Interactive Learning, Informal Networks and Innovation:
Evidence from Electronics Firm Survey in the Pearl River Delta, China

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Abstract

Learning by interacting defines the endogenous path of economic development in modern innovation studies. In this paper, we aim to investigate the way that firms undertake interactive learning in the Chinese context by introducing the role of informal Guanxi network. In this way, this paper tries to bridge the gap between studies on firm innovation activities and those on the role of informal network for business performance. Based on an electronics firm survey in the Pearl River Delta, China, this article demonstrates that firms undertaking the highest intensity of interactive learning with the widest scope of business partners, such as foreign customers, domestic customers, parent companies, universities and sales agents, tend to achieve better innovation outcomes. It also verifies a more important role of interactive learning in incremental product innovation than in discontinuous innovation as electronics firms operate in highly modularized value chains. Furthermore, the intensive interactive learning firms have a much higher tendency to apply informal Guanxi networks with long-term business partners as a complement to deficient formal institutions in interactive learning than other firms. Overall, this paper contributes to the understanding of the form and effect of interactive learning in the Chinese context. Finally, the paper addresses the possible lock-in issue and points out further research questions on the changing pattern of interactive learning within a maturing institutional framework.

Keywords: Interactive Learning; Incremental Innovation; Discontinuous Innovation; Informal Networks; Guanxi

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1. Introduction

Modern innovation studies adopt a system approach, in which the inter-firm linkages involve sustained quasi-cooperative relationships that shape the learning process and determine the innovation outcomes. The interactive learning process undertaken by groups of users and producers creates the diverse complexes of technological capabilities and determines the dynamics of the territorial innovation system as a whole (Lundvall, 1992; Smith, 2000). In addition, the research on regional innovation system extends the scope of interactive learning from within inter-firm linkages to the linkages between firms and other knowledge-producing institutes such as universities, research institutes and related service providers (Asheim and Coenen, 2005; Cooke et al., 1997; Howells, 1999; Revilla Diez, 2000).

Interactive learning is often discussed in relation to incremental innovation that relies on learning by doing and tacit knowledge in the economic geography literature (Capello 1999; Cooke 2001; Malmberg and Maskell, 2006). But some other authors found a positive impact of reliance on network strategies through interaction with external environment on discontinuous innovation (Mckee, 1992; Lambe and Spekman, 1997). The mixed evidence on the role of interactive learning on different types of innovation calls for further empirical investigation. In particular, industrial trends such as modularization and mass customization that emerged in the 2000s remains a less considered mechanism that affects the ways firms innovate.

Therefore, this paper attempts to relate interactive learning with the two types of innovation, i.e. incremental innovation and discontinuous innovation, by reflecting on the latest trend in modern industries. The context of the investigation is one of the largest electronics industry clusters, the Pearl River Delta. This industrial cluster has taken the opportunity of relocation and of subcontracting processing functions from global lead firms in the 1990s. With the support of developed modularization technology in the 2000s, many local electronics firms in the Pearl River Delta started to upgrade from low-end suppliers and processors to final producers of mature products such as mobile phones, MP3 players, and home-use electronics products by integrating "off the shelf" modularized subcomponents into new product design. The modularity in the electronics industry reduces the uncertainty of entering a new mature product market, and on the other hand, necessitates the interaction between specialized firms to explore the new market opportunities of new combinations within the current technological field. As such, the paper refreshes the theoretical discussion on the role of interactive learning on innovation through an empirical study in China.

In addition, a theory-informed investigation into the way interactive learning is organized in the context of China has been made. Informal Guanxi networks, are a key element of *savoir-vivre* for doing business in China and it has been proved by previous studies that they have a positive impact on reducing transaction costs and sustaining reliable and responsive supplier-customer relationships (Luo, 2002; Meyer et al., 2009; Wu and Choi, 2004; Zhou et al., 2003). However, the role of informal Guanxi networks in fostering interactive learning processes still remains unclear. As such, this article tries to bridge the gap between studies on firm innovation activities and studies on the role of Guanxi network for business performance. Beyond that, it aims to find out how Guanxi networks with long-term business partners differentiate itself from those with relatives and friends, and whether one of them serves as a viable strategy to complement the deficient formal institutional environment in China. The selection of a partner with whom a firm establishes a Guanxi network determines the degree to which they share similar technical and market knowledge. The extent of ‘cognitive proximity’ (Boschma, 2005) is an elementary factor for effective interactive learning.

Overall, by investigating the willingness and capacity of electronics firms in the Pearl River Delta, China, to undertake interactive learning in product innovation activities, this article sheds light on the innovation mechanism in the Chinese industrial clusters. In the face of the global recession and domestic inflation, the capacity of Chinese firms to draw on innovation externalities is of great importance for regional structural adjustments and long-term development. The empirical substances, i.e. a uniquely designed firm survey directly collected from managers of electronics firms in the Pearl River Delta, China, enables the further understanding of social factors (Guanxi) that facilitate innovation in the Chinese context, in which the institutional framework is quite different from that in industrialized countries.

The remainder of this article is structured as follows: the second section elucidates the interactive process of innovation activities and discusses how different types of Guanxi networks assist firms in interactive learning activities in the Chinese institutional setup. Two hypotheses are derived based on the theoretical discussion. The third section presents the dataset, related parameters and the methodology applied. The fourth section discusses the empirical results. The fifth section concludes and discusses policy implications.

2. Innovation, Interactive Learning and Informal Networks

2.1 Innovation as an Interactive Process

Unlike exogenous inputs such as capital and labor, innovation and learning contribute to the improvement of productivity and are determinant to long-term economic growth (Arrow, 1962; Nelson and Siegel, 1987; Romer, 1986).

In Lundvall's (1992) seminal work on national systems of innovation, he proposed that the approach towards systemic innovation and interactive learning considers the stock and rate of R&D investment as the new determining variable in economic growth. In other words, interactive learning creates increasing returns for the stock of knowledge and thus underpins long-term economic growth.

In this part, we borrow the classification of knowledge by Salter and Reddaway (1969), i.e. firm-specific knowledge, sector product-field-specific knowledge, and generally applicable knowledge, for the discussion on why and how firms undertake interactive learning in innovation activities.

2.2 Why Firms undertake Interactive Learning

The firm-specific knowledge is well elaborated on by Nelson and Winter's (1982) proposition of organizational routine. Routine consists of particular resources, skills, experience and know-how that the firm accumulates over time (Levitt and March, 1988), and is therefore difficult to imitate for others.

Organizational routines develop in a path-dependent manner, in which the firm tends to search for information and undertake activities related to its own knowledge sphere (Kline and Rosenberg, 1986). Therefore, the firm displays bounded rationality and competence in the innovation-related activities, which has two important implications for the role of interactive learning in innovation.

Firstly, bounded rationality implies that the decision-making process is determined by limited information, limited knowledge and limited resources of the individuals or entities, thus leading them to base decision-making on existing knowledge and capacity, which results in a satisfactory solution rather than an optimal one based on total rationality (Simon, 1957, 1991). As a result, firms with bounded rationality are not able to calculate the result of decision-making on innovation investment when faced with uncertainty in the environment. In order to reduce risk-related uncertainty, firms have to collect more technical information and market information from external organizations.

Secondly, the firms only master and excel in a limited range of products and processes due to the bounded competence. As a result, firms are constantly confronted with technological problems in the innovation process which lie outside their range of knowledge and competence (Smith, 2000). This kind of knowledge is not only limited to codified knowledge, such as the support of specialized equipment and operating software, but also refers to the more important tacit knowledge, such as technical know-how and experience, which is a key to problem-solving in the process of prototype development and the technically specific design. Due to the tacitness of most knowledge, the firms need to engage in face-to-face interaction with other organizations in order to solve these problems and optimize the innovation outcomes.

Therefore, due to bounded rationality and competence, firms need to complement internal efforts in innovation with interaction with other organizations in order to facilitate innovation-related decisions by searching for relevant information, and must also support innovation implementation with external codified and tacit knowledge.

2.3 How Firms undertake Interactive Learning

Tacit knowledge is not only confined to individuals or groups of cooperating individuals, but also embeds within specific industries, which is often referred to in the literature as the “technological paradigm” (Dosi, 1988). Technological paradigm refers to the common technological features, such as technical parameters, performance characteristics and use of materials shared by firms in an industry (Smith, 2000). Moreover, the sector product-field-specific knowledge also covers knowledge on markets, such as customer needs and the supply of industry-specific skills. Therefore, firms within the same production field are close in cognitive proximity, which facilities the interactive learning process (Boschma, 2004). Cognitive proximity within the same industrial space and supplier link would affect the search and imitation costs when exploiting knowledge.

Kline and Rosenberg’s (1986) early work on the “chain-linked model of innovation” suggests that increased demand of the user firms would generate a rapid rate of technical change for the suppliers. In the chain of innovation from the initial design to the production process, systematic interaction with user needs should be guaranteed in demand-oriented markets. In the Aalborg school of innovation systems, innovation activities within the vertically organized units have been the analytical focus. The search strategies and learning processes organized within the prevalent vertical linkages between the firms and their supplying firms of intermediate and capital goods distribute and transmit the qualitative knowledge related to product innovation (Lundvall et al., 2002; Lundvall, 1988). In order to secure profitable innovation outcomes, the user-producer interaction must be in place to ensure constant feedback on needs, adjusted design, and again on performance (Hage and Alter, 1997). Asheim and Gertler (2005) further elaborate that interactive learning between users and producers often takes place in industries in which synthetic knowledge is dominant. Synthetic knowledge pertains to the importance of applied and problem-solving knowledge, where the innovation process is oriented towards new combinations, new solutions and new utility concerning the user demands.

Interactive processes of knowledge transfer within supplier linkages bring about dynamic synergies rather than static efficiency on transaction cost reduction (Capello, 1999). In the dynamic synergies between customers and suppliers, market information is constantly exchanged, while experience and know-how are shared through engineering knowledge instruction and quality monitoring (often undertaken by the customers). Consequently, the technology trajectory is co-evolving due to the coordination of the production process. In the context of latecomer countries, the firms also rely heavily on the parent companies and foreign customers to acquire advanced codified knowledge and to better absorb the codified knowledge by having the engineers and managers from foreign partners train on site (Morrison et al., 2008; Yang, 2009; Yeung, 2009).

In a word, interactive learning within the vertically organized units, i.e. among suppliers, customers and parent companies, ensures the effective exchange of market information and constant feedback on technical problems and product adjustment, and thus promotes the product innovation outcomes.

In addition to accessing to sector product-field-specific knowledge, generally applicable knowledge that refers to scientific "know-why" knowledge is playing an increasingly important role in the problem-solving of innovation efforts (Lundvall and Johnson, 1994). It is of greater relevance for high-tech industries such as electronics, pharmaceuticals and chemistry, where the technological frontier is expanding at a rapid rate.

In contrast to the synthetic knowledge, which is more connected to sector product-field-specific knowledge, Asheim and Gertler (2005) propose that analytical knowledge is dominated by scientific know-why knowledge and is generated from internal documentation activities as well as collaboration with research institutes. From the research on Danish clusters, Jensen et al. (2007) also found that the mode of learning by doing, using and interacting is no longer able to sustain the competitiveness of firms. Firms that combine the DUI (doing, using and interacting) mode with the STI (science, technology and innovation) mode, i.e. connecting systematically with sources of codified scientific knowledge, outperform other firms in terms of finding new solutions and developing new products. Systematic connection with generic scientific knowledge can be achieved in the following two ways.

Firstly, generally applicable knowledge can be absorbed through internal efforts such as R&D activities, reverse engineering and licensing into a firm's knowledge stock. In the context of latecomer firms, R&D activities bear a social rate of return by influencing the absorptive capacity of the firms through social interaction (Griffith et al., 2003), as it determines the capability of firms to transform externally codified scientific knowledge into their own routines of more tacit knowledge. Moreover, they can also gain access to advanced codified knowledge either through the reverse engineering of the import products from global lead firms, or through formal licensing of the patents. All in all, the efficiency of these activities shapes and is in turn shaped by the absorptive capacity of firms to adapt them to their own specific needs.

Secondly, interaction with universities and research institutes assists firms in acquiring new knowledge through their intra- and interregional networks as well as in applying abstract scientific knowledge to production. Generally applicable knowledge cannot be immediately applied to commercial needs, and the spillover risk for the knowledge investors is too high. The public sector, therefore, which normally operates without profit-maximization goals, should be involved in the production of generally applicable knowledge due to the problem of appropriability (Smith, 2000).

To sum up, the use of external scientific knowledge depends on the firms' absorptive capacity, which is accumulated by internal activities such as R&D activities, reverse engineering and licensing. Furthermore, interactive learning with universities and research institutes assists firms in gaining better innovation performance.

2.4 How Interactive Learning Affect Different Types of Innovation

Based on the above discussion, it can be concluded that interactive learning is needed both in the decision-making and implementing processes of innovation due to the bounded rationality and bounded competence of firms, and it extends the scope of supplier linkages to knowledge-generating institutes.

The literature provides two different predictions about the impact of interactive learning on innovation. On the one hand, the learning economy approach (Lundvall et al., 2002; Asheim and Coenen, 2005) and territorial innovation models (Capello, 1999; Cooke, 2001; Malmberg and Maskell, 2006) expect that the networking among SMEs and localized knowledge spillover due to formal and informal arrangements of spatially proximate partners supports incremental innovation that follows existing technological paths. On the other hand, Mckee (1992) postulates that discontinuous innovation (e.g. new-to-the-firm product innovation) requires more environmental contact than incremental innovation (e.g. product line adjustment) and thus should embrace more contact breath in order to interpret the ambiguous environment. Lambe and Spekman (1997) go further to argue that entering an alliance is a key strategic element for firms to meet discontinuous technological change when the underlying technology meets the inherent limit.

A new trend that emerges in industrial organization since the 2000s, especially in the electronics industry and automotive industry, is mass customization supported by modularization technology (Baldwin and Clark, 2000; Sturgeon, 2002; VanAssche, 2008), whose consideration can partly solve the conflict between the two contradicting arguments mentioned above. By mass customization, firms achieve efficiency and flexibility simultaneously by deploying general-purpose assembly machines and purchasing modularized core parts (Silveira et al., 2001; Gereffi et al., 2005). Downstream producers of mature products transfer the risk of managing radical technological change to producers of high-tech core parts, which are highly concentrated in a few leading clusters around the world. At the same time, the risk to cope with changes in quantity on short notice and price competition is shifted to downstream producers by the lead firms. But the downstream producers still benefit from mass customization due to reduced uncertainty when entering into new technological fields, e.g. by discontinuous product innovation. For instance, firms can switch from producing USB sticks to MP3 players by procuring core parts, e.g. micro-processing chips. Core suppliers, e.g. of flash chips and designed exterior molds, can be still kept and search costs for new suppliers are reduced.

After the entry of a new mature product market, interactive learning with other organizations further aids the firm to exploit the market opportunities of the newly-explored technological field by continuously improved processes or products (Coe et al, 2004). Therefore, it can be deducted that the position of the learning economy approach holds if we assume that firms enter a mature product market, and most of the components of this product are highly modularized and thus share some similar components with other products. The second view point, on the other hand, holds for high-tech components that are in most cases unmodularized or even new-to-the-world inventions.

For firms engaged in interactive learning, the scope and intensity of interaction both matter. The scope of interactive learning refers to the number of external skills and competences at the firms' disposal, which yields increasing returns of the knowledge stock and enables firms to connect information and knowledge more easily. A wide scope of interactive learning not only allows firms to undertake more complex innovation activities, but also supports them to escape the lock-in when interacting with a too limited number of organizations, especially in a sector with turbulent technological change and rapid change in customer needs (Lundvall, 2005). Another aspect to consider is the intensity of interactive learning. Due to the path-dependent accumulation of knowledge, firms have to intensify their interactive learning activities if they are determined to change their conventional ways of cognition and practice in the interaction process. Moreover, new codes have to be developed on a trial and error basis in innovation activities (Lundvall, 1992; Meeus et al., 2001).

Finally, we can propose the first hypothesis:

Hypothesis 1: In industries based on modularization and mass customization, the scope and intensity of interactive learning with customers, parent companies, universities and research institutes in the innovation process contribute more to incremental innovation than to discontinuous innovation.

2.5 The Role of Informal Networks in Innovation-Oriented Interaction

The systems of innovation proposed by Lundvall (1985) suggest that interactive learning is also influenced by non-price relationships such as power, trust and loyalty. Effective transfer of knowledge requires mechanisms to coordinate the interaction of complementary pieces of knowledge.

Informal social relations, which are often related to geographical proximity, accelerate learning and constitute dynamic innovation synergies (Asheim et al., 2007; Asheim and Isaksen, 2002; Iammarino and McCann, 2006; Lazaarini et al., 2001;

Malmberg and Maskell, 2006; Porter, 2000b; Revilla Diez and Kiese, 2006). Social networking can be secured through daily face-to-face interaction such as meeting, chatting, eating together, entertaining together, etc. Face-to-face contact ensures that both interacting partners put efforts into the joint project and prevents them from engaging in free-ride behavior, which would harm the incentive of interactive learning in the future (Storper and Venables, 2004). In this way, trust and commitment is gradually established in the social process of interaction and reinforces the learning dynamics.

The firm strategy is basically a conscious response to the external environment. In an uncertain environment, firms tend to apply an informal network-based strategy (Peng, 2003). Due to the gradual approach of transition in China, many institutional setups have been subverted and not yet substituted, which has resulted in institutional loopholes. In recent years, many formal institutions such as laws, regulations and organizations (work unions, research institutes, patent office, etc.) have already been established, but their enforcement is still problematic. Furthermore, the transparency and corruption issues have created an unreliable institutional environment for doing business in China. Under these circumstances, the transaction cost is very high if people only rely on formal institutional framework. As a result, the business people are very likely to establish their own informal Guanxi network with business partners, friends and relatives to complement the inefficiency of the formal framework in facilitating economic exchanges (Zhou *et al.* 2003; Meyer *et al.* 2009).

Guanxi is a Chinese way of establishing and maintaining social interaction and it is now receiving more and more attention in the recent organizational literature (Park and Luo, 2001; Ramasamy et al., 2006; Zhang and Zhang, 2006). Lovett et al. (1999) define it as the informal interpersonal relationships and exchanges of favors. Guanxi consists of obligation and loyalty to family members or relatives - defined as the obligatory type of Guanxi, mutual assurance to friends, mutual classmates and colleagues - defined as the reciprocal type of Guanxi, and understandings with acquaintances - defined as the utilitarian type of Guanxi (Zhang and Zhang, 2006). In the business world, the reciprocal types of Guanxi play an important part in China (Peng, 2003), as the implicit rule of “paying back favors” (Chinese term: Renqing) strengthens the constant social interaction due to the fear of damaging one's social reputation and prestige.

The three types of Guanxi reflect to a certain degree the object of informal social interaction, which plays an important role in ensuring effective social communications and mutual understanding. Each object, e.g. business partners, friends or relatives, bear different cognitive proximity with the firms (Boschma, 2005). The reciprocal type of Guanxi with business partners is established upon sharing of expertise and knowledge base, i.e. close cognitive proximity, and it can be thus effectively applied in the ongoing interactive learning process, while reciprocal Guanxi with friends and obligatory Guanxi with relatives might be more often used to get access to particular resources. New cooperation partners, the object of utilitarian type of Guanxi, are mostly introduced into a Guanxi network by recommendation from reciprocally related friends, colleagues, business partners or obligatorily related family members. As wide scope of interactive learning is conductive to effective interactive learning, as postulated in hypothesis 1, firms can broaden the scope of interaction beyond the scope of long-term business partners and collect more information and knowledge by making contact with acquaintances from within the Guanxi network. The match of these acquaintance partners’ capabilities with the innovation needs of the firm underpins the success of the wide-scope interactive learning. In this case, acquaintance partners recommended by business partners are expected to outperform those recommended by friends and relatives as they share a common cognitive dimension with the firm.

The intermediary role of the long-term business partners can curb the risks of opportunism both in the decision-making process when collecting information and ideas and in the implementation process when gaining support of knowledge. A Guanxi network is not bilateral; it is rather an interwoven network, in which reputation and prestige flow through mouth-to-mouth dissemination (Zhang and Zhang, 2006). Therefore, the Guanxi is indeed a trilateral network among the innovating firm, the recommending firm, and the recommended firm.

In the decision-making process of product innovation, the risks of opportunism when sharing business ideas under weak property rights protection can be reduced by this trilateral network. Ramasamy et al. (2006) identifies trust as one of the working mechanisms of Guanxi in knowledge transfer. The trilateral network can be actually translated into trust through the reduction of information asymmetry, as it is possible to learn about the background, reputation, and capacity of your cooperation partner through the recommending firm, which helps to inhibit the recommended firm from developing a new solution or product based on the technology of the innovating firm without paying back a proportion of gains.

In the implementation process of product innovation, the risks of opportunism related to contract-based interaction or even more formal cooperation, especially when the side who do not own and invest specific assets would switch suddenly to other partners in the process, can be reduced (Standifird and Marshall, 2000). Breaking the contract, even oral contract in some cases, undermines reputation and prestige and endangers future cooperation even with other firms as bad reputation propagates through the Guanxi network. Thus, people are less disposed to destroy their Guanxi networks, which were built up by investing time and money, for quick profit. All in all, a second hypothesis on the impact of informal networks is formulated as follows:

Hypothesis 2: Due to cognitive proximity in technical and market knowledge, recommendation from long-term business partners is a more viable way to find capable cooperation partners and thus broadens the scope of interactive learning better than recommendations from relatives and friends.

3. Survey Data and Indicators

The data applied in the following analysis is a set of standardized questionnaire data on electronics firms in the Pearl River Delta, China, which was collected during the period between September and November 2009. The company survey was conducted in four cities on the east coast of the Pearl River Delta, where the electronics industry is the leading industry (as in Shenzhen and Dongguan) or gaining a considerable growth rate (as in Huizhou and Heyuan). The questionnaire survey was conducted via telephone and mail, in which the firms were contacted based on information provided on the 2009 electronics firm catalogue. The questions were addressed to the CEOs or senior executives of electronics companies in the PRD. Follow-up was conducted via telephone, aiming to complete the unanswered questions and improve the quality of the questionnaires. In total, 793 firms were contacted and 422 firms filled out the questionnaires, yielding a response rate of 53%. Among the firms surveyed, 167 are located in Shenzhen, 177 in Dongguan, 67 in Huizhou and 11 in Heyuan. Compared with the whole population in Guangdong province, the share of small-sized firms is 68% (Guangdong population: 73%) and the share of domestic firms is 52% (Guangdong population: 46%). As a result, the data set represents the whole population of electronics firms in Guangdong province rather well. In our analysis, we concentrate on firms that undertake new product innovation activities, of which there are 359 in total.

It should be mentioned that unanswered questions among the firms surveyed, along with firms which refused to answer, are likely to lead to a sample selection bias. Firms that are willing and able to answer the questionnaires usually have a higher level of human capital or more formal organizational frameworks, which eases the understanding and communication between firms and the universities that conducted the survey. Moreover, these firms are more interested in the strategic development plan we promised to provide after the survey than the firms that refused or left too many questions unanswered, which reflects their upgrading-oriented strategy. In fact, this selection bias controls for the technological level of the surveyed firms to a certain degree, because it ensures that the survey firms' innovation activities are not limited to very low-value innovation, such as complete imitation without adaptation that requires little or even no coordination and learning in the innovation process.

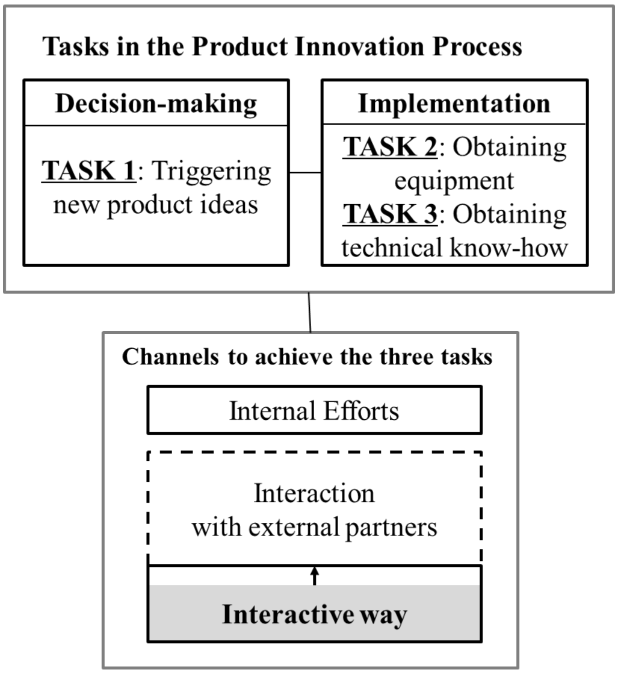

Figure 1 Structure of product innovation tasks in survey design

Figure 1 demonstrates the logic of the survey design on product innovation which cover three tasks of product innovation as discussed in the theoretical section. Table 1 further illustrates the specific items in the survey to operationalize the tasks and channels.

Based on the previous discussion on why firms undertake interactive learning, three tasks are taken into account throughout the new product development process: searching for information to facilitate innovation decision-making (Triggering new product ideas), obtaining equipment and software as well as obtaining technical know-how when product innovation idea is practically implemented. In accomplishing the three tasks, firms can use two channels: internal efforts and interaction with external partners. Specific items in these two blocks are derived from the previous discussion on how firms undertake interactive learning as well as pre-survey interviews to ensure the fitness with Chinese industrial practices (Table 1). Internal efforts, such as own R&D, reverse engineering and licensing, can be considered as either a strategy to minimize the risk of unintended knowledge leaks or investments that enhance the absorptive capacity. Interactions can be generally divided into those with vertically linked actors such as domestic customers, foreign customers and parent companies, and those with knowledge-generating institutions such as universities and research institutes. The intensity of undertaking internal efforts as well as the interaction with external partners is measured by the firms' evaluation of the importance on a Likert scale from 1-5 (with 5 indicating the highest importance).

With regard to hypothesis 2, the firms were asked the ways of finding partners for interactive learning. This question was split into three aspects, i.e. active searching, recommendation by business partners, and recommendation by relatives and friends.

Active searching refers to arms-length market relations, which are based on pure contract relations, while the last two items, namely recommendation by business partners, relatives and friends, represent the informal aspect of using social relations. It is expected to gain insight into the firms' network strategy in the interactive learning process by comparing their application of arms-length relationship (active searching) with various actors with their embeddedness in informal Guanxi networks (with long-term business partners or friends and relatives).

It has to be noted that it is not able to identify the use of Guanxi for all the three tasks in the survey. If so, the questions would have become too complex for the firms to answer. In order to ensure the success of the survey, only one general question has been asked to derive information on the use of informal Guanxi network in any of the three tasks. Therefore, interpretation is confined to whether the informal network has been used for any interactive learning processes (as formulated in hypothesis 2), but the purpose of applying it cannot be identified, which does not affect testing the second hypothesis.

Table 1 Indicator of Interactive Learning and Internal Efforts

Task 1: Triggering New Product Ideas	Internal Efforts	· Own idea collection · Reverse engineering · Licensing
	Interaction with external partners	· Demand from parent company · Demand from foreign customers · Demand from domestic customers · Market reports of sales agent · Market reports of universities or research institutes
Task 2: Obtaining Equipment Support	Internal Efforts	· Own purchase
	Interaction with external partners	· Support from parent company · Support from foreign customers · Support from domestic customers
Task 3: Obtaining Technical Know-how Support	Interaction with external partners	· Engineers sent by parent company · Engineers sent by foreign customers · Engineers sent by domestic customers · Engineers sent to foreign lead firms or customers · Engineers sent to domestic lead firms or customers · Engineers sent to universities
Interactive Way	Informal Guanxi Network	· Recommendation by business contacts, such as through long-term business partners · Recommendation by personal contacts, such as through friends or relatives
	Active Searching	Searching for information on partners *via Internet, exhibition and sales agents*

4. Empirical Results

4.1 Descriptive Results

We begin with a general overview of firm characteristics, new product development investment and its outcomes for the electronics firms that have introduced new products in the last three years in the Pearl River Delta, China. The average age of these firms was 10.8 years (calculated until 2010). Among the firms that are involved in product innovation, 8% were large firms and 39% had foreign participation. The firms are asked to give a rough number on the expenditure-to-sales ratio in new product development. The median value of this number was 20% in the first half of 2009, and one-third of the firms invested over 20% of sales in new product development. According to the 2004 national economic census, Wang and Lin (2010) pointed out that 39% of IT firms in Shenzhen – which is a core city in the Pearl River Delta – spent less than 10% of capital on R&D activities. From the survey results, a more intensive investment on market-oriented innovation (new product development) than on R&D can be seen, even if the survey year was during the recovery period of the financial crisis. As for the product innovation outcomes, more than 60% of the firms surveyed had achieved significant or very significant improvement on product design improvement, product function expansion and product category upgrading.

In the following section, new product innovation activities, i.e. channels of achieving the three tasks shown in figure 1, are analyzed. From Table 2, it can be seen that electronics firms in the Pearl River Delta rely very much on their own competence and reverse engineering to trigger innovation activities, indicating to some extent that firms in the Pearl River Delta are increasing their internal absorptive capacity to transform external knowledge, as in the form of advanced product samples, into new product ideas and market opportunities. On the other side, the demand from foreign customers and domestic customers plays a significant role in motivating the firms to undertake innovation. Internal efforts play a complementary role, rather than a substitutive one, in facilitating interactive learning. Compared to internal competence and closely linked partners in business operation, the role of sales agents, universities and research institutes on triggering innovation ideas is very limited.

Table 2 Firm Evaluation on Origins of Innovation Ideas

	Importance Strong (5)	——→			Weak (1)	Sum
Demand from domestic customers	30%	28%	21%	8%	14%	359
Own idea collection	30%	26%	25%	9%	10%	356
Reverse engineering	20%	33%	24%	10%	14%	359
Demand from foreign customers	28%	24%	17%	8%	24%	360
Market report of sales agent	15%	22%	23%	10%	30%	357
Licensing	8%	18%	21%	14%	40%	359
Demand from parent company	11%	14%	10%	12%	53%	354
Market reports of universities or research institutes	7%	10%	24%	15%	44%	358

Numbers in the first five columns indicate the percentage of firms providing the answer

In the process of realizing product innovation (Table 3), electronics firms in the Pearl River Delta turn firstly to domestic customers for the support of equipment and software, secondly to foreign customers and finally to the parent companies, which corresponds to the aspect of triggering innovation ideas.

Table 3 Firm Evaluation on Channels of Equipment Support

	Importance Strong (5)	——→			Weak (1)	Sum
Support from domestic customers	27%	24%	18%	9%	22%	347
Support from foreign customers	22%	18%	18%	12%	31%	343
Own purchase	11%	6%	8%	6%	70%	342
Support from parent company	8%	6%	6%	2%	77%	343

Numbers in the first five columns indicate the percentage of firms providing the answer

As for the technical support, the electronics firms in the Pearl River Delta turn most frequently to domestic customers to acquire technical experience and know-how, either in an active way (engineers sent to domestic lead firms or customers) or in a passive way (engineers sent by domestic customers). The foreign customer is the second most important channel of acquiring necessary technical knowledge in order to undertake successful innovations. The other channels, such as universities and the parent company, have the least weighting in the process aimed at acquiring technical support.

Table 4 Firm Evaluation on Channels of Technical Know-how Support

	Importance Strong (5)	⟶			Weak (1)	Sum
Engineers sent to domestic lead firms or customers	23%	27%	22%	7%	21%	350
Engineers sent by domestic customer	17%	24%	19%	11%	30%	348
Engineers sent to foreign lead firms or customers	16%	21%	18%	9%	36%	349
Engineers sent by foreign customer	16%	17%	17%	13%	37%	349
Engineers sent to universities	13%	12%	21%	14%	41%	349
Engineers sent by parent company	7%	6%	3%	4%	81%	350

Numbers in the first five columns indicate the percentage of firms providing the answer

In Table 5, it is shown that electronics firms in the Pearl River Delta interact with external actors in innovation activities mostly through exhibitions, the Internet and sales agents, suggesting an arms-length market relationship. Business contacts through recommendation by business partners are also widely applied. In contrast, the informal personal networks through recommendation by relatives and friends are rarely applied. Guanxi network that established between business partners is more applied than Guanxi network with friends and relatives in interactive learning process, which can be explained by the close cognitive proximity in technical and market knowledge shared by the partners that are active in the same or related industry. This corroborates the second hypothesis.

Table 5 Firm Evaluation on Interactive Way

	Importance Strong (5)	⟶			Weak (1)	Sum
Active searching	49%	29%	14%	3%	5%	354
Recommendation by business contacts	37%	35%	17%	3%	7%	354
Recommendation by personal contacts	16%	21%	29%	13%	21%	353

Numbers in the first five columns indicate the percentage of firms providing the answer

4.2 Econometric Analysis

As the observed data in the questionnaire take the form of ordered responses, latent class analysis is applied first to characterize groups of similar cases in ways of developing new product. A latent class model groups the observations in terms of probability. This stands out from normal grouping methods, as it is able to provide measurements of parsimony and goodness of fit that are statistically sound. In this way, the subjectivity of decisions on class number can be effectively controlled.

Table 6 shows the results of a latent class model when the 3-group solution is used. The fitness of this solution outperforms the 4-group solution owing to the more parsimonious and theoretically sound interpretability (Appendix A). The numbers in the table indicate the probabilities of firm's high evaluation of the importance of each channel conditional to the respective group. Thus, they represent the intensity of applying each interactive way when undertaking any of the three tasks in product innovation.

Table 6 Grouping of Electronics firms based on the Latent Class Model

	Probability of high evaluation[a]	Weak Interactive Learning Group	Moderate Interactive Learning Group	Intensive Interactive Learning Group
Triggering New Product ideas	Own idea collection	0.49	0.50	0.81
	Reverse engineering	0.45	0.48	0.77
	Licensing	0.14	0.24	0.56
	Demand from parent company	0.15	0.26	0.48
	Demand from foreign customers	0.38	0.51	0.83
	Demand from domestic customers	0.49	0.53	0.86
	Market reports of sales agents	0.22	0.40	0.69
	Market reports of universities or research institutes	0.03	0.17	0.49
Obtaining Equipment Support	Support from parent company	0.09	0.10	0.33
	Support from foreign customers	0.24	0.24	0.94
	Support from domestic customers	0.38	0.40	0.93
	Own purchase	0.19	0.06	0.27
Obtaining Technical Know-how Support	Engineers sent by parent company	0.08	0.09	0.26
	Engineers sent by foreign customers	0.16	0.29	0.76
	Engineers sent by domestic customers	0.24	0.41	0.80
	Engineers sent to foreign lead firms or customers	0.19	0.38	0.77
	Engineers sent to domestic lead firms or customers	0.35	0.53	0.78
	Engineers sent to universities	0.09	0.31	0.50
Interactive Way	Active searching	0.72	0.72	0.99
	Recommendation by business contacts	0.65	0.68	0.97
	Recommendation by personal contacts	0.25	0.38	0.59
Share of each group		50%	28%	22%

[a] Probabilities that the firm in each group gives a high evaluation, i.e. important (4) or very important (5) of the importance of each aspect in the product innovation process.

The grouping differentiates the firms quite well in terms of the scope and intensity of interactive learning in the product innovation process. The first group aggregates firms that are neither competent in internal learning efforts, such as reverse engineering, licensing and triggering of innovation ideas by internal discussion, nor actively involved in interactive learning processes, such as acquiring innovation-related information and ideas and obtaining necessary support of equipment and technical know-how from external actors (except for the relatively high probabilities of obtaining new product ideas from the demanding domestic customers). As for interactive learning activities this paper focuses on, they are underperformers.

The second group, which is referred to as the moderate interactive learning group, outperforms the weak interactive learning group in terms of interacting with external actors to trigger innovation ideas and obtain technical experience. Firms belonging to this group seem to turn more frequently to domestic customers (or domestic lead firms in terms of obtaining tacit knowledge) in the product innovation process. Like the weak interactive learning group, the firms in the moderate interactive learning group show moderate inclination to apply strategies of active searching and business networks when interacting with external partners. The probability of applying Guanxi networks with friends and relatives is also very low.

The third group, which is referred to as the intensive interactive learning group, shows the greatest inclination to undertake interactive learning activities in the product innovation process, especially in the aspect of getting innovation ideas and support of equipment and technical know-how from foreign and domestic customers. In addition, they also show a certain inclination, although a lower one, to turn to sales agents, universities and research institutes to trigger innovation ideas and acquiring technical know-how. Most importantly, intensive interactive learners show a clearer pattern in complementing arms-length searching with their informal Guanxi network when making interactions than the other two groups. Among the use of informal Guanxi networks, recommendation by business partners again outweighs the ones by friends or relatives to a large extent. This result corresponds to the result from Table 5 and further substantiates hypothesis 2 in the way that a wide scope of interactive learning is related to a Guanxi network with business partners that share a similar cognitive background on market and technical knowledge, rather than with cognitively distant friends and relatives. In general, the third group exceeds the other two groups in the probabilities for all the items as shown by Table 6, displaying a widest scope and most intensive form of interactive learning activities.

The class distribution indicates that interactive learning activities are still underdeveloped in the Pearl River Delta, China. Half of the firms surveyed are still very weak in undertaking this kind of learning activity to take advantage of dynamic externalities, i.e. the knowledge spillovers from other firms. 28% of the firms surveyed are nurturing the capability of interactive learning, while 22% have shown the willingness and acquired the capability to undertake interactive learning during the product innovation process. The low frequency of PRD's electronics firms in undertaking interactive learning reflects the immature internal absorptive capacity of most firms to understand and adapt knowledge from external actors effectively.

Table 7 shows the characteristics of each group in the aspects of average firm age, share of large firm, share of firms with foreign participation, sales growth, export market share, human capital and product innovation performance. In terms of firm characteristics, the intensive interactive learning group has slightly more participation from foreign capital. Furthermore, there are more large firms in the group of intensive interactive learning group. The firm characteristic that stands out is the human capital. The share of technical staff with bachelor degree or above in intensive interactive learning firms exceeds others by almost 10 percentage points. As for the firm performance, it is not surprising to find that intensive interactive learning firms experienced the least reduction in sales during the first half of 2009 compared to 2007 due to the financial crisis in late 2008, which again affirms the role of interactive learning in acquiring market information and reducing uncertainty. Moreover, they also lead other firms in terms of export performance and, most importantly for the analytical focus of this paper, product innovation performance.

Table 7 Descriptive Statistics of Each Group

	Group of latent analysis	Weak Interactive Learning Group	Moderate Interactive Learning Group	Intensive Interactive Learning Group
Firm Characteristics	Firm age (years as of 2010)	9.84	12.22	11.37
	Firm ownership (% of foreign firms)	0.36	0.41	0.42
	Firm size (% of large firms)	0.08	0.05	0.12
	Technical staff above bachelor degree (%)	33.75	32.61	42.15
Firm Performance	Sales growth (2007 - first half of 2009)	-12.6	-5.6	-2.5
	Export market (% of sales)	40.4	45.8	50.7
	Improvement on product design (average scoring from 1-5)	3.7	3.7	4.1
	Improvement on product function expansion (average scoring from 1-5)	3.6	3.6	4.1
	Improvement on product category upgrading (average scoring from 1-5)	3.4	3.8	3.9

After the descriptive difference-in-difference analysis, a causal difference-in-difference model is built and compares the effects of different degrees of interactive learning on the firm product innovation performance. In light of hypothesis 1, incremental innovation and discontinuous innovation are the two tested dependent variables. The indicator used for incremental product innovation performance is the average score of a firm's evaluation of the degree of improvement (ranging from 1 to 5 with increasing significance of change) in product design and product function expansion. Product design improvement refers to making the product design more attractive or feasible. For product function expansion, it refers to the addition or upgrading of product functions within the same product category. These two indicators represent innovations without changing existing technologies and market practice. Discontinuous innovation is represented by product category upgrading, which involves change in technology and market practice, such as producing mainboard instead of network adapters or MP3 players instead of flash memories. Separate estimations are run for each type of innovation as it is expected that the mechanisms behind incremental innovation and discontinuous innovation are different. Due to the discrete and ordered feature of this multinomial-choice variable, the ordered logit model was applied. The primary independent variables come from the latent class result and are introduced to the model as a series of dummy variables, for which the benchmark is the latter group indicated in Table 9. Other control variables in the regression are listed in Table 8.

Table 8 Control variables in the Ordered Logit Regression

	Indicators	Description
Firm Characteristics	Firm Size	Defined according to Chinese firm size standard, 1 as large firms with sales no less 300 million Yuan and no less than 2000 employee, otherwise as small and medium-sized with the value of 0
	Firm Ownership	1 as firms with foreign participation (wholly owned or joint venture), 0 as firms with 100% domestic participation
	Firm Age	Years since establishment of the firm
Absorptive Capacity	CEO Education	1 as CEO below bachelor degree 2 as CEO with bachelor degree 3 as CEO with graduate degree (master or doctor) 4 as CEO with bachelor or above combined with overseas experience
	Level of technical staff	Percentage of technical staff that have bachelor degree or above *multiplied by* training frequency
	Initial technological level of main product	Defined according to International Standard Industrial Classification of all Economic Activities, Rev 3, 0 as producing low-tech products when starting business, 1 as producing medium and high-tech products when starting business

Table 9 shows the result of the ordered logit regression. The p-values of the chi-square likelihood ratio for all the three models are under 0.01, which guarantees that the model as a whole fits significantly better than an empty model.

Table 9 Ordered Logit Regression on product innovation performance

Independent variables	Model 1 *Incremental Product Innovation*	Model 2 *Discontinuous Product Innovation*
Moderate Interactive Learning Group	-0.18	0.25
v.s. Weak Interactive Learning Group	(0.25)	(0.26)
Intensive Interactive Learning Group	1.09***	0.52*
v.s. Moderate Intensive Learning Group	(0.31)	(0.30)
Intensive Interactive Learning Group	0.91**	0.77***
v.s. Weak Interactive Learning Group	(0.29)	(0.29)
Firm Age	0.004	0.02
	(0.02)	(0.02)
Firm Size	0.19	-0.44
	(0.42)	(0.43)
Firm Ownership	-0.64***	-0.34*
	(0.22)	(0.18)
Level of technical staff	0.002*	0.002
	(0.001)	(0.002)
CEO Education	0.33***	0.22*
	(0.12)	(0.12)
Initial product technology	0.22	0.17
	(0.24)	(0.24)
Prob > chi2	0.000	0.007
Pseudo R square	0.04	0.03
Number of Observations	272	279

Standard errors in parentheses;

* Significance at the 0.1 level, ** significance at the 0.05 level, *** significance at the 0.01 level

From the two models, it can be seen that the intensive interactive learning firms possess a significantly higher probability of achieving better product innovation performance than both weak and moderate interactive learning firms, while the impact of belonging to the moderate interactive learning group does not significantly improve the product innovation performance compared to belonging to the weak interactive learning group. Efforts of widening the scope and enhancing the intensity of interactive learning to a great extent, however, only boost the performance of discontinuous innovation in a slight manner. Compared to discontinuous innovation, incremental innovation benefits much more from the investment in interactive learning. This result supports the first hypothesis that the scope and intensity of interactive learning in the innovation process contribute more to incremental innovation, as discontinuous innovation of entering a new product market in modular industries like electronics requires mostly minor adjustments of the production line rather than external interaction.

Nevertheless, moderate efforts of undertaking interactive learning even pose a negative impact on incremental product innovation performance, although not at a statistically significant level. In incremental product innovation, the coefficient for the intensive vs. moderate interactive group is bigger than that for the intensive vs. weak interactive group. This means that the contribution of the scope and intensity of interactive learning has a high threshold, in which a great leap – not just a moderate one - in making the efforts in widening and intensifying interactive learning should be made if rewards on new product performance are expected. The high threshold of interactive learning investment implies an increasing return of this activity, in which firms have to invest a lot to achieve higher return in order to make up for the cost of interaction, including establishing and maintaining a sound Guanxi network.

Among the independent variables, CEO education level stands out as the most influential indicators of internal absorptive capacity for firms to make better product innovation outcomes. It is also proved by the two models that foreign participation would significantly reduce the probability of achieving better innovation outcomes, especially in the aspect of incremental product innovation. It can be concluded at least that foreign firms do not participate actively in incremental product innovation activities. They are also quite reluctant to undertake discontinuous product innovation such as introducing new product categories. The better product innovation outcomes from domestic firms, on the other hand, might be related to their active participation in the less sophisticated domestic market (Meyer et al., 2012). However, if foreign firms undertake product innovation activities, they also rely on interactive learning to an even more intensified degree than domestic firms (See Table 7). The larger tendency of using external sources for innovation activities from the foreign firms has been demonstrated by Schiller (2011). Jefferson et al. (2003) also indicates that although foreign-owned medium and large sized firms do less product innovation activities in general, they tend to be high-performing innovators.

5. **Discussion and Conclusion**

Learning by interacting generates increasing return for the internal learning by doing and learning by using, creating positive externalities for the whole economy (Lundvall, 2005). The complementary role of interactive learning to internal efforts lies both in assisting firms in acquiring information to make innovation-related decisions, and in supporting firms with necessary support of equipment and know-how for problem-solving during the implementation process. The scope of interaction covers the learning with customers with regard to sector product-field-specific knowledge as well as learning with universities and research institutes with regard to generally applicable knowledge.

Based on the latent class model, we are able to identify three groups of firms that show an increasing degree of interactive learning activities. The third group, which includes only about one-fifth of the surveyed firms, undertakes the widest scope and highest intensity of interactive learning activities. For these intensive interactive learners, recommendation by long-term business partners through the Guanxi networks is used as an informal means of complementing the deficient formal institutions in China. Due to cognitive distance with firms in market and technical knowledge, Guanxi network through recommendations by friends and relatives is rarely applied as a way to establish interaction with external partners. Descriptive and causal difference-in-difference analysis further verifies that the scope and intensity of interactive learning contribute more to incremental product innovation outcomes than to discontinuous ones. The empirical investigation reveals a clear pattern of using interactive learning in China, in which firms interact via a combination of formal institutions and informal Guanxi networks among long-term business partners to exploit the tacit knowledge in modularized industries like electronics, rather than to support the entry into a new product market.

This line of thinking - that social capital is an important asset for organizing interactive learning and markets - is well covered by the institutional and cultural turn in many disciplines. In new growth theory, productive new ideas are endogenously shaped by institutional contexts (Romer, 1986). The approach of innovation systems proposes that social capital induces widely spread interactive learning in the whole economy, hence creating more net wealth (Lundvall, 2005). Likewise, the new institutionalism in economic geography embraces again the context-dependent epistemology, considering the possibility that the various social institutions in places determine the evolution of economic landscape (Clark et al., 2003).

Interactive learning embedded in the social context has important policy implications. By recognizing the insufficiency of arms-length market relations in organizing systematically interactive learning activities, it calls for policy action to solve the market failure in this respect. According to Smith's (2000) identification of the areas of market and system failure, the public sector can act in the following areas:

creating appropriate rules of the game in order to give enough incentive for firms to undertake interactive learning and support their capability in transforming it into profit, coordinating systematic change in the face of technological and market change, and providing infrastructure that can resist market failure, such as universities, research institutes, regulatory agencies and data banks.

Moreover, as indicated in our theoretical discussion, the informal Guanxi networks among long-term business partners with close cognitive proximity are important social assets in the Chinese context that the firms can take advantage of in achieving effective interactive learning. The empirical results also demonstrate that both domestic firms and foreign firms embed informal social networks in interactive learning as a way to promote product innovation. However, the foreign electronics firms do not show great interest in undertaking product innovation in the Pearl River Delta, China. Therefore, the Chinese government should encourage the foreign firms to be involved more actively in product innovation with measures such as tax reduction, subsidies and permits for domestic market access, for the interactive learning organized by foreign firms in the product innovation process is expected to generate knowledge spillover from the foreign sector to the domestic sector.

This paper contributes to the understanding of the role of interactive learning assisted by informal social networks in promoting incremental innovation activities in the context of China, where innovation is high on the agenda to revitalize economic growth in the face of external market change and domestic inflation pressure. However, Boschma (2005) indicates that too much commitment to social networks might induce a lock-in effect and underestimation related to the risk of opportunism. In China, it can be expected that firms resort less to social networks when stability-induced institutions are in place. Therefore, it is important to trace the interactive learning pattern and relate its evolution to the maturing institutional framework conditions in future research.

Appendix:

The choice of the grouping number is determined by two fitness criteria in the statistical sense: their BIC (Bayesian information criteria) and the AIC (Akaike information criteria). Most importantly, the interpretability of the model should be taken account of in order to ensure the theoretical soundness.

In Table A.1, it can be concluded that the 3-group solution fits best according to BIC criteria, while the 4-group solution fits best according to the AIC criteria. In the latent class model, the BIC criteria decide the number of grouping in a more conservative way than the AIC criteria. In this way, the interpretability should be applied to make a choice for the mixed pattern.

Table A.1 Selection Criteria (BIC) by Class

Classes	BIC	AIC
2	13198.8	12868.7
3	13075.1	12578.1
4	13137.5	12473.4

In Table A.2, we show the 4-group solution. In this solution, it is possible to identify the intensive interactive learning group (group 1) and the weak interactive learning group (group 4). However, group 2 and group 3 are quite similar in the scope and intensity of interactive learning, and therefore do not differ from each other in a significant way. In order to derive a parsimonious and well interpreted result, we finally used the 3-group solution as the basis for the empirical analysis.

Table A.2 The 4-group solution

	Probability of high evaluation	Group 1	Group 2	Group 3	Group 4
Triggering New Product ideas	Own idea collection	0.81	0.61	0.47	0.44
	Reverse engineering	0.82	0.56	0.48	0.37
	Licensing	0.60	0.28	0.21	0.08
	Demand from parent company	0.54	0.32	0.20	0.06
	Demand from foreign customers	0.88	0.69	0.46	0.19
	Demand from domestic customers	0.91	0.63	0.50	0.41
	Market reports of sales agents	0.70	0.40	0.39	0.13
	Market reports of universities or research institutes	0.50	0.13	0.18	0.02
Obtaining Equipment Support	Support from parent company	0.38	0.18	0.08	0.02
	Support from foreign customers	0.90	0.58	0.25	0.03
	Support from domestic customers	0.94	0.42	0.42	0.41
	Own purchase	0.29	0.14	0.06	0.22
Obtaining Technical Know-how Support	Engineers sent by parent company	0.34	0.17	0.03	0.03
	Engineers sent by foreign customers	0.87	0.42	0.23	0.00
	Engineers sent by domestic customers	0.85	0.41	0.39	0.16
	Engineers sent to foreign lead firms or customers	0.85	0.44	0.33	0.05
	Engineers sent to domestic lead firms or customers	0.81	0.49	0.53	0.29
	Engineers sent to universities	0.55	0.18	0.32	0.05
Interactive Way	Active searching	0.95	0.90	0.71	0.63
	Recommendation by business contacts	0.98	0.81	0.66	0.55
	Recommendation by personal contacts	0.71	0.27	0.35	0.25
Share of each group		17%	28%	25%	30%

Acknowledgement: The research has received funding from the German Research Foundation (DFG) within the priority program (SPP 1233) "Megacities-Megachallenge – the informal dynamics of global change" under grant RE1720/8-1.

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