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The Role of Social and Organizational Proximity for Product Innovation: Empirical insights from Electronics Firm Survey in Pearl River Delta, China

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Abstract

With the urgent need of Chinese government to initiate endogenous innovation after the financial crisis, the issue of localized learning and innovative milieu is of great relevance. In this paper, we investigate how the innovation behavior of firms to capitalize on either social or organizational proximity contributes to innovation in the Pearl River Delta (PRD), China. We aim for insights into whether localized innovative mechanisms based on informal social relations have emerged in the region. Based on a questionnaire survey of 422 electronics firms, this article demonstrates that firms that use social proximity to foster innovation are emerging in the PRD, while firms that rely solely on organizational proximity have a limited scope of product innovation and are experiencing difficulties in coping with the recent demand

shock. However, socially active innovators were not found to outperform organizationally dependent innovators in a significant way after controlling for other firm-specific variables. The result of the paper affirms the positive role of proximity use in innovation activities and gives insight into the development stage of innovative milieu by comparing the role of social proximity and organizational proximity, which contributes further to the scope of spatial innovation studies from the proximity perspective.

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An Emerging Innovative Milieu in the Pearl River Delta, China?

The Role of Social and Organizational Proximity for Product Innovation

1. Introduction

Vertical integration into the organizational hierarchy of global production systems is a key element of knowledge transfer for latecomer countries, and the issue of spatial mechanisms of knowledge creation and innovation is less well covered in the context of latecomers due to the underdevelopment of firm capacities and regional innovation systems. With the global recession and rapidly changing world economy, latecomer firms face great challenges in capitalizing on organizational proximity to leading global firms to upgrade their position in the value chain. There is thus an urgent need for latecomer regions to initiate an endogenous and localized knowledge creation process. We aim to explore this process by investigating the electronics cluster in the Pearl River Delta, China, which is the largest agglomeration in the global electronics industry. We apply the proximity concept and focus on the role of social proximity and organizational proximity in product innovation. In the context of China, informal and continual interaction among various economic players and the embeddedness in “Guanxi” networks are important factors for doing business. The capacity of firms to capitalize on the intangible asset of social proximity with business partners in order to foster innovation could be an indication of an emerging innovative milieu.

Since the open policy was introduced in 1978, China has seized the opportunity of a global industrial shift and has experienced dramatic economic growth in some export-oriented regions along the east coast. The Pearl River Delta, which is located on the south-east coast of the Guangdong Province, has developed into one of the biggest production sites for computers and electronics due to its advantage of low-cost and flexible production. An extra-regional perspective in the relevant literature (Dicken 1976;

Dollar 2001; Yeung 2006; Yeung 2009) demonstrates that integration into the vertical organizational hierarchy within global production networks is essential for the industrialization and development of latecomer regions.

As a consequence of the FDI-driven growth, technology transfer and learning has relied heavily on organizational proximity to leading global firms. In the long run, this poses challenges for the development of a sustained regional production system. Although local firms are able to attain know-how from their organizationally proximate parent companies or foreign customers, the incentive for leading global firms to invest further in the upgrading and innovation of their local suppliers is quite low. Upgrading in the global value chain requires local firms to be able to meet the specific demand of new product markets and subtly manipulate the relations with global partners (Chun 2009; Yeung 2009).

The limit of the FDI-driven production mode in the Pearl River Delta has become apparent with the irreversible trend of an industrial shift towards the inland of China and other low-cost regions in South-East Asia, which has accelerated recently due to the financial crisis. Moreover, many high-end production facilities and innovation centers have been set up in the Yangtze River Delta, China, with its more competitive public research and innovation infrastructure. Firms in PRD thus have to engage actively in value chain upgrading and innovation in order to stay competitive.

30 years of integration into global production networks has greatly improved the capacity of local firms in the Pearl River Delta. Actually, the spatial clustering of the electronics industry in the Pearl River Delta enables the functioning of a spatial mechanism that contributes to an innovation and learning process based on reciprocal and

trust-based relationships. Territorial agglomerations such as regions and cities are increasingly seen important as it is able to generate systematic learning and interactive innovation (Cooke, 1997). Porter (2000) suggests that industrial clusters exert new influence on competition in an increasingly complex and dynamic global economy. However, there are few studies on the role of spatial innovative mechanisms and the evolving trajectory of industrial clusters in less-advanced regions (Bell and Albu 1999; Giuliani 2002).

In contrast to the regional innovation system concept, which depicts a stylized model of the systematic regional innovative structure organized by various supporting infrastructures, the “innovative milieu” concept provides a process-focused view of the evolution of local linkages that allows informal transfer mechanisms of tacit knowledge (Monte and Paquet 1998; Capello 1999). It stresses the role of social proximity and institutional proximity in accelerating collective learning and fostering dynamic innovation synergies (Aydalot 1986; Aydalot and Keeble 1988; Camagni 1991; Maillat 1995; Capello 1999).

In China, the transition to a formal institutional framework for the market economy involving elements such as laws, regulations and legal procedures is still on the way, which explains the limited relevance of institutional proximity in business operation. Zhou et al. (2003) demonstrate that firms in the Pearl River Delta have to maintain intensive inter-personal interaction with customers due to the unreliable institutional system. Moreover, informal and continual interaction among various economic players, embedded in “Guanxi” networks, is an important method of doing business in Chinese society (Lovett, Simmons et al. 1999). Rather than simply applying informal practice in

flexible production to save transaction costs and thus react quickly to market needs (North 1990; Meyer, Schiller et al. 2009), the capacity to capitalize further on informal social relations in order to foster innovation is critical for the emergence of innovative milieus in the Pearl River Delta.

In a dynamic global economy, local firms are required to reinforce social and organizational proximity mutually. On the one hand, the capacity of local firms to capitalize on social proximity and to transform it into innovative synergy and profit gives greater incentive to foreign firms to transfer more advanced technology and activities to their organizationally proximate partners in developing countries. On the other hand, new technologies and market opportunities that are transferred to the local system by strategic coupling with distant partners initiate a dynamic collective learning process in these regions (Bathelt, Malmberg et al. 2004).

This paper aims to investigate the capacity of electronics firms in the Pearl River Delta to capitalize on social proximity and organizational proximity in the process of product innovation. It is assessed as to how the two proximities contribute to the innovation outcomes and business performance in the context of regional restructuring and upgrading. Insights into the evolving production system in the Pearl River Delta from an FDI-driven platform to an innovative milieu are expected during the course of this investigation. In this article, we focus on product innovation because it requires more coordination between complementary knowledge sources than process innovation, and is thus more oriented towards external learning (Capello, 1999).

The article proceeds as follows: the second section provides an overview of firms' current capacity and behavior in attaining knowledge from external partners to foster

their own innovation. Special attention will be paid to the role of organizational proximity to leading global firms and social proximity in latecomer countries such as China. Hypotheses are derived based on the theoretical discussion. The third section presents the data, methodology and the preliminary data processing. The fourth section discusses the empirical results. The fifth section concludes, derives policy implications and suggests the direction for further research.

2. Proximity in External Learning and Innovation

The process of acquisition, assimilation, transformation and exploitation of new knowledge depends on the combination of absorptive capacity at the firm level and mechanisms for transferring knowledge (Arora and Gambardella 1990; Cohen and Levinthal 1990; Gambardella 1992; Tripsas 1997). The coordination actions in the transfer of tacit knowledge rely heavily on stable and reciprocal relationships. Understanding and trust are needed to facilitate communication and strengthen the effect of interaction. In this section, various proximities that contribute to interaction in the knowledge transfer and innovation process are discussed in detail.

2.1 Proximity: concept and taxonomy

The concept of proximity, developed in the 1990s by French regional scientists, contributes to the understanding of the mechanisms behind the interactive process of knowledge transfer (Kirat and Lung 1999; Torre and Gilly 2000; Boschma 2005; Torre and Rallett 2005; Menzel 2008). Proximity plays an important role in promoting trust and understanding when complex and high-risk innovation activities are carried out.

Proximity carries a plural meaning. It goes beyond geographical proximity, which has a limited role without the support of other proximities. There are many classifications of proximity in the literature on the subject (Kirat and Lung, 1999; Torre and Rallet, 2005; Boschma, 2005). In order to make the discussion clearer, this article adopts the classification developed by Boschma (2005), who tries to cover various proximities in a comprehensive way. According to Boschma (2005), there are five different kinds of proximity:

- Cognitive Proximity: People who have the same knowledge base and expertise can better learn from each other. Cognitive proximity is based on similarities in technical and market competencies that affect the search and imitation costs when exploring new knowledge.
- Geographical Proximity: This indicates the physical distance between interacting players measured in time or money. Geographical proximity alone is not able to foster knowledge transfer and innovation. As Howells (Howells 2002) puts it, the impact of geographical proximity is rather indirect and subtle.
- Organizational Proximity: This refers to the sharing of reference space, such as shared knowledge and experience, that is strengthened by hierarchy and control within the same organization. With the development of communication and transportation technology, simple co-location is no longer a necessary determinant for knowledge transfer. Organizational networks transcend the boundary of countries and are vehicles of knowledge diffusion.
- Social Proximity: This relates to trust and commitment based on kinship, friendship and cooperation experience between individuals. Social proximity not only fosters the

communication of tacit knowledge, which is difficult to trade in the market, but also reduces opportunist behavior through the establishment of durable relations. It is often bound spatially because the geographical proximity increases the chances of meeting and communicating.

- Institutional Proximity: Unlike social proximity, which is embedded in social relations between agents at the micro level, institutional proximity is based on shared norms and values at the macro level. It is depersonalized and relies on general trust that is developed and established over a long period of time.

Cognitive proximity serves as a prerequisite for learning and is more easily achieved via interaction within the same industrial space and supplier link due to the continuity of knowledge transfer. Social proximity and institutional proximity often require geographical proximity to function properly. Capello (1999) demonstrates that social proximity and institutional proximity set in motion an informal and tacit transfer of information and know-how, which contributes to the transformation from a specialized area to an innovative milieu. On the extra-local scale, organizational proximity gives a different meaning to supplier linkages, which facilitate the transfer of tacit knowledge by control and hierarchy.

In the context of China, which is undergoing a gradual transition towards a market economy, many formal institutions such as laws, regulations and organizations (work unions, research institutes, patent office, etc.) have already been established, although their enforcement is still problematic. Moreover, the institutional framework is unstable in the transition phase. As a result, the economic players in China do not tend to rely too much on institutions to do business (Zhou, Li et al. 2003; Meyer, Schiller et al. 2009). In

our empirical discussion, we therefore do not focus on the role of institutional proximity at the macro level. Instead, the role of organizational and social proximity in fostering tacit knowledge transfer and dynamic innovative synergies is examined.

2.2 The role of organizational proximity in upgrading and innovation

The literature on global production networks has provided insights into the role of organizational proximity in industrial organization for multinational companies and its function as a vehicle of cross-country knowledge transfer. The global production network perspective covers both intra-firm and inter-firm transactions and forms of network coordination. It links together the flagship's own subsidiaries, affiliates and joint ventures with its subcontractors, suppliers and service providers, as well as with partners in strategic alliances. Outsourcing of volume manufacturing enables flagship firms to combine cost reduction, product differentiation, and a quick response to the market (Ernst and Kim 2002).

Organizations exist both as a bundle of transactions or contracts (Coase 1937) and as a bundle of knowledge (Barney 1991; Barney 2001). Following the logic of transaction cost minimization, the organizational boundary helps to curb the opportunist behavior of business partners, such as distorting business information, failing to fulfill commitments or malicious imitation, when rules and trust are lacking. For the global flagship that organizes production in developing countries, organizational proximity is conducive to reducing opportunist risk related to physical and human capital investment. In addition, hierarchy and control within the same organization enable the efficient downward transfer of knowledge. Many studies on developing countries have shown that most of the firms conduct innovation "in-house" instead of licensing and assigning contractual

arrangements to unaffiliated firms (Schmitz 1995; Schmitz and Nadvi 1999). One of the explanations offered by Teece (Teece and Winter 1984; Teece 1986) is that proprietary considerations are assisted by organizational integration, since contracts, proprietary rights and technology transfer via the market are complex and, especially in developing countries, often too expensive.

In other words, when the institutional environment, consisting of elements such as property rights and related business laws, is not fully developed, and the embeddedness of global firms is not mature enough to ensure social proximity that brings mutual trust, flagship companies tend to restrict knowledge to flowing only within the boundaries of the firm in order to reduce the chances of opportunism and ensure return on internal R&D efforts.

Organizational proximity to leading global firms provides access to knowledge, especially tacit knowledge in advanced technological fields. The flagship typically provides subsidiaries or closely cooperating suppliers with encoded knowledge, such as machinery, blueprints, production and quality control manuals, product and service specifications, and training handouts. Furthermore, latecomer firms also join the global production network in order to acquire tacit knowledge to absorb better the encoded knowledge by having the engineers and managers from foreign partners train on site. Yeung (2009) states the importance of external network building in acquiring capabilities in the Asian context. Morrison et al (2008) show that firms gain technological capabilities from participating in global value chains.

It is possible that the suppliers upgrade and co-evolve with the buyer when the technological and organizational change enables a more sophisticated supply chain

(Yeung 2008). In 2004, Lenovo bought the PC operation from IBM and upgraded from an OEM to an OBM producer. In 2004, TCL (Shenzhen) co-established a mobile phone joint venture with Alcatel. In 2007, China Electronic Cooperation subsidiary Sungfei (Shenzhen) acquired the mobile phone operation from Phillips. These are examples of upgrading by enhancing internal absorptive capacity and strategically recognizing the coupling chances with leading global firms.

However, organizational proximity alone has a limited role in upgrading and innovation. Firstly, many brand owners arrange the global strategic layout in such a way that strategic R&D, marketing and management are located in their home countries or in regions in developed countries where innovation partners and reliable institutions are available (Feinberg and Gupta 2004), while functions such as production, sales and logistics are located in developing countries (Pan and Chi 1999). Although the internationalization of R&D activities has grown significantly since the 1990s (OECD 1998), technology and knowledge to which domestic firms have access is still limited and mostly low-end. Secondly, global buyers tend to promote incremental product and process upgrading and oppose upgrading if this creates opportunities for suppliers to acquire a broader range of customers (Humphrey 2004). Therefore, the next section discusses the role of social proximity in fostering innovation as a means of overcoming the shortcomings of organizational proximity.

2.3 The role of social proximity in upgrading and innovation

Social ties and relations have an influence on economic outcomes (Granovetter 1985). Social proximity is secured through informal daily interaction such as meeting, chatting, eating and joint entertainment. Trust and commitment are gradually established in the

social interaction process, which contributes to interactive learning and cooperation. Social networks are not bound spatially, but can be sustained and produced by the ongoing collective interaction of players located close to each other (Boschma, 2005). It is worth mentioning that social proximity differs from institutional proximity: in the case of the former, people build trust in each other due to continual interaction and a deeper understanding in daily life, rather than in the latter, where common sets of values and recognition of rules are the key factors (North, 1990; Boschma, 2005).

Many firms in specialized clusters of developing countries compete fiercely in low-tech production. Because of the standardization of most low-tech products, the idiosyncratic nature of knowledge and capability is rather insignificant and little complementary knowledge can be shared between them, which results in too much cognitive proximity (Boschma, 2005). Therefore, firms are reluctant to share knowledge because the imitation cost is rather low. In this case, social proximity, such as that between customers and suppliers, is only used as a way of sustaining an agile and responsive production system. As a result, the role of social proximity in fostering innovation is limited, which leads to rather loose local innovation networks.

In the late 1980s and early 1990s, the GREMI school developed the concept of “innovative milieu” (Aydalot 1986; Aydalot and Keeble 1988; Camagni 1991) to analyze collective learning processes which go beyond the boundaries of firms but nevertheless remain within spatial boundaries. In the milieu, social proximity and institutional proximity guarantee the effective transfer of information and know-how (Almeida and Kogut 1999; Breschi and Lissoni 2001; Maggioni and Uberti 2005). However, this is only the necessary condition of a milieu. The sufficient condition is fulfilled if local firms are

capable of capitalizing on social proximity not only to facilitate effective knowledge transfer, but also to generate innovation outcomes. In other words, development of internal capacity is the precondition for social proximity to play a role in forming innovation synergies among local firms.

Guanxi, as an informal way of doing business in China, has received growing attention in the recent organizational literature (Park and Luo 2001; Ramasamy, Goh et al. 2006; Zhang and Zhang 2006). Similar to the concept of social proximity, Guanxi refers to the informal interpersonal relationships and exchanges of favors for the purpose of doing business in traditional Chinese society (Lovett, Simmons et al. 1999). There are three major categories of Guanxi: 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; as well as understandings with acquaintances, defined as the utilitarian type of Guanxi (Zhang and Zhang, 2006). Peng (2003) points out further that the reciprocal and utilitarian types of Guanxi are becoming more important than the obligatory type in later phases of the institutional transition. For reciprocal Guanxi between friends and fellows in particular, the implicit rule of “paying back favors” (Renqing in Chinese) due to the fear of damaging one's social reputation and prestige actually strengthens the constant social interaction. Generally speaking, Guanxi in China is a common practice and is even more complicated than any kind of Western interpersonal relationship, since the Chinese have been more or less unintentionally or unconsciously involved in complex Guanxi networks ever since they began their working lives.

From the organizational perspective, local firms tend to apply an informal network-

based strategy in the uncertain environment in China (Peng, 2003). In the Chinese business world today, Guanxi plays an important role in facilitating economic exchanges and overcoming administrative costs (Park and Luo, 2001), such as starting a business, concluding contracts, acquiring institutional protection and responding flexibly to changing demands. However, its role in innovation has not yet been analyzed. In fact, there are several aspects in which Guanxi can function to promote communication and innovation synergies among firms with sufficient internal capabilities.

Guanxi networks are important for innovative collaboration. Due to the gradual approach in the transition, many institutional setups have been subverted and not yet substituted, which has resulted in institutional loopholes. As a result, the legal system, property rights protection, industrial regulations and standards are all underdeveloped. Furthermore, the transparency and corruption issues have created an unreliable institutional environment. Under these circumstances, people tend to resort to Guanxi whenever issues emerge.

The prerequisites for interaction and cooperation in innovation are the sharing of information, knowledge and ideas, as well as commitment and loyalty in the investment phase. Therefore, there are risks of opportunism, i.e. asset specificity, and behavioral and environmental uncertainty (Standifird and Marshall 2000). Guanxi curbs opportunism in the following ways:

Firstly, Guanxi with business partners can reduce the risk of asset specificity, for example if firms have invested in specific assets and their partner suddenly switches to another collaborator during the process. The essence of Guanxi lies in the Confucian thought of harmony and an orderly world. Reciprocal Guanxi with business partners is

path-dependent to some extent because people avoid ruining the precious Guanxi network for short-term gain. Long-term Guanxi acts as a constraint of opportunism, creating mutual trust and assurance for cooperation.

Secondly, Guanxi networks with other partners, which might not directly involve innovation collaboration, can also reduce the risk of behavioral uncertainty in the innovation process. As an old Chinese saying goes, “you will never be defeated if you know everything about your opponent”. For example, if the cooperation partner in innovation activities wants to steal ideas to develop a new product on their own, and contracts and legal systems are not able to help or cost too much, it is safer to know ex ante about the background, reputation and capacity of your partner through the Guanxi network from other managers (as intermediaries) in the industry.

Thirdly, government officials in China exercise personal preference in the selection process in lieu of strict regulations and market mechanisms. As a result, Guanxi with government officials provides access to scarce resources such as innovation subsidies and high-end technology funds. Even more important is the fact that Guanxi with government officials can reduce environmental uncertainties. Innovation policies are always unsteady and vague in China. Mangers and entrepreneurs cannot simply rely on government bulletins as an information channel. They actually rely more on Guanxi when searching for and confirming information. They often obtain key information and a detailed explanation of policies through obligatory or reciprocal Guanxi. Information sorted through Guanxi networks is more reliable and trustworthy, and thus allows for better informed decisions on investments in innovation.

However, Guanxi networks carry the risk of a negative lock-in effect. As Guanxi

networks depend on the constant exchange of favors, it is also fragile once the exchange stops. Firms are locked in with current business partners, fearing a destruction of the subtle Guanxi network with a single business partner and all other partners who are related to this partner. In this case, firms do not act as profit-maximizing entities, but rather as Guanxi-satisfying ones. Outdated production modes and product types might persist and are harmful for upgrading and innovation (Hsu and Saxenian 2000). Moreover, the subtle weaving of the Guanxi network costs time and money (Fock and Woo 1998).

2.4 Brief Summary

We derive the following hypotheses from the discussion of organizational proximity and social proximity for product innovation of firms and within regions:

Hypothesis 1: By developing absorptive capacity and strategic coupling within the global production network, it is possible for latecomer firms in emerging regions to capitalize on organizational proximity in order to foster innovation and upgrading. However, firms that rely only on a vertical hierarchy with leading global firms to foster innovation have limited potential for upgrading their position in the value chain.

Hypothesis 2: Most Chinese firms are engaged in Guanxi networks, which is an ongoing mode of interaction for maintaining social proximity between business partners. Firms with limited capabilities and short-term strategies are only able to capitalize on Guanxi for low-cost and flexible production. On the other hand, in a mature local innovative milieu, firms are capable of using social proximity to facilitate the complex interaction in the innovation process and to upgrade their position in the value chain.

3. Data and Methodology

The electronics industry in the Pearl River Delta, China, has been selected as the research area for this study. Because the investigation focuses on the electronics industry in an export-oriented region, cognitive proximity is guaranteed due to the sharing of industrial code and knowledge, while geographical proximity is also guaranteed due to the co-location of the firms in the same mega-urban area. We, however, focus on the role of social proximity, i.e. embedded in Guanxi networks between individuals, as well as organizational proximity to global firms in fostering product innovation. These two forms of proximity can be addressed by conscious firm strategies, and can thus be achieved through the efforts of individual firms. In contrast, institutional proximity is not discussed, since the institutional environment is not yet stable enough for firms to rely on it, and individual firms are not able to influence the institutional setting through their own efforts in the short term.

The empirical data used to answer the research question was taken from a standardized survey of electronics firms in the Pearl River Delta, Guangdong Province, China. Bellandi and Tommaso (2005) points out that the industrial development in Guangdong Province is the subtle mixture of global network, public governance and the unexplored socio-cultural contexts. Therefore, this study would use survey data in the firm level to explore the role of socio-cultural factors, i.e., social proximity in fostering innovation.

The company survey targeted electronics firms in four cities in the eastern part of the Pearl River Delta (Figure 1), where the electronics industry is dominant (as in Shenzhen and Dongguan) or developing very quickly (as in Huizhou and Heyuan). In total, 422 electronics companies were interviewed during a three-month period from September to

November 2009. Of the surveyed firms, 167 are located in Shenzhen, 177 in Dongguan, 67 in Huizhou and 11 in Heyuan. The company survey was conducted by telephone and mail. Questionnaires were addressed to CEOs or senior executives of the companies. The telephone and mail method was complemented by a telephone follow-up aimed at reducing the number of unanswered questions. The response rate was 53%.

In order to test the hypotheses, typical innovation behavior that makes use of the two proximities in the product innovation process was firstly identified. In the empirical test, we mainly used cluster analysis to identify the typical innovation behavior of electronics firms in the Pearl River Delta. The focus was on the interaction with different partners, such as parent companies, foreign customers, domestic customers, universities and research institutions, and sales agents in various aspects of product innovation. Firms were asked to rank the importance (on a scale of 1 to 5 with increasing importance) of interaction with business partners in different aspects with regard to acquiring new innovative ideas and obtaining codified and tacit knowledge (Table 1). In addition, we asked them about the main mode of interaction with these business partners during the innovation process.

One of the limitations in our questionnaires is that we are not able to identify the interaction mode with each business partner in each specific innovation process. If so, the matrix of questionnaires would be too complex for the firms to answer. In order to ensure the success of the survey, only generable information on interaction way with business partners can be identified. However, we believe that by differentiating firm with the type such as parent companies, foreign customers, domestic customers and external knowledge institutes, information on the degree of each proximity with the partners can

be attained. For example, the organizational proximity with parent companies and foreign customers is closer than the one with domestic customers and external institutes in the context of latecomer countries as discussed before. Also, the social proximity with domestic customers and external institutes can substitute the lack of organizational proximity in some degree. Combined with the general question on interaction mode with all business partners, insight into the degree of proximity use in innovation process can be secured.

Because there are many items for each of these aspects, we have applied a factor analysis to reduce the items in order to simplify the interaction with external players in the product innovation process. The result of the factor analysis is shown in Table 1. In statistical terms, the result is satisfactory because the derived factors in each group are able to explain over 60% of the variance of the original sample.

By means of the factor analysis, different dimensions of proximity for the interaction with different players were identified. The results clearly show that the firms are not only acquiring codified knowledge and tacit knowledge from parent companies and foreign customers, but that they are also interacting with external partners beyond the organizational hierarchy, for example domestic customers, universities, research institutions and sales agents, to get new ideas and required knowledge. This is the first indication that several firms are applying a strategy of active learning. Guanxi networks are the major facilitator for interaction during innovation processes.

Table 1 Results of Factor Analysis

		Remarks	Explained variance of each factor	Total explained variance
New Product	NPI_external partners	Interacting with *domestic customers, universities, research institutions and sales*	33%	60%

Ideas		*agents* to gain innovation ideas		
	NPI_internal efforts	Making *internal learning efforts* such as own ideas, license purchasing and reverse engineering	15%	
	NPI_parent comp. & foreign	Relying on parent companies or foreign customers to gain innovation ideas	12%	
Obtaining Codified Knowledge	NPCK_customer	Interacting with *foreign and domestic customers* to get codified knowledge	34%	85%
	NPCK_parent comp.	Interacting with *parent companies* to get codified knowledge	27%	
	NPCK_self purchase	Purchase equipment self	24%	
Obtaining Tacit Knowledge	NPTK_active learning	Sending staff *to business partners* for training	44%	74%
	NPTK_passive from customer	Receiving training and know-how from people sent *by domestic and foreign customers*	17%	
	NPTK_passive from parent comp.	Receiving training and know-how from people sent *by parent company*	13%	
Interaction Method	NPInteraction _informal	Interacting with innovation partners *within Guanxi networks*	52%	79%
	NPInteraction _formal searching	Interacting with innovation partners by *searching via Internet and exhibition*	27%	

In section 4, a cluster analysis uses the items shown in Table 1 to identify different patterns of capitalizing on social and organizational proximity. In cluster analysis, there is rarely one single best solution. A good cluster analysis should be at first use as few clusters as possible and secondly capture all statistically and empirically important clusters. We follow a four-step procedure to ensure the internal validity of the clustering result (Delmar et al, 2003). At first, hierarchical clustering with Ward's method and Squared Euclidean distances was run to assess the possible clustering results. In this step, we came with 2 to 6 cluster solutions and derived each centroids from each cluster solutions. The second step was to use the centroids derived in the first step to perform the K-means cluster. The result of K-means cluster would be compared with that of hierarchical cluster by cross tabulation. A significant level in Lambda lower than 0.05 is considered to be able to verify the relative stability of the cluster results across samples. After running these two procedures, we concluded with three clusters that are internally

stable and easy to interpret from the perspective of innovation behaviors using different proximities.

The validation of the clustering result is further supported by external validity. If the clustering discriminates between variables not included in the clustering procedure, the clustering result is likely to represent distinct empirical categories. The clusters identified are then compared with respect to performance indicators such as sales growth, export orientation and product innovation.

Finally, we apply regression analysis to explore the exact relationship of the proximities and product innovation performance by controlling for firm-specific characteristics such as size, ownership, age and internal absorptive capacity.

The dependent variable in the regression model is product innovation performance. In questionnaire data, especially in developing countries, it is always difficult to obtain an exact measurement of new products that is reliable and comparable. Therefore, we asked firms to evaluate the degree of improvement of various aspects of production innovation performance, including product quality improvement, product function expansion and product categories upgrading (on a scale of 1 to 5 with increasing degrees of improvement). The dependent variable in the regression is the average score of these three items.

A shortcoming of this variable is that it has a bound value of 1 to 5. The problem here is that it is based on a subjective evaluation, and that those firms that marked the same score might not be completely similar in their achievement. Figure 2 shows the distribution of the composite score of innovation performance. The censoring of the data set can be clearly seen, since there are far more cases with scores of 3 to 5, which is to be

expected in questionnaire answers because the firms all attempt to make a good impression. With this particular issue of censored data, OLS regression provides inconsistent estimates of the parameters (Long 1997). Therefore, we apply a Tobit regression which is unaffected by this issue. The independent variables are defined in Table 2.

Table 2 Independent variables in Product Innovation Performance Regression

	Indicators	Description
Firm Characteristics	Size	Defined according to Chinese firm size standard, 1 as large firms with sales over 300 million Yuan, 0 as small and medium sized firms with sales below 300 million Yuan
	Ownership	1 as firms with foreign participation (wholly owned or joint venture), 0 as firms with 100% domestic participation
	Age	Years since establishment of the firm
Absorptive Capacity	Capacity of CEO	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
	Development Capability	1 as having product development capability, 0 as not
	Initial technological level of main product	Defined according to International Standard Industrial Classification of all Economic Activities, Rev 3, 1 as producing low-tech products when starting business, 2 as producing medium-tech products when starting business; 3 as producing high-tech products when starting business
Innovation Behavior	Behavior of capitalizing on different proximities	Defined by the cluster analysis in the next part; included in the model as a series of dummy variables.

Besides using conventional indicators, such as skills of technical and managerial staff, as an indicator for human resources, this study uses the educational background of the CEO. Leibenstein (1968) points out that in imperfect factor markets, entrepreneurs tend to carry out many activities for the survival and growth of the enterprise by themselves, such as searching and evaluating economic opportunities, taking ultimate responsibility for technical absorption and management, as well as marshaling financial resources. In our sample, 87% of the firms are small and medium sized and about 80% of employees are involved in production. The poor endowment with resources determines that

entrepreneurs shoulder most of the responsibilities in the process of product innovation.

4. Empirical results

4.1 Innovation behavior of electronics firms in the Pearl River Delta

Table 3 demonstrates the results of our cluster analysis, which differentiates between three types of innovation behavior related to the capacity of capitalizing on social and organizational proximity in the process of product innovation. The results correspond rather well with our conceptual considerations.

Table 3 Results of Cluster Analysis (Ward's method/Squared Euclidean distance)

	Socially active innovator	**Organizationally dependent innovator**	**Lame innovator**
NPI_external partner	**0.54**	**0.25**	-0.32
NPI_internal	**0.52**	0.07	-0.31
NPCK_customer	**0.60**	-0.15	-0.34
NPTK_passive from customer	**0.46**	0.07	-0.22
NPTK_active learning	**0.58**	-0.12	-0.35
NPInteraction_informal	**0.60**	-0.06	-0.33
NPInteraction_formal searching	**0.26**	-0.01	-0.17
NPI_parent comp. & foreign	-0.11	**1.01**	-0.12
NPCK_parent comp.	-0.38	**1.96**	-0.27
NPCK_self purchase	-0.17	**0.12**	0.10
NPTK_passive from parent comp.	-0.47	**2.06**	-0.16
Number	*103*	*41*	*171*

- **Socially active innovator:** Firms in this group interact frequently with external partners in combination with their internal capability. With regard to obtaining codified and tacit knowledge in the product innovation process, firms of this kind tend to rely more on customers, and use the active strategy of sending people to business partners for acquiring tacit knowledge. In the interaction process with these partners, firms in this category flexibly combine formal active searching and informal networks (Guanxi with family members, friends and business partners)

when interacting with partners in the innovation process. Although we cannot specify exactly which interaction method is applied by the firms when interacting with each partner (because the related matrix would be too complex to be answered by the firms), it is possible to conclude indirectly that firms in this group rely on social proximity to external partners in general during the process of product innovation to a greater degree than firms in the other two clusters. They are actually socially active innovators, and social proximity is not only used as a way of acquiring codified and tacit knowledge by interacting with external partners, but also as a way of triggering new product ideas, which is a feature of capable firms in an innovative milieu. Although these firms still rely on organizational proximity to foreign customers to a certain degree in order to acquire codified and tacit knowledge, they are already able to extend the scope of interactive learning in the innovation process to capitalize further on social proximity.

- **Organizationally dependent innovator:** In contrast, organizationally dependent innovators rely heavily on organizational proximity to gain access to and absorb knowledge. They turn to their parent companies to obtain codified and tacit knowledge in the process of product innovation, i.e. in a more passive way due to the hierarchical control. The new product ideas originate mainly from parent companies as well as from powerful foreign customers. It is worth mentioning that they show a certain tendency to interact with external partners to prompt product innovation, although with a lower degree than socially active innovators. However, the much lower value in informal interactions indicates that these firms are not

able to capitalize on social proximity to foster innovation as their socially active counterparts. Moreover, their method of interacting with innovative partners is not characterized by any particular feature, which indicates a more passive attitude towards product innovation compared to socially active innovators.

- **Lame innovator:** Compared to the previous two kinds of firms, lame innovators have low values for all the indicators that are related to product innovation. Lame innovators are not actively involved in triggering new ideas of innovation, nor do they strive to search for codified and tacit knowledge, which is important for positive product innovation performance. Moreover, they are quite vague and unsettled in their ways of interacting with partners in the innovation process. In short, they are not able to interact with external players to initiate innovation and do not have the capacity to organize internal learning.

A look at the number of firms in each cluster shows that the number of lame innovators exceeds the sum of socially active and organizationally dependent innovators in our sample. This is proof of the immature internal absorptive capacity of most firms in the Pearl River Delta to benefit from external interaction in order to trigger innovation. However, the number of socially active innovators is two times higher than the number of organizationally dependent innovators. This seems to be an indication of an emerging innovative milieu in the Pearl River Delta, where some local firms are capable of benefiting from localized knowledge sources by capitalizing on informal social relations. But it also reflects the difficulty of most firms in the Pearl River Delta to ’couple strategically’ with global firms to upgrade their position in the value chain. By studying

the relocation issue of Taiwanese Personal Computer firms, Yang (2009) also pointed out that Taiwanese firms in the Pearl River Delta are less oriented towards the strategic coupling of local and global knowledge sources than their counterparts in the Yangtze River Delta.

4.2 Performance and innovation behavior

Table 4 presents differences in sales growth, export orientation and product innovation between the clusters. Besides insignificant differences for the new product rate between each of the groups, at least one pair of groups differs significantly from another. This again validates the explanatory power of the three clusters.

Table 4 Performance of different Innovating Groups (T test of Samples)

Note: Group 1- Socially active innovator; Group 2- Organizationally dependent innovator; Group 3 – Lame innovator.

Sales growth in first half of 2009		Group 1	Group 2		Group 1	Group 3		Group 2	Group 3
	Mean	**21.3**	**-4.23**	Mean	21.3	24.4	Mean	**-4.23**	**24.4**
	Sig.[1]	**0.03**		Sig.	0.92		Sig.	**0.02**	
Foreign market share		Group 1	Group 2		Group 1	Group 3		Group 2	Group 3
	Mean	**35.9**	**55.4**	Mean	**35.9**	**44.4**	Mean	**55.4**	**44.4**
	Sig.	**0.002**		Sig.	**0.05**		Sig.	**0.08**	
New Product rate		Group 1	Group 2		Group 1	Group 3		Group 2	Group 3
	Mean	36.7	33.3	Mean	36.7	37.6	Mean	33.3	37.6
	Sig.	0.44		Sig.	0.78		Sig.	0.36	
Quality Improvement		Group 1	Group 2		Group 1	Group 3		Group 2	Group 3
	Mean	4.23	4.27	Mean	**4.23**	**4.01**	Mean	4.27	4.01
	Sig.	0.81		Sig.	**0.07**		Sig.	0.11	
Function Expansion		Group 1	Group 2		Group 1	Group 3		Group 2	Group 3
	Mean	3.88	3.80	Mean	**3.88**	**3.62**	Mean	3.80	3.62
	Sig.	0.70		Sig.	**0.07**		Sig.	0.38	
Product Upgrading		Group 1	Group 2		Group 1	Group 3		Group 2	Group 3
	Mean	3.82	3.95	Mean	**3.82**	**3.52**	Mean	**3.95**	**3.52**
	Sig.	0.52		Sig.	**0.06**		Sig.	**0.03**	

[1] Significance level of the difference between the mean value of the comparing groups

- Differences between organizationally dependent innovators and the other two groups

Almost 75% of the organizationally dependent innovators in our sample involve foreign ownership, while the share is only 30% among socially active innovators and 38% among lame innovators. This indicates that organizationally dependent innovators are more closely integrated into the global production network. This is further substantiated by their outstanding export performance compared to the other two groups (Table 4). However, sales growth after the financial crisis is negative and significantly lower than that of socially active innovators and even lame innovators. This suggests that the loose social embeddedness with business partners leads to a highly vulnerable and externally dependent mode of upgrading. With regard to product innovation, organizationally dependent innovators are better able to upgrade the product category that is produced by integrating within the global value chain compared to the lame innovators. However, they do not outperform the lame innovators in other aspects of product innovation, which suggests that depending solely on global production networks narrows the scope of product innovation.

- Differences between socially active innovators and lame innovators

The two groups represent a high share of domestic-oriented firms, especially the socially active innovators, whose export share is only around 35%. They are all able to reach moderate sales growth even in the face of the crisis. However, socially active innovators outperform lame innovators in many aspects of product innovation, such as quality improvement, product function expansion and product upgrading facilitated by the capacity to take advantage of informal social relations as well as some degree of organizational proximity to foreign customers in order to foster innovation.

Lame innovators represent the conventional producers in the Pearl River Delta. They are able to respond to market needs with low-cost and flexible production by taking advantage of informal relations with family members and friends. However, their lower absorptive capacity restricts them to utilizing informal social relations to foster innovation and upgrading. These firms represent the primary bottleneck for a shift in industrial development towards regional upgrading in the Pearl River Delta.

4.3 Impact of the proximities on product innovation performance

Table 5 shows the results of the Tobit regression with innovation performance as the dependent variable and innovation behavior and other control variables as independent variables. The results of the cluster analysis are used to define the innovation behavior as: 1 - socially active innovators, 2 - organizationally dependent innovators and 3 - lame innovators.

The chi-square likelihood ratio has a p-value of 0.002, which tells us that the model as a whole fits significantly better than an empty model. Moreover, the distribution of the residuals obey the normal rule, which indicates that heterokedastic issue, that might tortures the results of Tobit model, does not exist (Figure 3).

Table 5 Tobit regression on innovation behavior and innovation performance

Independent variables	*（1）Product Innovation Performance*[1] *（Average score of evaluation）*	*（2）Product Innovation Performance*[1] *（Average score of evaluation）*
Constant	3.45*** (0.207)[6]	3.18*** (0.199)
Capacity of CEO	0.11** (0.048)	0.11** (0.048)
Development Capability	0.17 (0.14)	0.17 (0.14)

Initial Product Type according to technology	Medium tech vs. low tech[2]	0.36*** (0.13)	0.36*** (0.13)	
	High tech vs. low tech[2]	0.41** (0.185)	0.41** (0.185)	
	Overall effect[5]	—**	—**	
Ownership		-0.15 (0.094)	-0.15 (0.094)	
Firm Size		-0.10 (0.191)	-0.10 (0.191)	
Firm Age		0.003 (0.008)	0.003 (0.008)	
Innovation Behavior	Organizationally dependent vs. socially active[3]	0.082 (0.202)	Organizationally dependent vs. lame[4]	0.35* (0.195)
	Lame vs. socially active[3]	-0.27** (0.129)	Socially active vs. lame[4]	0.27** (0.129)
	Overall effect[5]	—*	—*	
LR chi		25.51	25.51	
Prob > chi2		0.002	0.002	
Number of Observations		279	279	

1. Product innovation performance refers to improvement in product quality, product function and product categorical upgrading.
2. Initial product as low tech as the default group, which means low tech as 0, the other as 1;
3. Socially active innovator as the default group, which means socially active innovator as 0, the other as 1;
4. Lame innovator as the default group, which means lame innovator as 0, the other as 1;
5. T test of whether the overall effect of the categorical variable is statistically significant.
6. Standard errors in parentheses; *p<0.10, **p<0.05, ***p<0.01.

Among the control variables, the capacity of the CEO constitutes the primary element of internal absorptive capacity to foster innovation. For the small and medium sized firms, the CEO acts as a gatekeeper for choosing technologies, new market opportunities and business networks. Moreover, if firms initially produced medium and high-tech products, i.e. they were initially endowed with higher knowledge stock, they tend to perform better in product innovation than firms starting with low-tech production.

The main focus of the research question is the impact of innovation behavior on product innovation performance. Equation 1 and equation 2 are quite similar, with the exception that the default group of each dummy variable in the innovation behavior category is adjusted to compare the impact of each type of innovation behavior on innovation performance. If control variables for firm characteristics and absorptive

capacity are included in the model, socially active and organizationally dependent innovators possess a significantly better product innovation performance than lame innovators. This verifies the hypothesis that either social proximity or organizational proximity is an asset that firms are able to capitalize on in complex innovation processes. With the development of local capabilities in the Pearl River Delta after thirty years of industrialization, firms are gradually accumulating the capacity to capitalize on proximity to foster product innovation and upgrading.

However, socially active innovators, which interact with domestic customers and other knowledge institutions in the process of product innovation, do not differ significantly from organizationally dependent innovators in terms of product innovation performance. Even though organizationally dependent innovators were hit harder by the recent slump in global demand than socially active innovators, their innovation performance does not differ to a significant degree. In particular, organizationally dependent innovators seem to achieve a better performance in upgrading to better product categories than socially active innovators, though not to a significant degree.

This result implies an intriguing feature of the recent development stage of innovative milieus in the Pearl River Delta. Although socially active firms are emerging in this region, which altogether increases dynamic innovative synergies on the local scale, their capacity to transform fully this social asset into a high innovation performance is not yet sufficient. This underpins the instability of innovative synergies in emerging regions where small achievements are not sufficient to compensate for the risk and cost related to innovation activities (Capello, 1999). It might be attributed to the fact that trust building needs time, especially in innovation activities that are highly complex and risky and

involve high level of spillover effect. All in all, an innovative milieu is just emerging in the Pearl River Delta and is far from mature at present.

5. Discussion and conclusion

Proximity has been applied as a simple concept that deals explicitly with the issue of learning and innovation. As Massard and Mehier (2009) suggest, it provides a conceptually more sound measurement of accessibility than the concept of the externality of simply being there. Relational space based on rules, contracts and informal social interaction has been taken into comprehensive consideration. The relationship between different proximities and innovation has been the main focus of the existing literature, but quantitative methods for measuring different proximities are rarely discussed. Therefore, this paper has taken a step towards a measurable differentiation of types of innovation behavior related to the use of two relevant proximities, i.e. organizational and social proximity, and their impact on innovation performance in the context of an export-oriented region in China.

The paper concludes that an innovative milieu is emerging in the Pearl River Delta, and a certain number of firms are beginning to be able to capitalize on social proximity to foster innovation and growth. In the Pearl River Delta, informal social relations (Guanxi) play an important role for doing business. If firms achieve the capacity to take advantage of social proximity to foster innovation and upgrading, instead of simply reducing transaction costs and producing more cheaply and more flexibly, this is expected to be a powerful mechanism for regional upgrading in the near future. At the same time, firms that are highly dependent on organizational proximity to parent firms and foreign

customers have limitations with respect to innovation as well as coping with sudden demand shocks.

Ever since the beginning of the global recession, governments at different levels (province, city, towns) in the Pearl River Delta have felt that the strategy of low-cost production is losing its competitive edge and have fiercely promoted industrial upgrading and innovation. It is intriguing to see that some firms are now capable of exploring the local knowledge sources within the informal Guanxi network. However, the capacity to transform fully this informal social asset into greater output and performance is not yet mature. In this respect, governments can support firms in realizing more profit related to high innovation performance by means of providing innovation funds and regulating the domestic market.

By conducting a large-scale industry-specific firm survey in a specific period, we were able to assess which stage the nascent regional innovative milieu in the Pearl River Delta has reached and to compare this result with the initial externally-dependent mode which is often discussed in the literature in the context of latecomer countries. However, additional research should be conducted to trace the evolution or changes of the innovative milieu in the Pearl River Delta over time and in different sub-regions. It is important to bear in mind that alternative perspectives on the dynamic process of regional development in latecomer countries should be adopted.

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