How is Innovation fostered under different Institutional Setup: Comparing the Electronics Cluster in Shenzhen and Dongguan, China

1. Introduction

In the late 1990s, the concept of sub-national (regional and metropolitan) innovation system, which derived from the national innovation system literature, takes institutional and organizational dimension in the territorial level into consideration of innovation activities (Cooke et al., 1997, Howells, 1999, Cooke, 2001, Diez, 2002, Morgan, 2004, Asheim and Coenen, 2005). The theoretical discussion of territorial innovation system adopts an evolutionary view towards the casual relationship between territorial assets and innovation in the development process. The highest level of territorial production system lies in the shaping of innovation dynamics in which the local actors gradually develop the capacity and strategy to grasp the cumulative and socialized knowledge not only to foster learning and innovation, but also to turn it into profit (Porter, 1990, Cooke et al., 1997, Cooke and Morgan, 1998, Capello, 1999). Moreover, the institutional setup, which is context-specific and path-dependent, impacts on the way of interaction and learning between economic actors as the specialized cluster evolves (Revilla Diez, 2009).

When this line of thinking applies to empirical investigation, however, a stylist approach such as benchmarking is usually adopted. This is partly due to the mature innovation institutions in these areas such as Europe and North America, where the institutional setup tend to be static. In China, the transition from planned economy to market economy proceeds gradually which results in the constant adjustment of institutional setup responding to the need of rapid industrialization and restructuring stimulated by integration into the global economy. Moreover, public sector in China plays important role in organizing and coordinating economic activities in the way of financial arrangements, incentive provision and gain distribution scheme. This specific context provides the opportunity to gain insight into the impact of evolving institutional setup on innovation.

In this paper, we aim to shed light on how innovation is fostered under different institutional setup by comparing the institutional setups and their corresponding innovation dynamics in Shenzhen and Dongguan, China. Since the opening in late 1970s, the central

government either directly involved in economic development such as establishing economic special zones, or implicitly encouraged the bottom-up development mainly by releasing more economic developmental autonomy to local governments. In Shenzhen, the institutional setup is characterized by a state-oriented involvement of economic development with ex-ante strategic policy support. While in Dongugan, institutional setup is characterized by flexible and informal institutions organized mainly by town and village authorities that are favorable for overseas Chinese investment based on Guanxi (Leung, 1993, Yang, 2010).

Until 2000, high agglomeration of electronics industry has been developed in Pearl River Delta, especially in Shenzhen and Dongguan thanks to the opportunities of global industrial shift and reorganization. However, the different institutional set-up in these two cities would lead to different mechanism of innovation. After decades of rapid development relied on low-end export-oriented production, Shenzhen and Dongguan all encountered with the issue of restructuring from the low-value added production to high-value added activities such as innovation. Fu and Diez (2010) demonstrate the external knowledge spillover from FDI and import already trigger local knowledge spillover within the industries in Pearl River Delta. In this turning point, it is worthwhile to investigate the impact of institutional setup and its evolution in shaping the effective and sustainable innovation mechanism as well as the prospect of upgrading and restructuring.

Drawing upon the institution focused view of territorial innovation system, this paper argues that the institutions organized from bottom up targeting at attracting process trade, which has taken shape since opening in Dongguan, restricts the scope of interaction and learning related to innovation and would probably lock-in the city in low-end production activities if the existing institutional setup can not be broken up. On the other hand, institutional setup favoring the agglomeration of knowledge-related and knowledge-intensive institutes and ex-ante strategic support organized from top down in Shenzhen contributes to the reciprocal and systematic interaction between firms as well as knowledge institutes.

The remaining paper is organized as follows. The second section elucidates scales of institutional setup in making up territorial innovation system and how the evolving manner of institution shapes the innovation strategy and capacity. In the discussion, different institutional setups, for instance, the bottom-up and top-down ways to boost industrialization in the context of transitional China would be discussed. Afterwards, the data and method to explore the impact of institutional setup in these two cities on innovation mechanism would be

covered in the third section. The fourth section depicts the developmental path of electronics industry in Shenzhen and Dongguan under different institutional setup. Econometric results would be discussed in align with the theoretical discussion on institutional setup and innovation in the fifth section. Finally, the paper discusses the applicability of the results and further discusses the policy implication.

2. Top-down and Bottom-up Institutional Set up and Innovation: Two Hypotheses

To secure systematic learning and innovation synergies that occurs externally to the firm boundary, institutions play important role in providing access to information, ensuring credibility, coordinating collective actions and even creating learning atmosphere (Dalum et al., 1992, Sweeney, 1995, Amin, 1999, Haggard, 2004). In this way, innovation is carried out through a network of various actors underpinned by a specific institutional setup, and the evolution of institutional structures make up the system of innovation (Howells, 1999).

In Cooke et al. (1997)'s seminal work on bringing regional-level institutions instead of national level ones first into the consideration of innovation activities, three determining elements of institutions has been investigated (Table 1): 1) financial and budgetary capacity of public institutions to mobilize innovation-related resources; 2) Supported infrastructure to sustain externalized learning atmosphere; 3) Institutional competence to grasp new opportunities and avoid strong lock-in effect.

Table 1 Aspects of innovation supported capacities in territorial level

Financing & Budget	Accessibility for firms to capital market
	Capacity to impose taxes
	Autonomy for public spending
	High level of financial intermediaries
	Control over public procurement
Supported infrastructure	Density and quality of infrastructures for innovation
	Control or shared execution of part of strategic infrastructures
	Own educational and training system
	University related to the area
	Research laboratories in the area
Institutional competence	Capacity to design and execute industrial and technological policies
	Development of information and promotion policies
	(local, regional, …) science and technology programme

Adjusted from Cooke et al. (1997)

In China, the bottom-up and top-down way of development in China after opening policy is fundamental in gaining insight into the distribution of these three aspects among different territorial level. After the success of rural household contract responsibility system reform in

1978, a political consensus has been reached concerned on carrying out this developing concept further to wider scope. It was expected to arouse the enthusiasm of economic development by setting general economic goals and transferring the fiscal autonomy to lower level authorities, including imposing taxes and disposing of fiscal income where the exact proportion is negotiated between the higher level governments and lower level governments based on the performance in the last financial period.

Under the institutional arrangements of fiscal decentralization, a bottom up development approach has been widely spread out in coastal China, especially in formerly less industrialized rural areas. Almost two thirds of FDI investing in China in 1990 was going to non-large cities such as prefecture-level municipalities such as Dongguan and Suzhou (Airriess, 2008). Growth under this bottom-up institutional setup arose widely in small towns and vast countryside of Southern China and eastern Coast (Lin, 1997).

Meanwhile, the top-down institutional setup still plays important role in providing financial support and initiating industrial policies in China especially for strategically selected regions and industries. Besides, the supply of scarce knowledge-related and knowledge-intensive institutes is often limited within the national level. Central government policy oriented cities such as Beijing, Shanghai and Shenzhen enjoy great accessibility to these innovation supported infrastructures.

The institutional setups of bottom-up and top-down approach have been illustrated by similar visions on types of regional innovation system from the perspective of governance (Cooke and Morgan, 1998, Asheim and Coenen, 2005, Revilla Diez, 2009), i.e., the grassroots, network and dirigiste type of RIS. These three types differ in the way of degree of policy intervention as well as the relationship with knowledge-related organizations in different scales. Although this classification does not make explicit formulation on bottom-up and top-down approach, the relationship between policy support and innovation has been touched. Ex-post support which is more hands-on and industry-specific is oriented towards incremental problem solving, while ex-ante support is able to counter technological and cognitive lock-in (Asheim and Coenen, 2005).

In our analysis, institutional setup refers to the approach to initiate, organize and govern cluster development, which in an evolutionary way affects the rules of interaction and the collective learning process in the system of innovation (Fromhold-Eisebith and Eisebith, 2005).

The ways to initiate the cluster development shape the knowledge base of a place, determining the absorptive capacity of firms and other innovation related organizations. Absorptive capacity of innovation system as a whole impacts the effectiveness of interaction and learning among firms, making up the capacity of innovation agents to process the new and related information (Cohen and Levinthal, 1990, Gambardella, 1992, Tripsas, 1997, Zahra and George, 2002). This aspect is of great relevance in transition economy, as strongly institutionalized activities such as central command determines the distribution and density of knowledge-related institutes and organizations. In this manner, top-down approach outperforms bottom-up approach when advanced knowledge was generated and distributed within the framework of national innovation system. In sum, institutional setup that initiates development with better endowment of knowledge base bears wider scope and scale of organizational interaction and ensures higher efficiency of the innovation-oriented interaction when combined with more intensive internal information processing activities.

On the other hand, institutions, which are embedded in rules, norms and related operated organizations, act as the organizers and coordinators of economic activities, shaping the interacting way between the actors through various formal and informal arrangements (Cooke and Morgan, 1998, Edquist, 1997, Dosi, 1988). As postulated by Jepperson and Meyer (1991), institutions are stable designs for chronically repeated activity sequence. Therefore, institutional setup bears the characteristic path dependency, cumulative causation and lock-in in terms of context specificity (Hodgson, 1994).

There are two reasons for lock in effect. Firstly, “competency trap” might arise as being too good at something constrains the capacity to absorb new ideas and develop new trajectory (Levitt and March, 1988). In a broader sense, the locked-in competency refers to the competency of individual organizations to make specific achievements as well as the competency of institutions such as laws and norms to manipulate the relationships between various organizations so to achieve effective interactions and results. Secondly, vested interests in organizations emerge in the formation process of institutional setup, which might oppose the changes that undermines their current gains and positions (Boschma, 2004). This aspect is witnessed by the decline of heavily industrialized areas in Britain and Germany in late industrializing time. All together, it constitutes “cognitively sunk cost” that create negative reinforcing cycling, impeding new development dynamics and trajectory (Leonard-Barton, 1992).

In the transition economy, the bottom-up approach evolves gradually within the constrain of previous institutions, while the top-down approach is able to start with blank sheet or tear up old institutional setup (Easterly, 2008). The capability of top-down approach in bringing new dynamics into the economy is well reflected by the technology foresight. According to the practices in some countries such as Japan, Britain, Australia and New Zealand (Martin and Johnston, 1999), technology foresight, which is mostly conducted by government agency or advisory board with more responsibilities, generates concentration on long-term development on selected trajectories and develop a level of consensus on desirable futures. Technology foresight includes the practice of selecting technology priorities, identifying new strategic industries, creating partnership between sciences, industry and government as well as providing incentives for multidisciplinary research. Therefore, the top-down approach, which is mostly initiated and governed by national level agency with more power in the context of transition economy such as in China, is more able to draw technology foresight to inject new dynamics into development than bottom-up approach.

The bottom-up approach, which evolves from the pre-existing institutions, suffers more from negative lock-in than top-down approach as competency trap and vested interests are hard to be broke through without dynamics injecting by higher level authorities. In China, the incipient industrialization was mostly organized by the township and village enterprise in the basic level due to the small scale foreign investment in the beginning fearing the uncertainty of institutional reform in China. Because the earnings made by township and village enterprises were then the main source of fiscal income, they became the main recipient of infrastructure supply and policy incentive in the town and village level. Indeed, the town and village governments have been the primary Chinese-side stock holders on industrialization by providing cheap collectively owned land to foreign investors that posses equipment and capital. Moreover, the distribution of the processing earning is negotiated between the town and village governments and foreign investors, mostly under informal framework such as oral agreements. In this way, vested interests are taken shape among foreign firms, basic level authorities and related organizations within the framework of evolving institutional setup.

To sum up, institutional setup with more complex vest interests and less dynamics from outside runs the risk of negative lock-in. When the lock-in effect emerges in face of restructuring and upgrading, it would create systemic market and policy barriers to other development alternatives (Könnölä et al., 2006). In an innovation system that lacks renewal

dynamics, knowledge is often accumulated and repeatedly sustained through previous experience and learning by doing within a limited scope of network. Therefore, tacit knowledge is more important in promoting incremental innovation than in economies with more dynamics and absorptive capacity to search for new sources of innovation. Saviotti (1998) refers the search activities to “learning by not doing”, in which external environment is understood in a comparing manner between its component elements as well as with the internal routine and capability. The ability to learn by not doing can be strengthened with the capacity to understand wider range of codified knowledge such as technical literature not limited to local level.

From the above discussion, it can be concluded that different scales of institutional setup and their evolving manner impact on how innovation is fostered in the local scale, which is attributed to knowledge base of main players and embeddedness of rules and norms that defines the interacting ways of innovation actors. Drawing on this basic argument, two hypotheses can be drawn:

Hypothesis 1: Bottom-up institutional setup that is highly embedded in local clusters might lead to systematic market and policy barrier to new actors. It would restrict the scope of interaction and learning related to innovation, leading to the reliance on the transfer of tacit knowledge from limited actors to foster innovation.

Hypothesis 2: Top-down institutional setup is able to draw technology foresight by means of introducing new related industries and integrating resources. This practice, combining with market economy transition and global demand pull, is able to avoid negative lock-in in technological development. Moreover, top-down institutional setup in transition economy can add up the knowledge base of a place and enhances the absorptive capacity of the innovation actors, which trigger interactive learning and systematic innovation.

3. Data and Methodology

In order to test the hypotheses, a sample of electronics firms in Shenzhen and Dongguan, China was used. We focus the investigation on electronics industry due to its great dominance and development history in the research area that enables the inquiry into innovation in the face of restructuring and upgrading. As shown in Figure 1, the output value of electronics industry in Shenzhen and Dongguan kept growing during the period of 1994 and 2009. Dongguan, which is known for “world factory of electronics”, experienced much lower level

of output value growth than Shenzhen due to the concentration of low value processing.

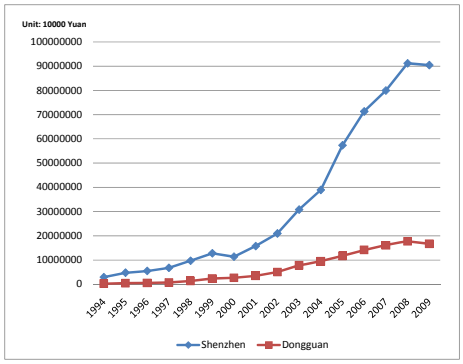

Figure 1 Output Value of Electronics Industry during 1994-2009

The institutional setups in Shenzhen and Dongguan, which evolve since opening to meet the need of rapid industrialization, correspond respectively to the top-down and bottom-up scenarios since opening in China. In our analysis, the scenarios and evolution process of different institutional setups would be depicted by reviewing on “Shenzhen Electronics Yearbook” and “Guangdong Electronics Yearbook”.

In the next step, a questionnaire data of electronics firms in these two cities would be employed to investigate on the factors that foster innovation outcomes. The questionnaire survey is conducted via telephone and posting in order to ensure the feasibility of the survey and validity of the data, and is strengthened by a follow-up process, which aims at persuading the firms to fill and send back the questionnaires as well as filling unanswered questions after the questionnaires return.. In order to get contact with more firms, we applied the second method: fair visiting. We randomly select the fairs and the firms there to distribute the questionnaires. Moreover, the fairs we visited have large number of firm exhibitors that it ensures the unbiased of the fair visiting result. Finally, we got 167 firms in Shenzhen and 177 firms in Dongguan, and the response rate in Shenzhen and Dongguan is 54% and 63%, respectively.

In the questionnaire, various aspects of external interaction and internal efforts during the innovation process such as getting new innovative ideas, acquiring codified knowledge and tacit knowledge has been asked according to their importance of application. The scope of interaction covers various business partners, such as parent companies, foreign customers,

domestic customers, universities and research institutions, and sales agents. Besides, the informality of interaction with the partners is identified.

In our analysis, ordered logit regression is applied due to the discrete and inherently ordered multinomial-choice variable, which adds up the subjective evaluation on the degree of improvement (ranging from 0 to 5 with increasing significance of change) on product function expansion and product category upgrading. Factor analysis is firstly applied to reduce the dimensions in order to simplify the following analysis, which is applied in the following regression as the main dimension of factors that fostered innovation performance. The derived factors are able to explain over 60% of the variance of the original sample In order to avoid multicollinearity, seven variables are finally selected as the independent variables. Table 2 shows the independent variables including the innovation behaviors in the innovation process and the control variables.

Table 2 Independent variables in Product Innovation Performance Regressions

	Indicators	Description
Innovation Behaviors	NPI_external partners	Interacting with *domestic customers, universities, research institutions and sales agents* to gain innovation ideas
	NPI_internal efforts	Making *internal learning efforts* such as own ideas, license purchasing and reverse engineering
	NPI_parent comp. & foreign	Relying on parent companies or foreign customers to gain innovation ideas
	NPTK_active learning	Sending staff *to business partners* for training
	NPTK_passive from customer	Receiving training and know-how from people sent *by domestic and foreign customers*
	NPTK_passive from parent comp.	Receiving training and know-how from people sent *by parent company*
	NPInteraction _informal	Interacting with innovation partners *within Guanxi networks*
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	Educational level of technical staff	Proportion of technical staff with bachelor degree and above
	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

4. Institutional Setups in Shenzhen and Dongguan, China: Developmental Path of Electronics Industry

4.1 Institutional Setup in Shenzhen since opening

The role of high-tech industry has been in focus in the very beginning of special zone development in Shenzhen. Due to its geographical proximity to Hongkong, the electronics industry has been developing rapidly relying on processing operation.

The motor power of the development of Shenzhen electronics industry in 1980s are the large firms that were originally important part of national innovation system in the planned economy before opening. These companies stemmed from large state-owned companies directly under the jurisdiction of state ministries and provinces, renowned universities and research institutes and military-related plants that were highly specialized in heavy industry. Special financial formulas such as joint venture between large state-owned companies and foreign investors are applied. These joint ventures were then able to introduce high-scale production line due to disposal of state-owned assents and scale economies of production. Moreover, the high endowment of human capital in state-owned companies enables the better absorption of “imported” technology that makes full use of technological spillover from foreign investment These units played an important role in organizing and nurturing the industrial cluster in the very beginning of development.

Besides joint venture with foreign companies, there were also joint venture between domestic state-owned firms, mainly between the firms under jurisdiction of state ministry and firms under the jurisdiction of Guangdong province. These joint domestic firms settle on network-base strategy of growth drawing upon personal trust and informal agreement among managers. Moreover, the ally of these state-own companies was always accompanied by tasks of developing a specific leading product technology. Moreover, Shenzhen City Government also initiated the direct investment in high-tech companies to nurture new growth opportunity and attract high-end foreign investment.

The inter-firm linkages of production, information and technology have been built with the growth of these Chinese firms allying between each other under the state order as well as with the foreign firms. In 1986, Shenzhen Electronics Group Company (later as Saige Group) was established under the approval of Shenzhen City Government, which unifies 117 companies among all the 178 companies in Shenzhen on voluntary basis. In 1988, Shenzhen Electronics Group Company arranged the construction of the first specialized electronic parts supply market in China “Saige Electronics Supply Market”, which is a remarkable milestone in organizing the supply chain of electronics industry in Shenzhen. Within this organizational arrangement, information and production opportunities is more frequently shared among

member companies. In this way, a tacit base of interaction in complex activities such as innovation based on shared values and common norms has take form

The foreign investment in Shenzhen was only experimental at first and does not constitute the pulling motor of development in Shenzhen. However, it did bring new management concepts to Shenzhen asides from the advanced equipments. Combing with Shenzhen's special background as the experimental field of opening policies, the revolutionary rate of institutional reform remained quite high and many private firms upspring from the state-owned companies and flourished quickly in 1990s. In fact, the development of electronics industry in Shenzhen was triggered by large domestic state-owned firms, but its vital growth is sustained by the growing small and medium sized firms. Compared to Beijing and Shanghai, where large state-owned companies and multinationals takes the leading role, Shenzhen is known for the progressing domestic private economy.

From the above discussion, it can be drawn that the development of electronics industry in Shenzhen is strongly supported by ex ante and planned involvement of state authorities and institutes and echoed with trend of the global industrial shift of electronics industry to low-cost regions in 1980s (Luthje, 2004).

4.2 Institutional Setup in Dongguan since opening

With the devolution of power from the central government to town and village government, the local government in Dongguan devoted into economic growth enthusiastically and has actually become the "laboratory technician" of the opening policies.

The industrialization process in Dongguan started in garment and shoe industries during 1980s. Compensation trade, i.e. processing raw materials on clients' demands, assembling parts for the clients and process according to the clients' samples, expanded quickly in many villages and towns. The source of orders mostly came from Hongkong. Dongguan local government put great focus on encouraging the Hongkong-Dongguanese to invest in hometown. In 1981, the office of outward processing and assembly was established to organize this important task. Moreover, the village and town government also greatly supported the development of compensation trade by offering cheap land, factory buildings and favorable policies. Due to the cultural proximity and geographical proximity to Hongkong, the rapid growth benefited the Hongkong bosses as well as the local peasants. The demonstration effect and the shaping vested interests have further strengthened the focus on

compensation trade in Dongguan.

A new agglomeration of electronics firms, mainly led by Taiwanese firms, has gradually taken shape in Dongguan in the middle of 1990s. Until then, a specialized production network among small and medium sized electronics firms has already developed in Taiwan organized by the brand companies and contract manufacturers. Therefore, the shift attracted by low-cost factors to Dongguan was systematically practiced by a cluster of Taiwanese firms with complex supplier linkages. Relying on the networked production bought by Taiwanese firms, the electronics industrial chain is now complete and integrated in Dongguan with a kitting rate more than 95%. In the beginning of 21st century, the compensation trade on electronics in Dongguan has reached its peak.

In the process of industrial development based on massive foreign investment, Dongguan province has devoted much of the fiscal revenue into infrastructure construction such factory buildings, road, electricity and telecommunication to improve the investment environment. Moreover, the government also invested in human capital improvement to enhance the absorption of introduced technology. In sum, the role of institutional support is mainly directed to industry-specific and hands-on service.

Therefore, the institutional support for industrial development is rather ex post. The investment is mainly organized by the small village and town governments, which lack the ability and incentive to undertake far-sighted ex ante developmental arrangements. According to our interview with president of electronics association (Interview with Dongguan Electronics Association President Ye, 2007), the competition on attracting foreign investment among town and village governments were quite fierce at that time, which finally led to the spread of electronics firms all over Dongguan. Due to the village-based industrial development, the land use efficiency in Dongguan is quite low and it is difficult to integrate the land to form a spatial agglomeration where the firms are able to interact with each other frequently. Instead, the interaction between Dongguan electronics firms is mainly sustained by supplier linkage, which makes tacit knowledge extremely important in fostering incremental innovation.

The reform of power devolution to basic level governments has greatly mobilized the initiative of local governments to develop economy and it was cost efficient at the transition time. However, the industrial base of Dongguan was almost nothing before the rapid growth. Thereby, the local skilled labor market and related industrial institutions underdeveloped

especially in face of great profit made too rapidly by compensation trade. Until 2009, there are only 1487 domestic private companies in Dongguan, which takes only 25% of the whole economy, and the percentage of private economy in industrial output and value-added is even lower, being 16% and 15% respectively. This less endogenous development path is expected to exert impact on the long-run development of regional innovation system in Dongguan.

To sum up, institutional setup in Dongguan is repeatedly strengthened for the aim of processing trade development with the symbiotic gain of the village and town level governments, oversees Chinese investors (mainly Hongkong and Taiwan) and local peasant. Moreover, the support of institutional organization is rather ex-post to enhance the comparative advantage of the existing developmental mode of mass low-end production.

5. Econometric Results

Table 3 gives the descriptive statistics for the variables. In our sample, most of the firms are small and medium sized (86% and 87% in Shenzhen and Dongguan, respectively). The share of domestic firms in Dongguan is less than that in Shenzhen. However, the firm age in both cities is much alike both in mean values and variations. Technical staffs possess higher absorptive capacity in Shenzhen than that in Dongguan according to the share of above bachelor degree technicians. In terms of innovation behaviors, Shenzhen firms resort more to external partners in triggering innovative ideas, while Dongguan firms rely more on transfer of tacit knowledge and displays higher tendency to use informal relations such friends and business partners. Nevertheless, Dongguan firms demonstrate higher intensity of relying on internal efforts such as own ideas, license purchase and reverse engineering to get innovative ideas, which might be attributed to some extraordinary high values. Moreover, whether the internal knowledge production process contributes to innovation performance should be further investigated.

Table 3 Descriptive Statistics

	Shenzhen				**Dongguan**			
	Mean	S.D.	Min.	Max.	Mean	S.D.	Min.	Max.
Size	0.14	0.35	0	1	0.13	0.34	0	1
Ownership	0.28	0.45	0	1	0.47	0.50	0	1
Age	10.4	7.6	1	57	12.2	7.1	2	51
Educational level of technical staff	0.43	0.36	0	1	0.33	0.30	0	1
Initial technological level of main product	1.99	0.63	1	3	1.78	0.64	1	3
NPI_external partners	0.10	1.05	-2.05	2.53	-0.07	0.96	-2.78	1.69
NPI_internal efforts	0.02	0.89	-2.67	1.68	0.11	1.06	-2.61	7.43

NPI_parent comp. & foreign	-0.22	0.87	-1.81	2.22	0.27	1.04	-2.89	2.90
NPTK_active learning	-0.03	1.01	-2.10	2.57	0.06	0.95	-2.19	2.10
NPTK_passive from customer	-0.02	0.94	-1.95	2.08	0.10	1.04	-2.13	2.27
NPTK_passive from parent comp.	-0.04	0.98	-1.38	3.28	0.10	1.02	-1.38	3.21
NPInteraction informal	-0.14	0.95	-2.52	1.60	0.14	1.03	-2.53	1.60

Verifying the hypotheses, Shenzhen firms and Dongguan firms differ from each other on the factors that foster innovation. Table 4 shows the result of the ordered logit regression on product innovation performance. Three models are run as comparison, i.e., whole model pooling Shenzhen and Dongguan data, Shenzhen model and Dongguan model. All the models fit significantly better than an empty model, which is indicated by the significant level of chi-square likelihood ratio. The whole model serves as an intermediate between the Shenzhen model and Dongguan model, which reflects the difference between Shenzhen and Dongguan better.

The coefficients in the ordered logit model display the ordered log-odds scale of change to higher order by one unit increase in the predictor while other variables are held constant. For example, if a Shenzhen firm were to increase the use of local partners including domestic customer, universities and research institutes as well as sales agents in the innovation process by one intensified degree, the ordered log-odds of making better improvement on innovation performance would increase by 0.78 while other variables in the model are held constant.

Unlike ordinary least square regression, the coefficients in ordered logit regression does not show the marginal effect of one single explanatory variable on the response variable. In fact, the marginal effect differs in different level of the response variable, which is in our case the degree of improvement incurred by innovation efforts.

Table 4 Ordered Logit Regression on innovation performance

Independent variables	*Product Innovation Performance*		
	Whole Model	**Shenzhen Model**	**Dongguan Model**
Educational Level of Technical Staff	**0.009**** **(0.004)**	**0.011**** **(0.005)**	0.005 (0.006)
Ownership	**-0.40*** **(0.102)**	**-0.77*** **(0.455)**	-0.35 (0.235)
Firm Size	-0.21 (0.383)	-0.73 (0.604)	-0.03 (0.539)
Firm Age	0.016 (0.017)	**0.06**** **(0.025)**	-0.02 (0.025)
Initial Product ~~Medium tech~~	0.36	-0.26	0.35

Type according to technology	vs. low tech[2]	(0.274)	(0.460)	(0.357)
	High tech vs. low tech[2]	0.59	0.30	**1.16****
		(0.385)	(0.576)	**(0.578)**
NPI_external partners		**0.42*****	**0.81*****	0.27
		(0.154)	**(0.267)**	(0.202)
NPI_internal efforts		**0.30****	**0.78*****	0.10
		(0.142)	**(0.255)**	(0.168)
NPI_parent comp. & foreign		**0.31****	0.21	**0.40****
		(0.142)	(0.249)	**(0.189)**
NPTK_active learning		-0.04	**-0.41***	0.11
		(0.149)	**(0.229)**	(0.215)
NPTK_passive from customer		-0.01	**-0.64*****	**0.39****
		(0.138)	**(0.214)**	**(0.197)**
NPTK_passive from parent comp.		0.02	-0.04	-0.09
		(0.141)	(0.227)	(0.199)
NPInteraction_informal		-0.03	0.03	-0.19
		(0.144)	(0.232)	(0.190)
Prob > chi2		0.001	0.000	0.015
Pseudo R2		0.04	0.09	0.06
Number of Observations		230	107	123

1. Standard errors in parentheses; *p<0.10, **p<0.05, ***p<0.01.
2. Initial product as low tech as the default group, which means low tech as 0, the other as 1;
3. T test of whether the overall effect of the categorical variable is statistically significant.

Observing firstly the variables indicating the behaviors in the various stage of product innovation process, Shenzhen firms combine its internal absorptive capacity with external interaction with other partners to trigger innovation ideas, which finally boosts the innovation performance. In the highest level of cluster development, the interactive learning does not only contribute to effective knowledge transfer, but also trigger the innovation and thus gain new creative resources drawing on the complementary knowledge of actors in the cluster (Capello, 1999). This indicates the strategy and capacity of Shenzhen electronics firms to capitalize on wider source of knowledge spillover, including domestic customers, sales agents, universities and research institutes.

On the other hand, innovation ideas originating within strict hierarchical organization, i.e., instructions from parent companies, boosts innovation performance for Dongguan firms. Moreover, technical know-how and experiences from the domestic and foreign customers plays important role in fostering innovation. Nevertheless, reliance on parent companies' instruction of tacit knowledge does not significantly improve the innovation performance, which indicates a certain degree of maturity of cluster development in Dongguan. Compared to the innovation activities in Shenzhen firms, the limited capacity to draw upon wider scope of external source to foster innovation reflects the bottleneck of upgrading in Dongguan, where innovation mechanism is restricted to the hierarchical order as well as to the transfer of

tacit knowledge within supplier linkage.

What is worth mentioning here is the significantly negative effect of tacit knowledge either by actively sending employees to learn technical experience or passively having engineers sent by other partner to instruct technical experience. This might be related to the loss of technical staff in the process of gaining tacit knowledge. The higher absorptive capacity of the technical staff in Shenzhen firms than those in Dongguan enables them to absorb the knowledge from other organizations more effectively and identify the opportunity with higher salary and position. However, it should be cautiously interpreted because the labor mobility among local firms should contribute to effective interactive learning process as a whole economy (Arrow, 1962, Almeida and Kogut, 1999). The significantly positive effect of technical staff's educational level for Shenzhen firms again verifies this argument, as firms gain spill-in human capital and its carried knowledge while losing others in the process of tacit knowledge transfer. Song et al. (2003) further points out that the effect of learning by hiring in fostering innovation can be strengthened when hired engineers are assigned for exploring technologically distant knowledge rather than reinforcing existing core competence.

Moreover, the difference in the significance level of control variables confirms the hypotheses from the other point. For Shenzhen firms in our sample, older firms tend to have higher performance in product innovation. This variable demonstrates the long history of capability accumulation related to innovation activities such as in technological development, management optimization and market research, which all together contributes to higher absorptive capacity and higher effectiveness in bringing out better innovation results. On contrary, the insignificant small impact of firm age on innovation performance for Dongguan firms indicates the firm strategy and capability is just newly developing around innovation-related activities. However, firms producing high tech electronics products when started, which indicates higher absorptive capacity, perform significantly better than firms producing low tech electronics products when started in Dongguan. In a word, firms in Dongguan rely more on the routine accumulated gradually within the firm boundary instead of complementary knowledge outside the firm than Shenzhen firms, leading to the lack of dynamism and incentive to trigger innovation.

In order to test the robustness of our results, we take the average score of evaluation on the degree of improvement on function expansion and categories upgrading as the dependent variable. Due to the censoring of this variable, tobit regression was run. Results are not

displayed due to the limited space. The coefficient sign and significance level is consistent with that in the ordered logit model, except for the impact of ownership is significantly negative in the Dongguan model of tobit regression.

6. Discussion and Conclusion

Institutionalist perspective towards regional development is characterized by supply-side support, which aims at providing supportive resources, securing collective actions and establishing the strategic goals (Hausner, 1995). This paper explores the capacity of different levels of institutional setup, i.e., the top-down and bottom-up approaches, in accomplishing these tasks. By investigating on the context-specific scenarios in two cities in China, which corresponds to the two institutional setups since the beginning of industrial development, this paper gives insight into how institutional setups shape the innovation behaviors, leading to divergent dynamism for regional development and upgrading. It appears that top-down institutional setup is more competent in providing innovation-related resources and adjusting the developmental path with strategic intervention than the bottom-up one, which all together widens the scope of interactive learning and shapes the behavioral rationalities of firms to resort more to external complementary knowledge.

While the newly recognized strand of bottom-up institutional supply supports its competency to mobilize the local resources and interdependencies (Amin, 2002), the result suggests a rather contrasting pattern, indicating this approach might lead to negative lock-in effect in face of restructuring and upgrading by restricting the firms within the repeated and narrow path of knowledge accumulation and generation. As institutional setup is subjective to context and sensitive to path-dependency, the discussion on the role of institutional setup on regional development and innovation should be cautiously interpreted. It should be remembered that the two cities in our analysis started the rapid industrialization out of nothing, that is to say, with nearly no endowment on local skills and industrial base. In this case, the bottom-up approach tends to restrain the scope of development within the disposal of less competent local authorities. The “grassroots” industrialization, which grows out of barren sand of local endowments, bears the risk of negative lock-in in the need of innovation and upgrading. Relocation of Taiwaness PC investment from Dongguan to Suzhou is potent verification of this argument, in which local initiatives to foster strategic coupling with global lead firms fails in spite of Dongguan’s first-mover advantage (Yang, 2009).

On the other hand, the empirical finding on the positive role of top-down institutional setup in shaping innovative synergies among the firms and innovation-related agents should not be viewed as arguments favoring the central planning way of development in Keynesian legacy. In fact, the developmental path of electronics industry in Shenzhen is actively integrated within the reorganization of global production network, boosting a plurality of autonomous agents with respective strategic goals in the transition economy. In this way, local assets and “untraded” norms develop based on the endowments provided by higher-scale organizations and the strategic framework encouraging dynamism.

In the early phase of industrialization, in which little skills and industrial routines exist in the local scale, it is concluded from our results that top-down approach outperforms bottom-up approach in shaping dynamic and reciprocal innovative synergies with its evolving to meet the need of restructuring. However, the bottom-up approach, which greatly mobilized the initiative of local governments to develop economy, was cost efficient as the national authority had limited resources to initiate top-down institutional approach that supports sustainable development throughout the whole country.

For clusters that developed out of bottom-up institutional setup in early phase of industrialization, two lessons can be learned. Firstly, strategic plan of industrial development should be carried out in order to avoid negative lock in, timely adjusting the developmental path to meet the changing market environment and identifying related new industries. Moreover, institutional setup should be accordingly regulated to unfasten the vested interests among the groups aiming at contrasting development goals. Secondly, policy focus should be put upon enhancing the absorptive capacity of firms and related organizations such as attracting high quality human capital and encouraging the accumulation and development of technological capabilities in firms.

With the development of local industrial clusters, experiences of building a sustainable territorial innovation system can be further borrowed from Europe and the USA where innovation institutions are mature. Even for the Shenzhen case in our analysis, the capacity of institutions in forming systematic linkages and interaction among innovation agents is still underdeveloped. In Europe, economic agents depend to a significant degree on public institutions in fostering innovation activities, while in the USA, the role of private institutions such as banks and venture capitals is prominent in organizing systematic learning and innovation. Ultimately, if the institutional setup is competent in performing inclusive,

monitoring, consultative and networking feature, it is more likely to allow high potential regional innovation system.

The transitional scenarios of institutional setup in China offer the opportunity to study the impact of institutional setup on the way that innovation is fostered from an evolutionary perspective. In the current literature of territorial innovation system, the empirical evidence on the role of institution in innovation lacks the evolutionary view due to the developed and mature institutional setup in the regions where the concept of innovation system is originated from. This paper takes the step in this aspect and contributes to the understanding of systematic innovation process embedded within a broader institutional framework. Along this line, it would be useful to explore further the specific elements of institutional setup and their co-evolving within different scales in shaping innovation strategy and capacity in a territorial innovation system. In addition, context specificity should be fully discussed before conclusions are made.

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