
Coercive activities	*Promoting standards* Grindley et. al., 1994; Sine et al., 2002
	Forcing innovation by regulation Porter and Linde, 1995; Sine et al., 2002
	Forcing innovation by social pressure King and Lenox, 2000

Another type of innovation intermediation activity, namely, direct enabling activities, is also investigated in the relevant literature. Direct enabling activities primarily impart technology, marketing and business information, and conduct innovative research on a one-to-one basis. Specifically, in order to learn about technology, for instance, focal firms develop, test and improve equipment (Grindley et al., 1994), and absorb expert knowledge from consultants or universities (Bessant & Rush, 1995; Debackere & Veugelers, 2005; Etzkowiz & Leydesdorff, 2000). Focal firms also gather external valuable marketing information from client firms (von Hippel, 1986), adopt agency business intermediation activities to facilitate the downstream marketing and distribution of products (Li & Atuahene-Gima, 2002), and use various sources of business advice (Bennett & Robson, 1999). Direct enabling innovation intermediation activities facilitate innovation not only by imparting a wide range of information, but also by conducting innovative activities on behalf of focal firms. For example, the activities may involve conducting contract research activities and managing patents for industrial firms (Debackere & Veugelers, 2005; Motohashi & Yun, 2005).

While the aforementioned innovation intermediation activities have the objective to enable the innovativeness of focal firms, other innovation intermediation activities typically impose coercive influence on focal firms and balance the interests of the firms and other constituents, such as public environment and security. The effect of these activities is uncertain. The coercive activities which have been greatly influenced by institutional forces can be divided into regulative-force and normative-force activities (Sine, Haveman, & Tolbert, 2005). The regulative-force activities influence the focal firms by means of explicit coercive regulations, for example, the development of standards for equipment interfaces (Grindley et al., 1994). Environmental regulations also force firms to create the innovations that benefit the public environment (Porter & Linde, 1995). On the other hand, the normative-force activities also influence the focal firms by means of implicit social norms (King & Lenox, 2000).

3.1.2 Organizations that Perform Innovation Intermediation Activities

In this study, the organizational actors are considered as innovation intermediaries, and they involve for-profit firms, universities, government agencies, research institutes, and non-profit industry associations.

This study not only considers firms, governments, and universities which are typically considered in the innovation surveys, but also takes into account non-profit innovation intermediaries. The study focuses on non-profit research institutes and industry associations because these are well understood in many cultures. Non-profit research institutes are a natural candidate for inclusion owing to their long history (US National Research Council, 1999). Industry associations are also fairly well understood globally (Kennedy, 2008), and they are an interesting choice because of divergent views on their roles as intermediaries. While certain literature limits the activities conducted by industry associations to the indirect services for their member firms, such as lobbing and promotion (Human & Provan, 1997), other researchers show the important role of industry associations in facilitating innovation (Dalziel, 2006; Lee et al., 2009). Other candidate non-profit intermediaries such as science parks, incubators, and research consortia are not included due to the lack of universal understanding.

For-profit firms may act as important organizational actors that conduct innovation intermediation activities. These firms may include lead user firms that provide valuable information of novel products or processes to marketing researchers (von Hippel, 1986), and various consulting firms that provide professional services (Bennett & Robson, 1999; Hargadon & Sutton, 1997; Zhang & Li, 2010). Non-profit organizations, such as non-profit industry associations (Dalziel, 2006; King & Lenox, 2000), may also play an important role in innovation intermediation activities. In addition, innovation intermediation activities are also conducted by government sponsored research agencies (Branstetter & Sakakibara, 2002), and by university-based technology transfer organizations (Acworth, 2010; Debackere & Veugelers, 2005; Siegel et al., 2003).

3.2 Hypotheses Development

In the following, I derive four hypotheses on the relative importance of for-profit firms, governments, universities, and industry associations.

3.2.1 The Importance of For-profit Firms

In order to enable their innovation processes, for-profit firms are most likely to cooperate with other for-profit firms (Bennett & Robson, 1999; Freel, 2003; Hargadon & Sutton, 1997; von Hippel, 1986; Zhang & Li, 2010). This argument may be attributed to the similar way of communication and management among for-profit firms. Cooperation between focal firms and other for-profit firms involves a wide range of enabling innovation intermediation activities. Specifically, lead client firms provide the information of novel products or processes to marketing researchers in focal firms (von Hippel, 1986). Additionally, private sector suppliers make the highest impact on providing business advice (Bennett & Robson, 1999). A for-profit consulting firm also performs a supportive role in transmitting and transforming technological knowledge (Hargadon & Sutton, 1997). Similarly, new firms' ties with service intermediaries, such as technology service firms, accounting and financial service firms, law firms, and talent search firms, contribute to the focal firms' product innovation by providing technical, financial, and networking information (Zhang & Li, 2010). In contrast, other researchers may argue that the use of external organizational actors depends on the type of innovation. Specifically, radical innovations in products or processes require more research-based information commonly from universities and research institutes than incremental changes that can be implemented with market or business sources of information primarily via inter-firm cooperation (Amara & Landry, 2005; Tödtling, Lehner, & Kaufmann, 2008). Since a significant proportion of researchers holds a traditional view that for-profit firms are most likely to enable the innovation process, I provide a hypothesis as follows.

Hypothesis 1: For-profit firms are more strongly associated with the importance of innovation intermediation activities than governments, universities, research institutes, or industry associations.

3.2.2 The Importance of Governments

Government agencies attempt to satisfy the needs of majorities. As a result, they typically apply coercive institutional force to balance the interests of focal firms and the interests of other constituents in society, such as the public welfare, social security, and the environment. Although government agencies constrain the behaviors of focal firms by the means of coercive institutional force, much of the relevant literature emphasizes the role of regulations and standards in facilitating the innovation process of industrial firms. For example, well-designed environmental policies from government may lead to enhancing efficiency, choosing efficient production technology, and increasing the heterogeneity of organizational founding by regulative institutional force (Porter & Linde, 1995; Sine et al., 2002). While most literature supports the view that government agencies merely play a role in initiating regulative programs, other literature argues that government agencies enable the innovation process through the means of facilitating financing and collaborations involving multiple organizations. Specifically, government agencies initiate and sponsor research consortia that facilitate multi-partner alliances (Sakakibara & Branstetter, 2003). They also act as primary actors such as those within the Finnish innovation system in terms of direct funding and indirect collaborative resourcing (Inkinen & Suorsa, 2010). The following hypothesis is consistent with the traditional perspective that government agencies stimulate the innovation process of focal firms by coercive institutional force.

Hypothesis 2: Government agencies will be more strongly associated with the importance of specific innovation intermediation activities than for-profit firms, universities, research institutes, or industry associations. The activities include promoting standards and forcing firms to innovate through regulations or social pressure.

3.2.3 The Importance of Universities

Universities have traditionally been considered an important bridging agent to facilitate innovation due to the advantages of talented human resource, research and development, and transferring technological knowledge. They primarily rely on the technology transfer offices (TTOs) to facilitate contract research activities and manage patents and licenses (Debackere & Veugelers, 2005; Rothaermel & Thursby, 2005). Similarly, universities also emphasize the transfer and exchange of technological knowledge with industrial firms (Acworth, 2008; Motohashi & Yun, 2007; Siegel et al., 2003). In addition to conducting research activities and transferring technology, universities perform a significant role in identifying knowledgeable people. For example, Gregorio and Shane (2003) maintain that intellectual eminence, such as high quality human resources and knowledgeable individuals, plays an important role in transferring and commercializing technology. Löfsten and Lindelöf (2002) also find that firms are significantly more likely to utilize the linkages with local universities to identify graduates and enable innovation activities. In summary, universities contribute to stimulating the whole innovation system and typically focus on conducting innovative research and development, transferring technological knowledge, and identifying knowledgeable individuals.

Hypothesis 3: Universities will be more strongly associated with the importance of particular innovation intermediation activities than for-profit firms, governments, research institutes, or industry associations. The activities involve identifying knowledgeable individuals, helping firms learn about new technologies, and undertaking innovative activities on behalf of firms.

3.2.4 The Importance of Industry Associations

Non-profit industry associations are also essential to enable the innovation process. Every national economic system primarily consists of numerous small and medium enterprises (SMEs). The business strategy of SMEs does not focus on R&D, so they do not necessarily need the services from universities or research institutes. In contrast, they need industry associations to help them establish the networks with other enterprises. Moreover, the firms find industry associations reliable and trustworthy because industry associations generally locate nearby these firms and represent their voice. Thus, industry associations post themselves in a position to facilitate innovation collaborations among multiple firms in a particular industry. Relevant literature limits the activities conducted by industry associations to the indirect services for their member firms, such as lobbying and promotion (Human & Provan, 1997). Additionally, Bennett and Robson (1999) consider that intermediary collective associations appear chiefly to fill niche gaps with advice of a less significant kind in terms of perceived impact on providing business advice. Similarly, King and Lenox (2000) demonstrate that it is difficult for social pressure from industry self-regulations to impose a positive influence without explicit regulations due to opportunistic behavior. Other researchers, however, assert the importance of industry associations. Dalziel (2006) empirically shows that industry associations are more frequently cited as collaborators than either research institutes or universities. Lee et al. (2009) describe a Korean association which enables SMEs to identify partners and facilitate innovation collaborations. Although there is a lack of confirmation of the role of industry associations, I provide the following hypothesis:

Hypothesis 4: Industry associations will be the actors most strongly associated with the importance of identifying partner firms and facilitating multiple partner innovation collaborations.

4. Methodology

I rely on data from the so-called Managing Innovation in the New Economy project to test my hypotheses. In this section, I first introduce the data of the Managing Innovation in the New Economy project, and the subsample of that data I use. I then conduct bias tests to compare my subsample to the omitted subsample. Following this, I describe the measures and analytic approach I use to test hypotheses. Finally, I attempt to measure the relative importance of organizational actors in regression models.

4.1 Managing Innovation in the New Economy Project

The idea of the Managing Innovation in the New Economy (MINE) project came from a pilot study on the management of industrial innovation. This pilot study conducted75 interviews with the technical officers of a range of firms and undertook a survey of 73 firms in the areas of North American, Europe, and Asia. The result showed that firms within most sectors innovate in similar ways, while firms within some sectors innovate in fairly distinct ways (Miller & Floricel, 2008). Thus, the researchers were motivated to develop the large-scale MINE project.

The MINE research project was funded by the Social Sciences and Humanities Research Council of Canada in 2003 and collaborated with the Industrial Research Institutes, the Science Policy Research Unit of the University of Sussex (Miller & Floricel, 2008). The general goal of MINE research project was to identify and analyze the ways in which value is created and captured, considering a range of innovation strategies, organizational policies, R&D structures, and innovation management practices, as well as the role of different actors in the innovation process.

In my study, I draw on the MINE Survey which is a primary instrument of data collection for MINE research project. The survey has 11 pages and includes eight sections with 423 items in total. It took approximately one hour for each respondent firm to complete the survey. The eight sections are the sectoral context of innovation, value creation capabilities, firm's innovation strategy, organizing for innovation, firm's innovation network, practices that firms use to manage innovation, firm performance, and firm information.

The population of respondent firms tends to be large firms that conduct R&D activities. The survey data was collected from the vice-presidents of research and development and the chief technology officers during the period from 2005 to 2007. A research team, which consists of graduate students and doctoral students, requested the permission of the managers to complete the survey by telephone and emails. If the managers agreed to participate, they were given a password that enabled them to access and complete the web-version of the survey. The researchers in the project have claimed a response rate of 25% respondent firms (Floricel & Ibanescu, 2008: p.460), but in reality the response rate was lower. Not all the companies that were telephoned agreed to complete the survey. Many company or personal names in the list of candidates cannot be reached during the data collection phrase, and the design of the survey is complex. Thus, it is not easy to build an accurate response rate (Floricel & Ibanescu, 2008). But of the respondent firms that agreed to complete the survey, 25% actually did so. The actual response rate may be close to 12% which means the results must be interpreted with caution.

The final sample size of this survey is 940 respondent firms. The firms in this sample are from a wide range of sectors and countries (Floricel, Doufherty, Miller, & Ibanescu, 2008). The firms are mostly selected from electrical equipment, appliance, and component manufacturing, transportation equipment manufacturing, mining, chemical manufacturing, and computer and electronic product manufacturing , software publishing services, engineering service, computer systems design and related services, management and business services, and scientific and technical consulting services. The firms are mostly selected from Canada, the United States, the United Kingdom, France, Switzerland, China, and Korea (with a few from Austria, South America, and Africa).

4.2 Study Sample

I use a subset of the survey to measure the relative importance of the innovation intermediation activities and the organizational actors that perform them. The key questions (Table 4.1 in the Appendix) on innovation intermediation activities and organizational actors that perform them are in Section 5 on Page 8 of the survey. Therefore, I use 499 respondent firms of full sample of 940 respondent firms which answered the key questions.

As the reduced sample of 499 respondent firms may be biased with respect to the full sample, I conduct bias tests to compare the characteristics of firms in the reduced sample and the characteristics of firms in the full sample. In Subsection 4.2.1 I describe the variables used in bias tests. In Subsection 4.2.2 I report on the results of bias tests.

4.2.1 Variables in Bias Tests

In the following, I examine twelve variables that are used in bias tests. The twelve variables (see Table 4.2) include five general variables that reflect the general characteristics of investment, resource, and profitability, three industry variables that reflect the characteristics in science-based industries, stable and large-scale industries, and high-competitive industries, and four country variables that reflect the characteristics in Canada, the United States, China, and South Korea.

Table 4.2 Summary of Variables

Variables
1. General Variables
1a. R & D investment over sales
1b. Number of employees
1c. The time and energy of the firm's employees that is devoted to innovation (Ordinal)
1d. Annual sales growth (Ordinal)
1e. Average net profit (Ordinal)
2. Industry Variables
2a. Science-based industries;
2b. Stable and large-scale industries
2c. Highly competitive industries
3. Country Variables
3a. Canada
3b. the US
3c. China
3d. South Korea

4.2.1.1 General Variables

I first select a dataset of the five general variables, and this dataset includes 714 respondent firms. I then divide this dataset into a sample of 499 firms that reflect the characteristics of firms in reduced sample and the other sample of 215 firms that reflect the characteristics of firms in omitted sample. In so doing, I compare the general characteristics of firms in the reduced sample and the general characteristics of firms in the omitted sample. Independent 2-sample t-tests and ANOVA tests are widely used to compare the means of continuous variables between two samples. I choose independent 2-sample t-tests for continuous variables rather than ANOVA, because an assumption of ANOVA is equal variance assumption, while independent 2-sample t-tests are free from this assumption. In addition, Mann-Whitney U tests are widely used to compare the mean ranks of ordinal variables between two samples (Wilcoxon, 1945).

4.2.1.2 Industry Variables

In order to examine the proportions of respondent firms by industry, I first identify the industry of each respondent firm. Of the full sample of 940 respondent firms, only 344 respondent firms provided the information of industry because the item that asks about industry name was on the last page of the survey. So instead, I use 10 questions from the first page of the survey that ask about characteristics. The respondents were asked to use a 7 point scale (1: totally disagree; 4: Neutral; 7: totally agree) to rate the degree to which they agree or disagree with each of the following statement:

1. Knowledge production in the academic fields relevant for our sector is very intense;
2. Our sector contributes a lot of data, ideas, and papers to academic research;
3. All firms in our sector rely on the same stable technological base;
4. New knowledge results from the gradual accumulation of experience inside firms;
5. Regulatory approval is a critical prerequisite for commercializing any new product;
6. Large unit cost reductions can be obtained by increasing the scale of operations;
7. Most of the products of our sector face severe cost constraints;
8. Governments allocate a lot of resources to support research and innovation;
9. Established competitors constantly challenge our positions;
10. Our products are constantly under attack from low-cost substitutes.

I employ K-means cluster analysis to group the respondent firms in the full sample of 940 respondent firms to find the approporiate number of clusters. I choose three clusters on the basis of face validity. The three clusters are science-based industry group, stable and large-scalue industries, and highly competitive industries. As shown in Figure 4.1 below, firms in science-based industries have high level of extent of scientific products (Items 1, 2); firms in large-scale and stable technology industry group have stable technical knowledge base and high level of regulatory intervention and government support (Items 3, 5, 8); and firms in highly competitive industries are cost sensitive and face severe competition in markets (Items 6, 7, 9, 10).

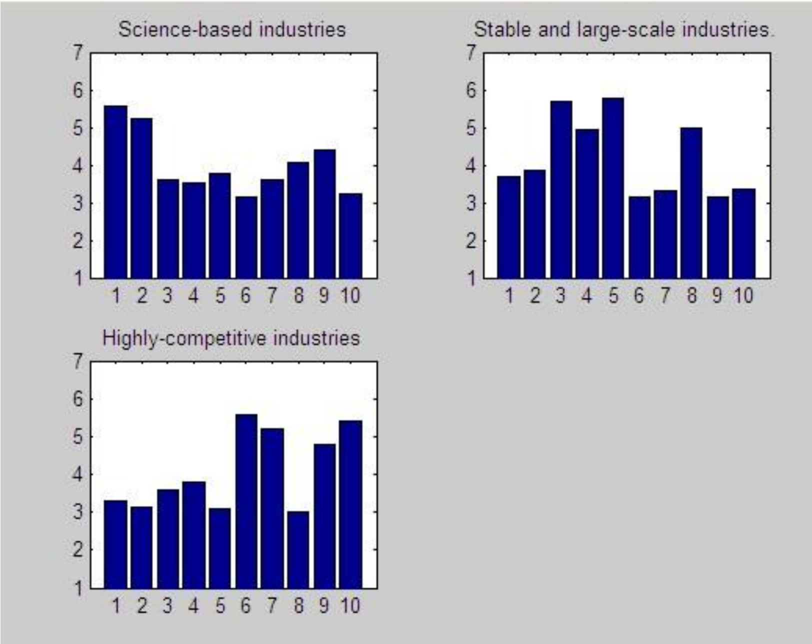

Figure 4.1. Characteristics of Industry Groups

By clustering the full sample of 940 respondent firms, I attain the center of each cluster. Buidling on these centers, I group the firms of both reduced and omitted samples into 3 clusters. I then compare the proportions of firms by three industry groups in full sample, reduced sample, and omitted sample. Figure 4.2 shows that proportions of firms from each indstry group in three samples are almost the same.

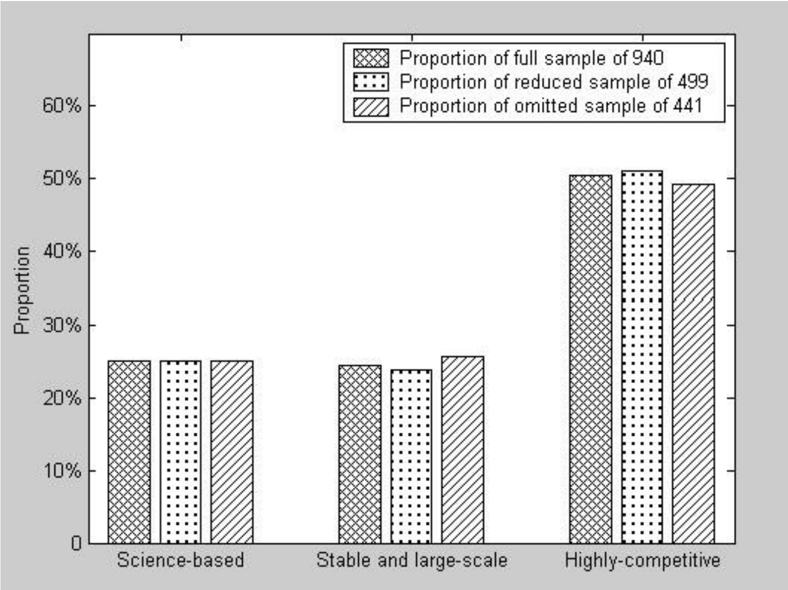

Figure 4.2. Proportion of Samples by Industry

4.2.1.3 Country Variables

Figure 4.3 shows the proportions of firms from four different countries in the full sample, the reduced sample, and the omitted sample. The results show that the proportion of firms from Asia (China and South Korea) in the reduced sample is higher than the proportion of firms from Asia in the omitted sample. In contrast, the proportion of firms from Canada in the reduced sample is lower than the proportion of firms from Canada in the omitted sample. The proportions of firms from the United States in two samples are almost the same.

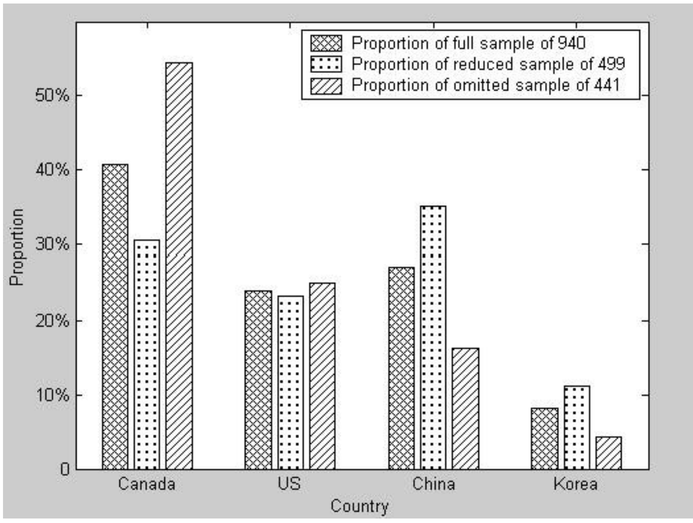

Figure 4.3. Proportion of Samples by Country

4.2.2 Results on Bias Tests

Results from t-tests and Mann-Whitney U tests on the five general variables show that the reduced sample is biased, shown in Table 4.3. Compared to the omitted sample, the respondent firms in reduced sample have less R&D investment over sales and less proportion of total time and energy of employees devoted to innovation, but higher annual sales growth and average net profit on sales over last three years. In other words, the respondent firms in my reduced sample emphasize sales growth and net profit but not investment in R&D and innovative activities.

I use Chi-square tests to examine the difference between the proportions of firms in three industry groups. The results (see Table 4.3) show that the differences between the proportions of firms in three industry groups are not statistically significant, so the bias of the reduced sample is not caused by industry.

I also use Chi-square tests to examine the difference between the proportions of firms from each of the four countries. The results show that there is a high proportion of firms from Asia but a low proportion of firms from North America in the reduced sample, while there is a low proportion of firms from Asia but a high proportion of firms from North America in omitted sample. As the growth in GDP of Asian countries has been higher than the growth of GDP in North American countries in recent years, and as Asian firms have been considered as being less innovative than Western firms (Breznitz & Murphree, 2011; Gu & Lundvall, 2006), differences in firm nationalities in the reduced and omitted samples may explain the differences in the general variables in the two samples. As a consequence of this bias, care must be taken in the interpretation of my results.

Table 4.3 Summary of Variables Used in Bias Tests

Variable	N	Test	Result
1.General Variable			
1a. R & D investment over sales	714	2-sample t-test	**-2.69****
1b. Number of employees	714	2-sample t-test	1.51
1c. Time and energy of the firm's employees that is devoted to innovation	714	Mann-Whitney test	**-2.04****
1d. Annual sales growth	714	Mann-Whitney test	**-2.30****
1e. Average net profit	714	Mann-Whitney test	**-3.89****
2. Industry Variables			
2a. Proportion of firms in science-based industries	186	Chi-square test	0.00
2b. Proportion of firms in large-scale and stable technology industries	182	Chi-square test	1.00
2c. Proportion of firms in highly competitive industries	375	Chi-square test	0.73
3.Country Variables			
3a. Proportion of firms in Canada	302	Chi-square test	**126.01*****
3b. Proportion of firms in the United States	178	Chi-square test	1.09
3c. Proportion of firms in China	201	Chi-square test	**156.55*****
3d. Proportion of firms in South Korea	60	Chi-square test	**7.82****

*: p< 0.05; **: p<0.01; ***: p<0.001. I report Z value for Mann-Whitney test; negative Z values ean that the mean rank of the first sample is higher than the mean rank of the second sample.

4.3 Measures

4.3.1 Dependent, Independent and Control Variables

The importance of each of ten innovation intermediation activities is represented as a dependent variable. The important of ten innovation intermediation activities is measured on the scale of 1 to 7 in the survey (1: Not at all important; 4: somewhat important; 7: Extremely important).

This study also examines the use of five external organizational actors. The use of each organizational actor is constructed by the responses in the survey relevant to whether or not a respondent firm considers a particular organizational actor is used for each innovation intermediation activity. This is reported as a dummy variable taking the value of 1 when the respondent firm indicates that a certain actor is used for an innovation intermediation process and 0 otherwise.

Table 4.4 Summary of Variables and Measures

Variables	Measures
Dependent Variables	Y1: Importance of identifying knowledgeable people; Y2: Importance of identifying partner firms; Y3: Importance of facilitating innovation collaboration involving multiple organizations; Y4: Importance of helping firms learn new technology; Y5: Importance of helping firms learn new markets; Y6: Importance of providing business advice; Y7: Importance of undertaking innovative activities on behalf of firms; Y8: Importance of promoting standards; Y9: Importance of forcing firms innovate by regulation; Y10: Importance of forcing firms innovate by social pressure.
Independent Variables	X1: Use of for-profit firms for each intermediation activity; X2: Use of governments for each intermediation activity; X3: Use of universities for each intermediation activity; X4: Use of research institutions for each intermediation activity; X5: Use of industry associations for each intermediation activity.
Control Variables	C1: Proportion of R&D investment over sales; C2: Proportion of the total time and energy of all the employees devoted to innovation ; C3: Annual sales growth; C4: Average net profit on sales; C5: Number of employees.

In addition to the dependent and independent measures, I control for the attributes of firms, including firm size, innovativeness, and profitability. I first consider five variables that describe the firm's attributes, including investments in R&D, investments in human resource, average net profit, annual sales growth, and number of employees. Of these five control variables, the first four variables are ordinal variables. This means that respondent firms should select from a list of options on these four questions in survey. Only the variable of number of employees is a continuous variable. I also control for firm size, which is measured by the number of employees, and I transform this measure by natural logarithmic because it is expected that the effect of size may increase at a diminishing rate (Li & Atuahene-Gima, 2002). I summarize the dependent, independent, and control measures of regression models in Table 4.4.

4.3.2 Descriptive Statistics and Correlation Matrix

Table 4.5 (see below) provides the descriptive statistics and correlation matrix on independent variables, dependent variables and control variables. The descriptive statistics on the ten dependent variables show that two enabling innovation intermediation activities, namely, helping firms learn about new technologies and helping firms learn about new markets, are considered the most important. In contrast, two coercive innovation intermediation activities, namely, forcing firms to innovate by regulations or forcing firms to innovate through social pressure, are considered the least important. Of the enabling activities, the activities relevant to knowledge factors, such as identifying knowledgeable people, helping firms learn about new technologies, helping firms learn about new markets, and providing firms with business advice, are more important than the activities relevant to collaboration, such as identifying partner firms and organizations, and facilitating innovation collaborations.

The descriptive statistics on independent variables (the use of organizational actors) in Table 4.5 show that universities are most frequently used in three innovation intermediation activities, involving identifying knowledgeable people (mean=0.43), helping firms learn about new technology (mean=0.52), and undertaking innovative activities on behalf of firms (mean=0.49). Second, for-profit firms and industry associations are most frequently used to identify partner firms and organizations (mean=0.47 or 0.42) and facilitate innovation involving multiple organizations (mean=0.32 or 0.42). Third, government agencies are most frequently connected with two innovation intermediation activities, such as forcing firms to innovate by changing regulations (mean=0.71), and forcing firms to innovate through social pressure (mean=0.48). Finally, it needs to be noted that, compared to other organizational actors, research institutes are less frequently cited as important actors for innovation intermediation activities.

Table 4.5 also shows the bivariate correlation matrix that reflects the correlations between the variables in each of the ten models. Notwithstanding the high correlations between each dependent variable and the corresponding independent variables in some cases, the correlations among independent variables are generally low (below 0.3) in all cases. The low correlations between independent variables suggest satisfactory discriminant validity (J. Cohen, P. Cohen, West, & Aiken, 2003). Moreover, the values of the variance inflation factor for each of the ten models are all less than 5, which is well cutoff of 10 (Draper & Smith, 1998). The evidence suggests that the multi-collinearity is not a problem.

Table 4.5 Descriptive Statistics and Correlation Matrix (N=499)

Variables	Mean	SD.	DV	IV1	IV2	IV3	IV4	IV5	C1	C2	C3	C4	C5
Model 1													
DV: Identify people	4.61	1.58											
IV1: Firms	0.37	0.48	0.18**										
IV2: Governments	0.16	0.37	0.12**	0.03									
IV3: Universities	0.43	0.50	0.30**	0.00	0.14**								
IV4: Research institutes	0.15	0.35	0.16**	0.01	0.13**	0.21**							
IV5: Industry associations	0.35	0.48	0.22**	0.07	0.10*	0.06	0.14**						
C1: R&D investment	13.18	17.18	0.10*	-0.04	0.03	0.11*	0.06	0.01					
C2: HR investment	4	2	0.06	-0.02	0.08	0.12**	0.08	-0.02	0.45**				
C3: Sales growth	4	1	0.09*	-0.05	0.02	-0.01	0.00	-0.05	0.15**	0.21**			
C4: Net profit	3	1	0.04	0.00	0.02	0.01	-0.01	0.02	-0.02	0.11**	0.45**		
C5: # of employees	13095	42591	0.03	0.05	-0.06	0.09*	0.08	0.11*	-0.07	-0.04	-0.11**	-0.01	
Model 2													
DV: Identify partners	4.61	1.58											
IV1: Firms	0.37	0.48	0.25**										
IV2: Governments	0.16	0.37	0.14**	-0.06									
IV3: Universities	0.43	0.50	0.13**	0.01	0.14**								
IV4: Research institutes	0.15	0.35	0.17**	0.02	0.11**	0.21**							
IV5: Industry associations	0.35	0.48	0.25**	0.05	0.03	0.04	0.13**						
C1: R&D investment	13.18	17.18	0.13**	-0.02	0.03	0.03	0.05	0.04					
C2: HR investment	4	2	0.11**	0.01	0.14**	0.02	0.04	0.01	0.45**				
C3: Sales growth	4	1	0.13**	-0.04	0.03	-0.03	0.01	0.00	0.14**	0.22**			
C4: Net profit	3	1	0.07	0.00	-0.08	0.01	-0.03	0.03	-0.02	0.13**	0.44**		
C5: # of employees	13095	42591	0.07	0.10*	-0.09*	0.05	0.08	0.08	-0.07	-0.04	-0.11**	0.00	

Table (*Continued*)

Variables	Mean	SD.	DV	IV1	IV2	IV3	IV4	IV5	C1	C2	C3	C4	C5
Model 3													
DV: Facilitate collaboration	4.31	1.67	1.00										
IV1: Firms	0.31	0.46	0.19**	1.00									
IV2: Governments	0.32	0.47	0.23**	-0.02	1.00								
IV3: Universities	0.21	0.41	0.20**	0.08*	0.12**	1.00							
IV4: Research institutes	0.15	0.36	0.16**	0.07	0.14**	0.27**	1.00						
IV5: Industry associations	0.42	0.49	0.29**	0.07	0.05	-0.03	0.13**	1.00					
C1: R&D investment	13.18	17.18	0.09*	0.03	-0.01	0.01	0.08	0.07	1.00				
C2: HR investment	4	2	0.06	0.03	0.07	-0.01	0.02	0.04	0.44**	1.00			
C3: Sales growth	4	1	0.06	0.03	0.03	-0.04	-0.02	-0.02	0.14**	0.22**	1.00		
C4: Net profit	3	1	0.04	0.05	0.01	0.01	-0.03	-0.04	0.00	0.13**	0.45**	1.00	
C5: # of employees	13095	42591	0.13**	0.13**	0.03	-0.02	0.03	0.13**	-0.07	-0.04	-0.11**	0.00	1.00
Model 4													
DV: Learn technology	5.21	1.46	1.00										
IV1: Firms	0.46	0.50	0.18**	1.00									
IV2: Governments	0.21	0.41	0.04	0.02	1.00								
IV3: Universities	0.52	0.50	0.20**	-0.08	0.12**	1.00							
IV4: Research institutes	0.20	0.40	0.17**	0.07	0.06	0.15**	1.00						
IV5: Industry associations	0.45	0.50	0.15**	0.10*	0.11**	0.00	0.13**	1.00					
C1: R&D investment	13.18	17.18	0.08*	-0.07	-0.04	0.06	0.00	0.03	1.00				
C2: HR investment	4	2	0.04	-0.01	-0.03	0.05	0.01	-0.01	0.45**	1.00			
C3: Sales growth	4	1	0.04	-0.03	-0.03	-0.05	0.00	-0.01	0.14**	0.22**	1.00		
C4: Net profit	3	1	0.04	0.04	-0.04	0.02	-0.03	-0.03	-0.02	0.12**	0.45**	1.00	
C5: # of employees	13095	42591	0.07	0.15**	0.07	0.07	0.07	0.11**	-0.07	-0.04	-0.11	0.00	1.00

Table (*Continued*)

Variables	Mean	SD.	DV	IV1	IV2	IV3	IV4	IV5	C1	C2	C3	C4	C5
Model 5													
DV: Learn markets	4.98	1.64	1.00										
IV1: Firms	0.51	0.50	0.21**	1.00									
IV2: Governments	0.24	0.43	0.09*	-0.16**	1.00								
IV3: Universities	0.08	0.28	0.13**	0.02	0.16**	1.00							
IV4: Research institutes	0.16	0.37	0.20**	0.10*	0.10*	0.19**	1.00						
IV5: Industry associations	0.52	0.50	0.25**	0.02	0.05	0.04	0.12**	1.00					
C1: R&D investment	13.18	17.18	0.08	0.06	-0.02	0.04	-0.02	0.06	1.00				
C2: HR investment	4	2	0.12**	0.06	0.00	0.02	0.05	0.02	0.45**	1.00			
C3: Sales growth	4	1	0.07	-0.03	0.00	0.05	0.04	-0.02	0.14**	0.21**	1.00		
C4: Net profit	3	1	0.01	0.01	-0.01	0.04	-0.05	0.01	-0.02	0.12**	0.45**	1.00	
C5: # of employees	13095	42591	0.03	0.08	0.04	0.00	0.04	0.10*	-0.07	-0.04	-0.11**	0.00	1.00
Model 6													
DV: Learn business	4.49	1.62	1.00										
IV1: Firms	0.44	0.50	0.18**	1.00									
IV2: Governments	0.16	0.37	0.07	-0.07	1.00								
IV3: Universities	0.12	0.32	0.15**	-0.03	0.24**	1.00							
IV4: Research institutes	0.12	0.33	0.17**	-0.03	0.10*	0.24**	1.00						
IV5: Industry associations	0.38	0.48	0.18**	-0.06	0.12**	0.09*	0.13**	1.00					
C1: R&D investment	13.18	17.18	0.07	-0.01	0.00	-0.05	0.04	0.02	1.00				
C2: HR investment	4	2	0.06	-0.01	0.03	0.00	0.06	0.03	0.45**	1.00			
C3: Sales growth	4	1	0.13**	-0.03	-0.05	0.06	0.08	-0.05	0.15**	0.22**	1.00		
C4: Net profit	3	1	0.08	0.01	-0.09*	0.05	0.00	0.00	-0.02	0.12**	0.44**	1.00	
C5: # of employees	13095	42591	-0.01	0.14**	-0.04	0.07	0.01	0.04	-0.07	-0.04	-0.11	0.00	1.00

Table (*Continued*)

Variables	Mean	SD.	DV	IV1	IV2	IV3	IV4	IV5	C1	C2	C3	C4	C5
Model 7													
DV: Undertake innovation	4.39	1.81	1.00										
IV1: Firms	0.23	0.42	0.06	1.00									
IV2: Governments	0.48	0.50	0.15**	-0.07	1.00								
IV3: Universities	0.13	0.34	0.24**	-0.04	0.00	1.00							
IV4: Research institutes	0.14	0.35	0.18**	-0.04	0.00	0.10*	1.00						
IV5: Industry associations	0.46	0.50	0.13**	-0.02	-0.02	-0.10*	-0.01	1.00					
C1: R&D investment	13.18	17.18	0.07	0.05	-0.01	-0.01	0.04	-0.01	1.00				
C2: HR investment	4	2	0.02	0.05	0.05	-0.01	0.03	0.01	0.45**	1.00			
C3: Sales growth	4	1	0.05	0.02	-0.02	-0.12**	0.02	-0.01	0.15**	0.22**	1.00		
C4: Net profit	3	1	-0.01	0.03	-0.06	-0.02	0.00	0.01	-0.02	0.12**	0.44**	1.00	
C5: # of employees	13095	42591	0.06	0.05	-0.04	0.04	0.10*	0.05	-0.07	-0.04	-0.11**	0.00	1.00
Model 8													
DV: Promote standards	3.93	1.78	1.00										
IV1: Firms	0.28	0.45	0.15**	1.00									
IV2: Governments	0.15	0.35	0.26**	0.00	1.00								
IV3: Universities	0.39	0.49	0.16**	0.21**	0.11**	1.00							
IV4: Research institutes	0.17	0.38	0.15**	0.10*	0.02	0.24**	1.00						
IV5: Industry associations	0.21	0.40	0.25**	0.08	0.01	0.01	0.05	1.00					
C1: R&D investment	13.18	17.18	-0.01	0.06	0.00	-0.02	-0.06	-0.04	1.00				
C2: HR investment	4	2	0.02	0.09*	0.03	0.00	0.04	0.02	0.45**	1.00			
C3: Sales growth	4	1	0.06	0.01	0.02	0.01	0.03	-0.07	0.13**	0.21**	1.00		
C4: Net profit	3	1	0.02	0.03	0.01	0.05	0.01	0.00	-0.01	0.12**	0.45**	1.00	
C5: # of employees	13095	42591	0.15**	0.12**	0.02	0.10*	0.09*	0.16**	-0.07	-0.04	-0.11**	0.00	1.00

Table (*Continued*)

Variables	Mean	SD.	DV	IV1	IV2	IV3	IV4	IV5	C1	C2	C3	C4	C5
Model 9													
DV: Force innovate-regulation	3.78	1.85	1.00										
IV1: Firms	0.12	0.32	0.15**	1.00									
IV2: Governments	0.71	0.45	0.27**	-0.13**	1.00								
IV3: Universities	0.04	0.19	0.12**	0.12**	-0.12**	1.00							
IV4: Research institutes	0.05	0.22	0.10*	0.12**	-0.07	0.22**	1.00						
IV5: Industry associations	0.18	0.39	0.18**	0.14**	0.02	-0.01	0.06	1.00					
C1: R&D investment	13.18	17.18	-0.09*	0.03	-0.03	0.01	-0.05	-0.03	1.00				
C2: HR investment	4	2	-0.15**	0.03	-0.09*	0.05	0.03	0.02	0.45**	1.00			
C3: Sales growth	4	1	0.01	0.00	-0.14**	0.07	0.00	0.04	0.14**	0.22**	1.00		
C4: Net profit	3	1	0.01	0.03	-0.01	0.08	0.01	0.03	-0.01	0.13**	0.45**	1.00	
C5: # of employees	13095	42591	0.11**	0.06	0.09*	0.03	-0.05	-0.01	-0.07	-0.04	-0.11**	-0.01	1.00
Model 10													
DV: Force innovate-social	3.51	1.82	1.00										
IV1: Firms	0.16	0.37	0.15**	1.00									
IV2: Governments	0.48	0.50	0.25**	-0.11**	1.00								
IV3: Universities	0.08	0.28	0.18**	0.10*	0.01	1.00							
IV4: Research institutes	0.10	0.30	0.14**	0.12**	0.00	0.24**	1.00						
IV5: Industry associations	0.22	0.41	0.22**	0.08	0.09*	0.04	0.07	1.00					
C1: R&D investment	13.18	17.18	-0.04	-0.04	-0.05	-0.04	-0.06	0.03	1.00				
C2: HR investment	4	2	-0.11**	-0.05	0.06	-0.06	0.00	0.02	0.45**	1.00			
C3: Sales growth	4	1	0.03	-0.01	-0.04	-0.03	-0.06	0.01	0.15**	0.22**	1.00		
C4: Net profit	3	1	-0.01	0.04	0.01	0.02	-0.01	-0.01	-0.02	0.12**	0.44**	1.00	
C5: # of employees	13095	42591	0.08	0.02	0.06	0.04	0.07	-0.02	-0.07	-0.04	-0.11**	0.00	1.00

4.4 Rationale of Analytic Approach

In this section, I clarify the selection of statistical methods that are used to analyze my data. In view of the characteristics of dependent variable (Scaling 1-7), my potential options include correlation analysis, linear regression model, ordinal logistic regression model, and modified ordinal regression model by collapsing the dependent variable. The rationale of methods selection is detailed in the following.

4.4.1 Correlation Analysis

In statistics, the correlation usually refers to Pearson correlation coefficient, and it is a measure of the linear dependence between two variables (Rodgers & Nicewander, 1998). This correlation coefficient ranges from -1 to 1. A coefficient with a value of -1 or 1 implies that the relationship between two variables is linear, while a coefficient with the value of 0 implies that there is no linear correlation between these two variables. A coefficient with its absolute value between 0 and 1 implies that there is a non-linear correlation between two variables (Kendall & Stuart, 1973).

Using this method, I can only reflect the relationship between the dependent variable (the importance of each of ten innovation intermediation activities) and one independent variable. Thus, this method does not consider the effects of other independent variables on the dependent variable. Moreover, this method is not applicable because I need to consider the effects of control variables.

4.4.2 Ordinary Least Squares Regression

Motivated by the limitation of correlation analysis, I consider the ordinary least squares

(OLS) regression method (Cohen et al., 2003). OLS regression is an approach to estimating the relationship between the dependent variable and one or more independent variables.

The main assumptions of OLS regression include little correlation between independent variables (also denoted as multi-collinearity) and normal distribution of dependent variable (Draper & Smith, 1998). Using SPSS, I check the first assumption by calculating the variance inflation factor (VIF), which reflects the severity of multicollinearity between independent variables (Draper & Smith, 1998). The results show that the VIF of all models are less than 5 (this has been discussed in section 4.3.1), so these independent variables have little multicollinearity.

Next, I check the second assumption to test whether the dependent variable is normally distributed. I show the frequency of the dependent variables for each of ten models by the histograms (Figure 4.4). The results show that the distribution of dependent variable in some models violates the assumption. Thus, I have to select other methods, instead of OLS, to analyze our data.

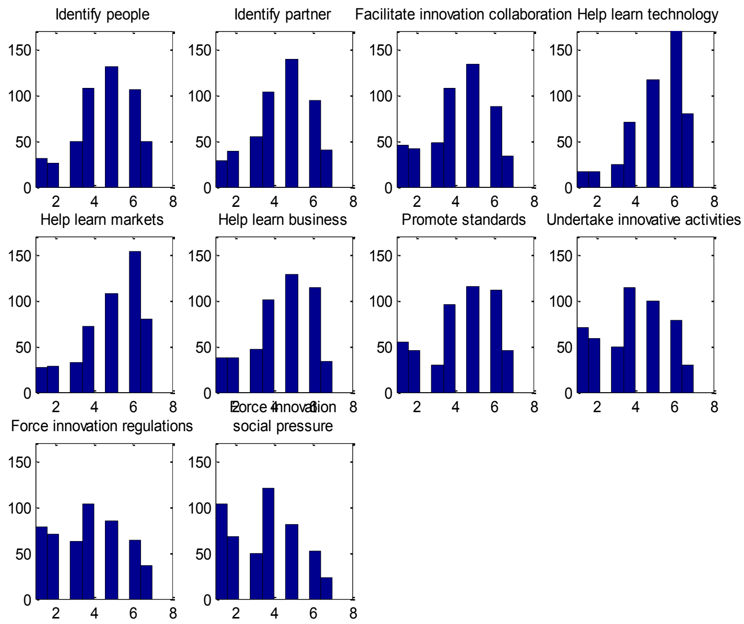

Figure 4.4. Histograms on dependent variables

4.4.3 Ordinal Logistic Regression

In statistics, ordinal logistic (OL) regression can be thought of as an extension of the OLS regression model by the dichotomy of dependent variables (Gooderham, Tobiassen, Døving, & Nordhaug, 2003). OL regression makes no assumptions about the distribution of dependent variable and allows dependent variables to be either continuous or discrete variables. The primary assumption of ordinal logistic regression is proportional odds assumption (Ruefli & Wiggins, 2003). In the following, I test this assumption of OL regression.

Given the 1 to 7 scaled dependent variable, in the test of proportional odds assumption, I observe the ratio of the number of scores above or equal to a threshold to the number of scores below that threshold. When the threshold is set as 1, 2, 3, 4, 5, 6, respectively, I can attain six groups of odds ratio. Then, the test on proportional odds assumption is the test on the difference between these six groups of odds ratio, and the latter is tested by Chi-square test. If the result of Chi-square test is significant, it implies that the assumption of OL regression is violated (Wang & Schaan, 2008). I use SPSS to attain the results of Chi-Square test (denoted as Chi-Square in Table 4.6). As shown in Table.2, the results of Chi-Square test are significant in most models (except Model 10), so the proportional odds assumption of OL regression is violated. I have to modify this OL regression method to analyze the data.

Table 4.6 Chi-Square Tests on Ten Models

Importance of Innovation Intermediation Activity	Chi-Square
Model 1: Identify people	**92.71*** **
Model 2: Identify partner	**111.46*** **
Model 3: Facilitate innovation collaborations	**156.01*** **
Model 4: Help learn technology	**107.33*** **
Model 5: Help learn markets	**92.01*** **
Model 6: Help learn business	**95.22*** **
Model 7: Promote standards	**87.47** **
Model 8: Undertake innovative activities	**80.01** **
Model 9: Force innovation by regulations	**77.57** **
Model 10: Force innovation by social pressure	65.67

***: p<0.001; **: p<0.01; *: p<0.05

4.4.4 Modified Ordinal Logistic Regression

When the assumption of OL regression is violated, the most commonly used method is to modify it by collapsing or regrouping the dependent variable (Strömberg, 1996). The general rule of collapsing dependent variables is to obtain an acceptable P-value of Chi-Square tests by merging or regrouping the values of dependent variables.

Given *N* scales of the dependent variable, the number of collapsed groups may range from 2 to *N* (when group number is 2, the OL regression reduces to Binary Logistic Regression) (Greenland, 1993). In my case, *N* equals to 7, so the number of collapsed group can be 2, 3, 4, 5, 6, 7. For the number *k* (*k*=2, 3, 4, 5, 6, 7), I have

(N-1)!/((k-1)!(N-k)!) different collapsing schemes. The detailed collapsing schemes and their corresponding P-value are listed in Table 4.7. Given 0.05 as the threshold of P-value of Chi-Square test, I select the collapsing scheme which first reaches this threshold.

Table 4.7 Example of the Process of Selecting Collapsing Schemes

Number of collapsed groups	Scheme of collapsing dependent variable	Chi-Square	P-value
7	1 |2 |3 |4 |5 |6 |7	92.71	0.000
6	1 2 |3 |4 |5 |6 |7	74.69	0.001
	1 |2 3 |4 |5 |6 |7	87.10	0.000
	1 |2 |3 4 |5 |6 |7	78.60	0.000
	1 |2 |3 |4 5 |6 |7	81.02	0.000
	1 |2 |3 |4 |5 6 |7	74.57	0.001
	1 |2 |3 |4 |5 |6 7	76.60	0.000
5	1 |2 |3 |4| 5 6 7	72.74	0.000
	1 |2 |3 |4 5 |6 7	60.91	0.000
	1 |2 |3 |4 5 6 |7	57.47	0.002
	1 |2 |3 4 |5 |6 7	60.16	0.001
	1 |2 |3 4 |5 6 |7	54.16	0.002
	1 |2 |3 4 5 |6 |7	53.72	0.005
	1 |2 3 |4 |5 |6 7	71.33	0.000
	1 |2 3 |4 |5 6 |7	59.23	0.002
	1 |2 3 4 |5 |6 |7	71.88	0.000
	1 2 |3 |4 |5 |6 7	54.66	0.005
	1 2 |3 |4 |5 6 |7	59.58	0.001
	1 2 |3 |4 5 |6 |7	54.55	0.005
	1 2 |3 4 |5 |6 |7	65.85	0.000
	1 2 3 |4 |5 |6 |7	54.90	0.010
4	**1 2 3 4 |5 |6 |7**	**31.46**	**0.050**

In Table 4.7 I take the first model of the importance of innovation intermediation activity on identifying people as an example, and the analysis in other models can be done in the same way. I first check the original data without collapsing, and its P-value is smaller than 0.05, which implies that the proportional odds assumption is violated. Thus, I need to collapse the data to attain a P-value above 0.05. Next, I collapse the values of dependent variable into six groups (corresponding to 6 potential schemes of collapsing) and check the P-value of each scheme. I find that the P-values of all these schemes are smaller than 0.05 and thus continue to collapse the values of dependent variable into five groups (corresponding to 15 potential schemes of collapsing). When checking the P-values, I find that the scheme of (1 2 3 |4 |5 |6 |7) can attain the threshold of 0.05. Thus, I stop our collapsing work and consider the scheme of (1 2 3 |4 |5 |6 |7) as my selected scheme. In this selected scheme, the values 1-3 of dependent variable in original dataset are coded as 1 in the collapsed dataset, and the values 4, 5, 6, 7 of dependent variable are coded as 2, 3, 4, 5, respectively, in the collapsed dataset. Finally, I list the schemes of collapsing variables in ten models in Table 4.8

Table 4.8 Selected Collapsing Schemes on Dependent Variables

Dependent Variables	Selected collapsing schemes	Chi-Square	P-value
Model 1: Identify people	1 2 3 4 |5 |6 |7	31.46	0.05
Model 2: Identify partner	1 2 3 |4 |5 |6 7	30.57	0.06
Model 3: Facilitate innovation collaborations	1 2 3 |4 |5 |6 7	27.64	0.19
Model 4: Help learn technology	1 2 3 |4 |5 |6 |7	40.50	0.06
Model 5: Help learn markets	1 2 3 4 |5 |6 7	27.91	0.11
Model 6: Help learn business	1 2 3 4 |5 |6 7	50.80	0.05
Model 7: Promote standards	1 2 3 4 |5 |6 7	50.80	0.05
Model 8: Undertake innovative activities	1 2 3 |4 |5 |6 7	20.27	0.44
Model 9: Force innovation by regulations	1 2 |3 |4 |5 |6 7	60.50	0.05
Model 10: Force innovation by social pressure	1 |2 |3 |4 |5 |6 |7	65.67	0.05

4.5 Measuring Relative Importance

As my goal is to assess the relative importance of organizational actors, it is necessary to rank the relative importance of independent variables on the dependent variables. There is, however, little consensus on how best to rank independent variables in regression models (Kruskal, 1989). To ensure reliability, I use five ranking methods which are most widely used by researchers to evaluate the relative importance of the independent variables in the regression models. The five methods for ranking the relative importance of independent variables are most widely used in the relevant statistics papers, and they include standardized coefficients, ratio of variance (ROV), p-values of Student's t-test, p-values of Wald test, and c-statistics. In these five methods, only ROV method assumes that the relationship between the dependent variable and independent variables is linear. Thus, the method of ROV is applicable for linear regression model, but not applicable for ordinal logistic regression model because the dependent variable in ordinal regression is not linearly related to independent variables.

First, standardized coefficients are the estimates resulting from the process in which ordinary coefficients are standardized by subtracting the mean and dividing by the standard deviation. The standardization of coefficients is aimed at answering the question on which the independent variables have a greater effect on the dependent variable in a regression model, when the variables are measured in different units of measurement. Therefore, the relative importance of independent variables can be measured by the absolute value of the standardized coefficients.

Although p-values of Student's t-tests and p-values of Wald test the relative importance in different ways, they have the same underlying idea. As for a particular independent variable, the null hypothesis of both tests is no association between this independent variable and the dependent variable. The null hypothesis should be rejected if the p-value of the Student's t-test or p-value of the Wald tests is small. In other words, the both types of tests show the evidence of a non-zero association between the independent variable and the dependent variable. Greater t-values or p-values indicate stronger evidence of the non-zero association between dependent variables and independent variables. Therefore, I use the p-values of Student's t-tests and p-values of Wald tests to evaluate the relative importance of independent variables to the corresponding dependent variables (Altman, 1991; Thompson, 2009).

Finally, Concordance (also known as c-statistics) is a transformation of original coefficients that is used to test the correlation between the independent variables and the dependent variable (Lin, 1989). Thus, c-statistics can be used to measure the relative importance of independent variables. The c-statistics coefficient C_i (i=1,2……n) for a particular independent variable X_i (i=1,2……n) is defined as

$$C_i = \frac{2C_i Var(X_i)Var(Y)}{Var^2(X_i) + Var^2(Y) + (mean(X_i) - mean(Y))^2} \tag{4.5}$$

where Y is the dependent variable, C_i is the original coefficient between Y and X_i, mean(X) represents the mean of variable X, and Var(X) represents the variance of variable X.

5. Results

In this section, I first compare the difference between the results of ordinal logistic (OL) regression models and the results of ordinary least square (OLS) regression. I then show the results on the mean ranks of the relative importance of organizational actors that conduct innovation intermediation activities and present the interpretation of the results.

5.1 Comparing Ordinary Least Square Regression and Modified Ordinal Logistic Regression

I employ both the OLS regression and the modified OL regression to examine the relationship between the impact of innovation intermediation activities and organizational actors. The OLS regression is easy to implement, but its assumption of normal distribution of dependent variable does not hold when the dependent variables are measured by a 7-point scale. The detailed process of checking the assumption violation is presented in the methodology section. As for the modified OL regression, I modify the ordinal logistic regression by collapsing the levels of dependent variables to ensure that the influence of each independent variable is constant across the levels of each dependent variable. This modified OL regression model is applicable in my case, but it has the risk of losing information due to collapsing the levels of the dependent variable (Goderham et al., 2004).

Table 5.1 depicts the comparison between OLS regression and ordinal logistic regression models, and it shows the significance and values of the coefficients in the regression models are similar with only some exceptions. The two notable exceptions on the relations between independent variables and dependent variables include the coefficients of *"Research institute"* in Model 1a and 1b, and the coefficients of "*University"* in Model 2a and 2b. The estimation of these coefficients by the OLS regression model is not statistically significant, while it is significant by the modified ordinal logistic regression model. This difference of statistic significance of estimated coefficients may be attributed to the non-linear impact of independent variables on the dependent variable (Goderham et al., 2004). But the two exceptions have little influence on the hypotheses testing.

Using the two types of regression can attain the similar estimation of coefficients. This result suggests that the OLS regression is applicable for analyzing my data although the assumption of normal distribution of dependent variable is violated. This violation of assumption has negligible errors on the estimation of coefficients. In addition, the modified ordinal logistic regression is also effective to analyze my data, and the amount of information loss caused by collapsing the levels of each dependent variable has little impact on the estimation of coefficients. The high-level similarity of coefficients estimated by these two models shows the reliability of the relationships between each dependent variable and independent variables across ten models.

Table 5.1 Ordinary Least Square Regression and Ordinal Logistic Regression Models (N=499)

Independent Variables	Model 1a (OLS) Identify people	Model 1b (Ordinal) Identify people	Model 2a (OLS) Identify partners	Model 2b (Ordinal) Identify partners
Firm	0.52***	0.68***	0.82***	0.99***
	(4.00)	(17.20)	(6.52)	(36.74)
Government agency	0.27	0.35	0.49***	0.55**
	(1.51)	(2.55)	(3.31)	(8.62)
University	0.86***	1.00***	0.37	0.51*
	(6.55)	(36.00)	(1.91)	(4.26)
Research institute	0.36	0.48*	0.55*	0.49*
	(1.93)	(4.34)	(2.12)	(6.48)
Industry association	0.56***	0.63***	0.65***	0.75***
	(4.18)	(14.01)	(5.19)	(21.87)
Number of employees	0.00	0.00	0.00	0.00
	(-0.24)	(0.13)	(1.49)	(2.27)
Annual sales growth	0.14**	0.15*	0.13*	0.17*
	(2.59)	(4.89)	(2.53)	(6.29)
R & D investment	0.60	0.01	0.01**	0.02**
	(1.35)	(2.24)	(2.89)	(10.15)
HR investment	-0.05	-0.04	-0.04	-0.05
	(-1.90)	(0.50)	(-0.84)	(0.74)
Net profit on sales	-0.02	0.00	0.05	0.08
	(-0.29)	(0.00)	(0.92)	(1.43)
Constant	3.40***	--	2.88***	--
F	11.11***	--	14.37***	--
Chi-square	--	93.22***	--	119.88***
Adjusted R^2	0.16	--	0.20	--
Nagelkerke R^2	--	0.17	--	0.21

Note: t- value or chi-square value in parentheses; *: p<0.05; **: p<0.01; ***: p<0.001.

Table *(Continued)*

Independent Variables	Model 3a (OLS) Facilitate innovation collaboration	Model 3b (Ordinal) Facilitate innovation collaboration	Model 4a (OLS) Help learn- technology	Model 4b (Ordinal) Help learn- technology
Firm	**0.52***** (3.61)	**0.55**** (9.87)	**0.56***** (4.51)	**0.63***** (14.59)
Government agency	**0.72***** (5.10)	**0.85***** (24.36)	0.11 (0.73)	0.13 (0.47)
University	**0.70***** (4.24)	**0.87***** (18.35)	**0.57***** (4.61)	**0.72***** (19.35)
Research institute	0.20 (1.07)	0.26 (1.34)	**0.47**** (3.02)	**0.71***** (11.70)
Industry association	**0.89***** (6.62)	**1.01***** (37.35)	0.33 (1.65)	0.32 (3.96)
Number of employees	**0.00**** (2.20)	**0.00*** (5.77)	0.00 (0.39)	0.00 (0.61)
Annual sales growth	0.07 (1.29)	0.09 (1.82)	0.05 (1.02)	0.08 (1.54)
R & D investment	**0.01**** (2.14)	**0.01**** (6.89)	0.70 (1.64)	0.01 (2.53)
HR investment	-0.05 (-1.03)	-0.04 (0.57)	-0.04 (-0.90)	-0.02 (0.10)
Net profit on sales	0.04 (0.74)	0.03 (0.15)	0.02 (0.40)	0.05 (0.52)
Constant	**2.99*****	--	**4.19*****	--
F	**15.03*****	--	**7.45*****	--
Chi-square	--	**128.73*****	--	**63.51*****
Adjusted R^2	0.21		0.11	
Nagelkerke R^2	--	0.22	--	0.12

*: p<0.05; **: p<0.01; ***: p<0.001.

Table *(Continued)*

Independent Variables	Model 5a (OLS) Help learn- market	Model 5b (Ordinal) Help learn- market	Model 6a (OLS) Help learn business	Model 6b (Ordinal) Help learn business
Firm	**0.71***** (5.24)	**0.85***** (24.70)	**0.67***** (4.95)	**0.70***** (19.08)
Government agency	**0.41**** (2.59)	0.32 (2.45)	0.16 (0.83)	0.16 (0.55)
University	0.40 (1.61)	0.43 (1.60)	0.52* (2.37)	0.29 (3.00)
Research institute	**0.59**** (3.15)	**0.74**** (8.28)	0.63 (1.94)	**0.49*** (5.48)
Industry association	**0.75***** (5.63)	**0.81***** (23.12)	**0.57***** (4.11)	**0.63***** (14.55)
Number of employees	0.00 (-0.32)	0.00 (0.36)	0.00 (-0.87)	0.00 (1.27)
Annual sales growth	0.08 (1.42)	0.13 (3.47)	**0.13*** (2.16)	**0.15*** (4.81)
R & D investment	0.40 (0.95)	0.01 (0.86)	0.60 (1.40)	0.01 (3.47)
HR investment	0.04 (0.79)	0.03 (0.22)	-0.03 (-0.57)	-0.04 (0.49)
Net profit on sales	-0.02 (-0.41)	-0.03 (0.18)	0.05 (0.79)	0.09 (1.85)
Constant	**3.56*****	--	**3.24*****	--
F	**10.39*****	--	**7.83*****	--
Chi-square	--	**76.57*****	--	**73.16*****
Adjusted R^2	0.15	--	0.11	--
Nagelkerke R^2	--	0.15	--	0.13

*: p<0.05; **: p<0.01; ***: p<0.001.

Table *(Continued)*

Independent Variables	Model 7a (OLS) Undertake innovative activities	Model 7b (Ordinal) Undertake innovative activities	Model 8a (OLS) Promote standards	Model 8b (Ordinal) Promote standards
Firm	**0.37***	**0.37***	**0.47****	**0.55****
	(2.32)	(4.30)	(2.65)	(6.85)
Government agency	0.27	0.30	**0.92*****	**0.78*****
	(1.74)	(3.37)	(6.39)	(20.83)
University	**0.97*****	**0.93*****	0.38	**0.38**
	(6.45)	(30.52)	(1.72)	(2.08)
Research institute	**0.71*****	**0.61****	0.37	**0.36**
	(3.66)	(8.10)	(1.99)	(2.06)
Industry association	**0.47****	**0.62****	**0.82*****	**0.79*****
	(2.74)	(9.60)	(5.65)	(21.30)
Number of employees	0.00	0.00	**0.00***	**0.00***
	(0.92)	(0.16)	(2.28)	(4.58)
Annual sales growth	0.13	0.10	**0.14***	0.13
	(1.94)	(2.83)	(2.32)	(3.15)
R & D investment	0.40	0.00	0.00	0.00
	(0.77)	(0.68)	(-0.03)	(0.07)
HR investment	-0.04	-0.04	-0.05	-0.06
	(-0.79)	(0.46)	(-0.93)	(1.05)
Net profit on sales	-0.04	-0.01	-0.04	-0.02
	(-0.61)	(0.03)	(-0.61)	(0.07)
Constant	**2.81*****	--	**3.08*****	--
F	**9.12*****	--	**12.42*****	--
Chi-square	--	**59.48*****	--	**74.32*****
Adjusted R^2	0.13	--	0.18	--
Nagelkerke R^2	--	0.12	--	0.15

*: p<0.05; **: p<0.01; ***: p<0.001.

Table *(Continued)*

Independent Variables	Model 9a(OLS) Force innovation-regulations	Model 9b(Ordinal) Force innovation-regulations	Model 10a (OLS) Force innovation-social pressure	Model 10b(Ordinal) Force innovation-social
Firm	0.50	0.48	**0.70****	**0.85*****
	(1.82)	(2.06)	(3.48)	(15.36)
Government agency	**1.24*****	**1.44*****	**0.96*****	**1.08*****
	(7.48)	(60.16)	(6.57)	(44.75)
University	0.33	0.58	0.54	0.46
	(2.28)	(5.68)	(1.73)	(4.69)
Research institute	0.54	0.57	0.51	**0.65***
	(1.59)	(2.54)	(1.36)	(5.62)
Industry association	**0.78*****	**0.75****	**0.77*****	**0.81****
	(4.09)	(8.70)	(4.35)	(17.91)
Number of employees	0.00	**0.00***	0.00	0.00
	(1.92)	(4.77)	(1.68)	(3.69)
Annual sales growth	0.11	0.12	**0.14***	**0.14***
	(1.66)	(2.89)	(2.18)	(4.45)
R & D investment	-0.90	**-0.01***	0.40	0.00
	(-1.88)	(4.05)	(0.76)	(0.22)
HR investment	**-0.13***	**-0.131***	**-0.16****	**-0.17****
	(-2.36)	(5.30)	(-3.40)	(8.85)
Net profit on sales	-0.02	-0.020	-0.05	-0.07
	(-0.29)	(0.09)	(-0.79)	(1.26)
Constant	2.85	--	2.88	--
F or Chi-square	13.10	124.80	11.88	114.51
	0.19	0.22	0.17	0.20
Adjusted R^2	0.50	0.48	**0.70****	**0.85*****
Nagelkerke R^2	(1.82)	(2.06)	(3.48)	(15.36)

*: p<0.05; **: p<0.01; ***: p<0.001.

5.2 Importance of Organizational Actors on Innovation Intermediation Activities

Building on the relationship in each model, I examine the relative importance of each organizational actor on innovation intermediation activities variable in this section. To test Hypotheses, I use the reverse coded mean ranks shown in Table 5.2. These ranks are the averages of standardized coefficients, t-values of Student's t-tests, p-values of Wald tests, and c-statistics, and they are aimed at testing the relative importance of organizational actors in particular innovation intermediation activities. For example, Regression Model 1 in Table 5.2 shows that universities are most strongly related with the activity "knowledgeable people identification" as the corresponding coefficient is the largest and the most statistically significant ($\beta=1.00$; $p<0.001$ in Model 1b of Table 5.1). Accordingly, the actor "university obtains the highest rank (reverse mean rank=5) in Model 1.

5.2.1 The Importance of For-profit Firms

Hypothesis 1 states that for-profit firms are the actors most strongly associated with all innovation intermediation activities. Table 5.2 shows that firms are not the actors most frequently associated with all innovation intermediation activities. Firms are the highest ranked actors only in Models 2, 5 and 6 (reverse mean rank=5 or 4.8). This suggests that compared to governments, universities, research institutes, and industry associations, for-profit firms are more strongly associated with the importance of only three enabling innovation intermediation activities, namely, identifying partner firms, helping firms learn business advice, and helping firms learn about new markets. Therefore, Hypothesis 1 is partially supported.

Most literature supports that firms are most likely to cooperate with other for-profit firms to enable the innovation process (Bennett & Robson, 1999; Freel, 2003; Hargadon & Sutton, 1997; von Hippel, 1986; Zhang & Li, 2010). But the results of this study show that for-profit firms are important actors to identify partner firms and learn and exchange knowledge, while they are not the most important actors to help firms learn technology, undertake innovation activities on behalf of firms, or facilitate innovation collaboration. The primary goal of for-profit firms is to maximize their profitability, so there is a conflict between increasing profitability and learning new technology. In addition, the market failures, such as information asymmetries, information spill-over, and imperfection in capacity, may make it impossible that firms cannot undertake innovation activities on behalf of other firms and facilitate innovation collaboration (Klerkx & Leeuwis, 2008).

5.2.2 The Importance of Governments

Hypothesis 2 states that government agencies are the actors most strongly associated with the importance of coercive innovation intermediation activities. Governments are the actors most strongly associated with promoting standards and forcing firms to innovate through regulations or social pressure as government agencies obtain the highest ranks in Models 8, 9, and 10 of Table 5.2 (reverse mean rank=5 or 4.8). Therefore, Hypothesis 2 is supported. But it should be noted that government agencies are the least important organizational actor for the three innovation intermediation activities that enable the innovation process, namely, identifying knowledgeable individuals, helping firms learn about new technologies, and providing firm with business advice.

The results suggest that government agencies are not the most important actors to conduct enabling innovation intermediation activities. Instead, governments could play a crucial role in funding other actors, such as universities, service intermediaries, and non-profit intermediaries.

5.2.3 The Importance of Universities

Hypothesis 3 suggests that universities are the actors most strongly associated with the innovation intermediation activities relevant to research and development. Models 1, 4, 7 in Table 5.2 show that the innovation intermediation activities for which universities are the most important actors in providing firms with technology, identifying knowledgeable individuals, and undertaking innovative activities on behalf of firms (reverse mean rank=5). Hypothesis 3 is supported.

This result is not surprising because universities are typically the source of high quality people and graduates, have specialized labs and equipment, and lack conflicting commercial objectives. Being a source of high-quality people allows universities to help firms identify knowledge people (Gregorio and Shane, 2003). Specialized labs and equipment allow universities to undertake innovation activities on behalf of firms (Debackere & Veugelers, 2005; Rothaermel & Thursby, 2005). The lack of conflicting commercial objectives allows universities to help firms learn about new technology (Motohashi & Yun, 2007; Siegel et al., 2003)

Table 5.2 Relative Importance of Organizational Actors on Innovation Intermediation Activities (N=499)

Reverse Mean Rank / Model	Firm	Government agency	University	Research institute	Industry association
Model 1 Identify people	4	1.2	5	1.8	3
Model 2 Identify partners	4.8	3	1	2	4.2
Model 3 Facilitate innovation	3.8	2.6	2.6	1	5
Model 4 Help learn- tech	4	1.2	5	2.2	2.6
Model 5 Help learn- market	4.8	1.8	1.4	2.8	4.2
Model 6 Help learn- business	5	1.4	2.6	2	4
Model 7 Undertake innovative activities	2.4	2.6	5	3.6	1.4
Model 8 Promote standards	2.8	4.8	1.4	3.6	2.4
Model 9 Force innovation- regulations	2.8	5	1	2	3.6
Model 10 Force innovation- social pressure	2.8	5	2	1.2	4

Note: Cells contain reverse coded mean ranks; the highest rank means that the particular organizational actor is most strongly associated with the corresponding innovation intermediation activity.

5.2.4 The Importance of Industry Associations

Hypothesis 4 suggests that industry associations are the most important actors for identifying partner firms and facilitating multiple partner innovation collaborations. The result in Model 3 from Table 5.2 shows that of the five organizational actors, industry associations exert the most significant influence on only one enabling activity, namely, facilitating innovation involving multiple organizations (reverse mean rank=5). Thus, Hypothesis 4 is not fully supported.

There is disagreement on whether or not industry associations as innovation intermediaries. The result of my study shows that industry associations are the most important actors to facilitate multiple partner innovation collaborations. This suggests that industry associations can find their niche in a particular innovation intermediation activity. This is consistent with other studies (Bennett and Robson, 1999). But it is of interest to note that industry associations are the second most important organizational actor for three enabling activities: Identifying partner firms, helping firms learn about new markets, and providing firms with business advice. Therefore, the impact of industry associations should not be ignored.

5.3 Results of Control Variables

There are three interesting results of control variables in the regression models. First, Table 5.1 shows that the importance of three innovation intermediation activities "helping firms identify people", "helping firms identify partner firms", and "providing firms with business advice" has a positive relationship with annual sales growth. This implies that the respondent firms with high annual sales growth are more likely to consider that these three innovation intermediation activities important. Second, Table 5.1 also shows that the respondent firms of large size (measured by the number of employees) and that are R&D intensive are more likely to facilitate multiple-party innovation collaboration than others. Third, there is a positive relationships between the importance of innovation intermediaries activities “promote standards” and “force firms to innovative by regulation” and firm size. This suggests that large respondent firms are sensitive to the two innovation intermediation activities: Forcing firms to innovate by regulations and forcing firms to innovate through social pressure.

6. Conclusion

This study is motivated by the limitations in the literature on innovation intermediaries and studies based on Community Innovation Surveys (CISs). The literature on innovation intermediaries reports on the impact of specific types of organizations, but has not considered the relative importance of different types of organizations. While the studies using CIS data consider relative importance, a range of activities are not considered. To address these limitations, I investigate the relationships between innovation intermediation activities and the organizational actors that perform them with a view to advancing our understanding of the relative importance of the enabling contributions of a range of organizational actors.

Using a sample of 499 firms, I test four hypotheses on the relative importance of actors that conduct innovation intermediation activities. The results do not support two hypotheses on the importance of for-profit firms and industry associations, while the results of other two hypotheses confirm the widely accepted contributions of universities and governments in innovation intermediation activities. These findings may help policy makers and managers better understand the importance of innovation intermediation activities and actors that perform them. I present the contributions to policy makers and managers and the limitations of my study in the following subsections.

6.1 Contributions

6.1.1 Contributions to Research and Policy on Innovation Intermediaries

First, my study empirically examines the relative importance of the innovation intermediation activities that are conducted by for-profit intermediaries and non-firm intermediaries, such as universities, governments, and industry associations. Contrary to the findings of the Community Innovation Surveys, I find that firms are not always the most important sources of information or the most important collaborators (Dalziel, 2006; Department for Innovation, Universities & Skills, 2009; Lee et al., 2009). For example, the most important innovation intermediation activity is helping firms learn about new technologies, and universities are the most important actors in performing this activity. Other innovation intermediation activities for which firms are not the most important actors are identifying knowledgeable individuals, facilitating innovation that involves multiple organizations, and undertaking innovation activities. Universities are the most important actors in identifying knowledgeable individuals and undertaking innovation activities. Industry associations are the most important actors in facilitating multi-party innovation collaborations. These findings may facilitate policy makers to effectively allocate the resources by providing financial and regulatory support for enabling the mutual effects of multiple actors in the innovation process. For example, policy makers provide funds or facilitate strategic innovation policy to build the different intermediated network models in diverse sectors or regions (Acworth, 2008; Lee et al., 2010; Smedlund, 2006). These models involve the mutual support on the innovation process from a range of actors such as firms, universities, government agencies, and non-profit intermediaries

In addition, the Community Innovation Surveys analyze only two innovation intermediation activities, namely, sources of information and innovation collaborations (CIS, 2004: p7-8) because these surveys provide policy makers with high-level data. Rather than asking about two innovation activities as Community Innovation Surveys do, I ask about ten innovation intermediation activities. I consider not only facilitating innovation cooperation and imparting sources of information, but also identifying knowledgeable people and partner organizations, and undertaking innovation activities. Moreover, I consider three sources of information, namely, technology information, marketing information, and business information. These findings may help the designers of innovation surveys reflect on the importance of diverse innovation intermediation activities and the multiple actors that perform them and facilitating the improvement of innovation surveys in the area of innovation intermediaries.

6.1.2 Managerial Implications

Managers have long been advised to establish external relations with organizations such as other firms, universities, government agencies, and non-profit organizations. They would most likely consider for-profit firms as the most important strategic partners due to similarities in communication and management styles among for-profit firms. But my findings show that for-profit firms are not always the most important actors in intermediating and facilitating innovation. Managers can rely on for-profit firms only to identify partner firms, to learn business advice, and to learn about new markets. And industry associations can be considered as the most important actors to facilitate innovation collaborations that involve multiple parties.

6.2 Limitations and Future Research Directions

My study has limitations that should be addressed in future research. First, the bias of sample may influence the generalization of final results. The proportion of Asian firms in my study sample is higher than the proportion of Asian firms in the full sample. The proportion of Asian firms in my study sample is higher than the proportion of Asian firms in the full sample. Chinese society emphasizes personal trust, not the development of institutional trust (Gu and Lundvall, 2006). This may explain why, when compared to their Western counterparts, firms in China are weaker in promoting collaborations with other firms (Park & Luo, 2001). Therefore, the results show that for-profit firms are not the most important actors for the innovation intermediation activity of facilitating innovation collaborations may be a consequence of the large number of Asian firms in the study sample. Researchers have promoted the importance of industry associations in either Asian or North America (Dalziel, 2006; Kennedy, 2008; Lee et al, 2009), so the result that industry associations are the most important actors for the innovation intermediation activity of facilitate innovation collaborations may likely be generalized to both of the North America and Asian firms. The results regarding the relative importance of universities and governments can likely be generalized to both of the North American and Asian firms.

Second, this study considers ten innovation intermediation activities which abstract from a diverse range of micro-activities by referencing the outcomes. Future work is expected to distinguish between activities and outcomes. The outcomes may be short-term, intermediate and long-term. Finally, the innovation intermediation activities are divided into ten activities, but other innovation intermediation activities, such as financial support, research and development, promotion and community building, have not been examined. Future work may consider more a holistic picture of innovation intermediation activities. Yet, many papers have studied the impact of financial support and research and development, excluding these activities may be reasonable and acceptable.

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Appendix

Table 1.1 Contributions of Studies on Innovation Intermediation Activities and Innovation Intermediaries

Studies	Contributions
Acworth, 2008	Building on the KIC (use full name) model proposed by the Cambridge-MIT Institute (CMI), this paper describes the functional components, support mechanisms, organizational structure, review processes and mechanisms for knowledge exchange.
Aldrich and Sasaki, 1995	This paper conducts a comparative study on the inter-organizational arrangements for RandD performed by the consortia in Japan and US. The results from the quantitative survey show that they have made very different choices about how they will conduct research.
Bennett and Robson, 1999	This paper provides the first large-scale coverage of all main sources of supply of SME advice, ranging from the private sector, through social networks, to business associations & government-backed agents. It is to assess the extent and impact of external advice to SMEs and to test if different relationships of trust with the supplier influence levels of use and impact.
Bessant and Rush,1995	This paper pays particular attention to the intermediary roles which can be played by consultants in bridging the managerial gap, the changing nature and scope of service offered by consultants and the contributions they can make within technology policy.
Branstetter and Sakakibara, 2002	This paper examines the impact of a large number of Japanese government-sponsored research consortia on the research productivity of participating firms, and their evidence suggests that consortia are most effective when they focus on basic research and have high level of RandD spillovers.
Debackere and Veugelers, 2005	This paper offers deeper insights into how effective industry science links can be fostered through the design and evolution of university-based technology transfer organizations (TTOs).
Gregorio and Shane, 2003	This paper use a longitudinal survey to get insights into the reasons why some universities generate more new companies to transfer their technology than do others.

Table 1.1 *(Continued)*

Studies	Contributions
Dalziel, 2006	The paper shows that industry associations have a strong impact on the ability of Canadian firms to innovate; also describes how the measurement guidelines of the Frascati and Oslo Manuals make it difficult to observe the existence and impact of nonprofit organizations that perform innovation enabler roles.
Dalziel, 2007	Offer a deeper insight into the differences between organizational actors and organizational roles of non-profit organizations. Also suggest that non-profits are more likely are than firm, governments, or universities to be perceived as institutional enablers.
Dalziel, 2009	This researcher considers innovation intermediaries as a single class of organizations which compensate for contract failures and reduce the innovation gap to enable innovation. Also, she specifies the activities of innovation intermediaries and justifies why these activities exist.
Etzkowiz and Leydesdorff, 2000	This paper emphasizes the important role of university in transferring knowledge & technology and proposes the triple helix model of university-industry-government relations. It argues that university research may function increasingly as a locus in the lab of such knowledge-intensive societies.
Grindley et. al., 1994	Look back the transformation and experience of a research consortium SEMATECH, the article attempts to transfer the vertical collaboration model within SEMATECH to other industries. This article focuses on specifying the vertical innovation which involves public and private organizations, such as suppliers, user firms, and government agencies.
Hargadon and Sutton, 1997	Apply multiple data sources to elaborate on how IDEO, a product design consulting firm, develops innovative products. This ethnography primarily blends network and memory perspectives, which suggests that network theory might be developed further by devoting more attention to the transformation and combination of ideas and resources.
Howells, 2006	Review and synthesis the relevant literature; develop a typology of the different roles/functions of intermediation process within innovation; extend the existing theory and unfold a more complete story of the model and the roles/functions of innovation intermediaries

Table 1.1 *(Continued)*

Studies	Contributions
Human and Provan, 1997	This paper analyzes the problem concerning what outcomes firms achieve from network participation and reveals the positive value of small-to-medium-sized enterprise networks to involved member firms.
Lee, et al., 2009	This paper attempts to identify collaboration models to enhance the potential of open innovation for SMEs. Of various collaboration models, an intermediated network model in Korea is investigated, and this model compensates for SMEs' limited abilities in searching for partners and building trust between network members. The results indicate that networking is an effective way to facilitate open innovation among SMEs.
Löfsten and Lindelöf, 2002	This paper examines the characteristics and growth of 273 firms which are on and off ten science parks in order to identify the impact of science parks in Sweden. It also shows that firms located in science parks were significantly more likely to have a link with a local university than off-park firms.
Li and Atuahene-Gima, 2002	This paper examines the roles of firms characteristics and environment factors in the creation of inter-firm linkages.
Motohashi and Yun, 2007	The linkages of S&T activities between industry and science are investigated in the context of innovation system reforms.
Rothaermel and Thursby, 2005	This paper investigates the research question of how knowledge actually flows from universities to incubator firms, and it also assesses the impact of these knowledge flows on incubator firm-level differential performance.
Sakakibara and Branstetter, 2003	This paper empirically evaluates the impacts of the US Advanced Technology Program sponsored consortia on pre-commercial research productivity of member firms
Zhang and Li, 2010	The paper shows that new ventures' ties with service intermediaries, such as technology service firms, accounting and financial service firms, law firms, and talent search firms, contribute to the ventures' product innovation by broadening the scope of their external technical, financial, and networking information search.

Table 1.2 Limitations of Studies on Innovation Intermediation Activities and Innovation Intermediaries

Studies	Limitations		
	Sample Size	Types of innovation intermediation activities	Type of innovation intermediaries
Acworth, 2008	A case study on Silent Aircraft Initiative Program	Primarily focus on technological knowledge exchange	Silent Aircraft Initiative Program to evaluate the practical application of the KIC concept proposed by the Cambridge-MIT Institute (CMI) in UK.
Aldrich and Sasaki, 1995	The same questionnaire was administered to 39 consortium managers in US and 54 in Japan	Focus on how to conduct research.	Research consortia in Japan and US
Bennett and Robson, 1999	Large sample size (2547 respondents)	Only one activity: providing external business advice	It covers a wide range of advice sources, such as accountants, solicitors, banks, business friend, customers, suppliers, and so on.
Bessant and Rush,1995	Programs under the Advanced Manufacturing Technology support	Transferring expert knowledge, carrying experiences from other field or context into another, acting as brokers to client firms, and articulate the users' needs.	Various consultants who play intermediary roles, including technology brokers, university liaison departments, regional technology centers, innovation agencies, and cross national networks. Here, *however, confounds organizations and organizational roles*
Branstetter and Sakakibara, 2002	A large number of research consortia in Japan	Focus on analyzing the patenting in the targeted technologies	Government sponsored research consortia which primarily involve governments and industrial firms.

Table 1.2 *(Continued)*

Studies	Limitations		
	Sample Size	Types of innovation intermediation activities	Type of innovation intermediaries
Dalziel, 2006	Large sample size (2123 establishments in 35 knowledge-based service industries in Canada)	The activities that non-profit organizations such as industry associations perform involve identifying and legitimizing agents, facilitating the creation of ties between agents, increasing access to resources through brokerage, facilitating joint action through closure.	Describe the enabling impact of nonprofit organizations and focus on the impact of industry associations
Dalziel, 2007	This is a theoretical paper. Future research will involve using a random sample to test the propositions	The innovation process is enabled by various enabling activities. But this study doesn't provide any empirical evidence	Consider non-profit organizations as an overarching group of organizational actors
Debackere and Veugelers, 2005	The innovation intermediation activities implemented by an university-based technology transfer organization in Belgium	Focus on three dimensions: facilitating contract research activities, managing IP, and transferring technology knowledge	An university-based technology transfer organization: K.U. Leuven Research and Development (LRD) in Belgium.
Gregorio and Shane, 2003	The sample size is restricted to 101 universities that are both in the AUTM database and responded to our survey	How to transfer scientific discoveries	101 U.S. universities

Table 1.2 *(Continued)*

Studies	Limitations		
	Sample Size	Types of innovation intermediation activities	Type of innovation intermediaries
Dalziel, 2009	Theoretical paper	The activities of innovation intermediaries cover three categories: inter-organizational networking activities, technology development and related activities, and other activities, such as training activities, physical space offering, etc.	Various intermediaries
Etzkowiz and Leydesdorff, 2000	Theoretical paper	Apply the triple helix model to transfer knowledge and technology	Overemphasize the role of universities; but diminish the role of non-profit organizations which also play an intermediation role in facilitating innovation
Grindley et. al., 1994	This article is based on a research consortium.	Focus on the innovation intermediation activities experienced by SEMATECH (a research consortium), such as vertical collaborations involving multiple organizations and development of standards	The research consortium is a non-profit organization.
Hargadon and Sutton, 1997	This article is based on a consulting firm	Elaborates on a process model of technology brokering, involving acquiring, storing, and retrieving knowledge	A consulting firm

Table 1.2 *(Continued)*

Studies	Limitations		
	Sample Size	Types of innovation intermediation activities	Type of innovation intermediaries
Howells, 2006	The research is based on twenty-two innovation intermediaries. The sample was not randomly selected.	A typology of ten innovation intermediation activities	All twenty-two innovation intermediaries are private non-profit in nature.
Human and Provan, 1997	Two networks of small-to-medium-sized manufacturing enterprises in the US wood products industry	Inter-organizational exchanges of friendship, information, business, and competencies; Organizational credibility; and access to resources	Small-and-medium-sized networks
Lee, et al., 2009	Data from an innovation survey in Korea (This survey is conducted by another organization, so the authors don't have first-hand data and just cite the results from the data.)	Facilitate innovation collaborations for SMEs, which involves identifying partner firms, constructing and managing network, and providing the relevant information and services	Focus on the case of the KICMS, an association established to enable collaboration between Korean SMEs.
Li and Atuahene-Gima, 2002	Randomly select 300 ventures, and the effective sample size is 184 ventures	Agency business activity, a downstream type of alliance involving marketing and distribution of the products of foreign firms	184 Chinese high-technology new ventures (HTNVs)

Table 1.2 *(Continued)*

Studies	Limitations		
	Sample Size	Types of innovation intermediation activities	Type of innovation intermediaries
Motohashi and Yun, 2007	A firm level dataset from SandT survey at National Bureau of Statistics (NBS) of PRC for about 22,000 manufacturing firms	The linkages of S&T activities between industrial firms and other organizations, such as universities, public research institutes, etc.	Multiple organizations, including universities, public institutes, and industrial firms.
Rothaermel & Thursby, 2005	Data for the 79 firms were collected annually for the 6-year time period between 1998 and 2003	Transfer technology knowledge flows by the means of license and backward citations.	Technology incubators are university-based technology initiatives
Sakakibara and Branstetter, 2003	96 research consortia in US	Multi-partner alliances may engage intensively in basic research	US government sponsored research consortia
Zhang and Li, 2010	500 new manufacturing firms	Focus on innovation search which can be defined as a problem solving activity in which firms solve problems through combining knowledge elements to create new products	For-profit service intermediaries, such as technology service firms, accounting and financial service firms, law firms, and talent search firms.

Table 4.1 Managing in New Economy Survey

Focal firms rely on partners such as for profit firms, government, universities, research institutes, and industry associations for innovation intermediation activities. Please indicate that the importance of innovation intermediation activities in the left column, and indicate the types of organizations that perform the activities in the right column.

Innovation intermediation activities	Importance of activities							F	GA	U	RI	IA
1. Identifies knowledgeable individuals	1	2	3	4	5	6	7					
2. Identifies partner firms and organizations	1	2	3	4	5	6	7					
3. Facilitates innovation involving multiple organizations	1	2	3	4	5	6	7					
4. Helps our firms learn about new technologies	1	2	3	4	5	6	7					
5. Helps our firms learn about new markets	1	2	3	4	5	6	7					
6. Provides our firm with business advice	1	2	3	4	5	6	7					
7. Undertakes innovation activities on our behalf	1	2	3	4	5	6	7					
8. Promotes enabling standards	1	2	3	4	5	6	7					
9. Forces us to innovate by changing regulations	1	2	3	4	5	6	7					
10. Forces us to innovate through social pressure	1	2	3	4	5	6	7					

1: Not at all important; 7: Extremely important.
F: For-profit firms; GA: Government agencies; U: Universities; RI: Research institutes; IA: Industry associations