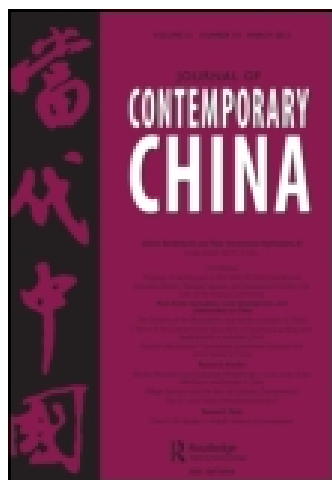


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# Local States, Institutional Changes and Innovation Systems: Beijing and Shanghai compared

TSE-KANG LENG and JENN-HWAN WANG\*

*The purpose of this paper is to look into the transformation of local innovation systems in the high-tech parks of Shanghai and Beijing and their technological learning and upgrading. The areas that we have chosen to investigate are Beijing's Zhongguancun and Shanghai's Yangpu District. The main reason that we selected these two areas for study is because they are home to most of the top universities and R&D institutes in these two cities. Our main focus will be on how institutions—the local state, inter-firm relations and the relationship between R&D institutions and firms—are co-evolving to shape and constrain a local system of innovation. Our research finds that the capacities and autonomy of the Zhongguancun of Beijing's Haidian District and Yangpu District of Shanghai differ in various aspects, but both regions are struggling to upgrade innovation and enhance economic development. The 'high-tech cluster' provides a useful instrument or label to achieve goals other than innovation and R&D. Elite universities are regarded as engines for network formation, but visible and invisible walls of Chinese universities discount efforts to foster a university-centered innovation hub which especially shows in the Yangpu case.*

## I. Introduction

Since China began its economic reform in 1978, economic development has become a dominant policy at different levels of government. Various policy tools were used to spur economic growth, most notably experimental zones or high-tech parks. Governments at the central and local levels intended to use special tax incentives to attract both local and foreign firms to set up operations in the zones in order to generate economic growth. The competition among local governments in building

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these economic zones to attract foreign investments has become so widespread that some authors have even called China's model of economic development a type of 'economy of special zones'.<sup>1</sup> In contrast to special zones in other cities and regions, where foreign investment was the major concern, economic zones in Beijing and Shanghai were assigned, and expected to perform, functions not only to develop the local economy but also to upgrade the technological level at the national level.

Under these circumstances, both Beijing and Shanghai intended to fully utilize the endowment of the concentration of elite universities and R&D institutes in their cities to create a synergy effect with local firms so as to generate indigenous innovation. The model which both cities have been imitating is Silicon Valley in the USA, where universities, R&D institutes and firms reside nearby and together can generate an innovative environment. The purpose of this paper is to look into the transformation of local innovation systems in the high-tech parks of Shanghai and Beijing and their technological learning and upgrading.

The existing literature on China's local innovation system mainly focuses on the role of the local state in building infrastructure to attract foreign capital so as to create a technological diffusion effect,<sup>2</sup> or to look into state actions that may stimulate cooperation among R&D institutes, universities and firms in specific areas. Nevertheless, few studies have investigated questions regarding how the local state at different levels in one specific area concurrently pursues technological upgrading and innovation which may or may not be able to create a local innovation system.

The purpose of this paper is to fill this theoretical gap. The areas that we have chosen to investigate are Beijing's Zhongguancun (ZGC) and Shanghai's Yangpu District.<sup>3</sup> The main reason that we selected these two areas for study is because they are home to most of the top universities and R&D institutes in these two cities. Our main focus will be on how institutions—the local state, inter-firm relations and the relationship between R&D institutions and firms—are co-evolving to shape and constrain a local system of innovation.<sup>4</sup> Our study will show that ZGC has outperformed Yangpu in terms of creating an innovation system due to its better institutional arrangements in linking various actors in the region.

Adopting institutional approaches to study technological innovation and scientific parks in China, the authors will first analyze the theoretical dimension of local states in high-tech development. In order to demonstrate the similarities and differences of the two cases, Section III provides contrasts of institutional evolution and

1. Wei Ge, 'Special economic zones and the opening of the Chinese economy: some lessons for economic liberalization', *World Development* 27(7), (1999), pp. 1267–1285; Adam Segal, *Digital Dragon: High-Technology Enterprises in China* (Ithaca, NY: Cornell University Press, 2003).

2. Y. Zhou and X. Tong, 'An innovative region in China: interaction between multinational corporations and local firms in a high-tech cluster in Beijing', *Economic Geography* 79(2), (2003), pp. 129–152; J. H. Wang, 'China's dualist model on technological catching up: a comparative perspective', *The Pacific Review* 19(3), (2006), pp. 385–403; Yu Zhou, 'Synchronizing export orientation with import substitution: creating competitive indigenous high-tech companies in China', *World Development* 36(11), (2008), pp. 2353–2370.

3. For previous work on the intrinsic relationship between the process of space production in building high-tech industrial parks and the effect on urban development, please refer to Jenn-hwan Wang and Tse-Kang Leng, 'Production of space and space of production: high-tech industrial parks in Beijing and Shanghai', *Cross Current* 1(1), (May 2012), pp. 47–73.

4. The reason that we did not select Zhangjiang Science Park in Shanghai is that Zhangjiang is designed to host foreign manufacturing firms rather than to create an environment for linking domestic R&D institutes and firms.

transformation in Zhongguancun and Yangpu. In Section IV, the authors try to identify the interaction of key actors—research universities, business communities, local states—in the process of institutional transformation and innovation. Section V continues to discuss the institutional limitations of such interaction, including institutional embeddedness, bureaucratic constraints, innovative culture and dilemmas of urban development. The concluding remarks provide a tentative assessment of the performance of the two cases under study.

## II. Local state and China's local innovation system

One of the major characteristics of the Chinese economic reforms has been its local state activism<sup>5</sup> that results in, as Segal describes, 'a national economy that looks like a mosaic of regional economies'.<sup>6</sup> Most of the existing studies either focus on local states' role in manipulating regulations by allowing local and foreign enterprises to receive maximum tax advantages and exemptions,<sup>7</sup> or on local officials' active role in facilitating the collaboration of foreign firms with local firms to maximize local firms' market share,<sup>8</sup> or on local bureaucrats' actions that try to integrate the local R&D system with domestic firms in shaping the local innovation system and promoting industrial upgrading.<sup>9</sup> Few studies, however, have investigated how the local state at different levels uses strategies to concurrently pursue technological innovation that may or may not be able to create a local innovation system.

China's R&D system has undergone a thorough transformation since 1978. In general, the tendencies of the reform were from centrally planned to local and market-oriented, from stressing state-owned enterprises' role in innovation to emphasizing the importance of non-state, high-technology enterprises, from isolation of R&D from industrial production to an increase in their integration.<sup>10</sup> One of the most representative policies to do with local and regional development was the Torch Program which was initiated in May 1988.<sup>11</sup> The main task of the Torch Program was

5. Jean C. Oi, 'Fiscal reform and the economic foundations of local state corporatism in China', *World Politics* 45(1), (1992), pp. 99–126; Jean C. Oi, 'The role of the local state in China's transitional economy', *The China Quarterly* 144, (December 1995), pp. 1132–1149; Nan Lin, 'Local market socialism: local corporatism in action in rural China', *Theory and Society* 24(3), (1995), pp. 301–354; Andrew Walder, 'Local governments as industrial firms: an organizational analysis of China's transitional economy', *American Journal of Sociology* 101(22), (1995), pp. 263–301.

6. Segal, *Digital Dragon*, p. 9.

7. You Tien Hsing, *Making Capitalism in China: The Taiwan Connection* (New York: Oxford University Press, 1998); David Zweig, *Internationalizing China: Domestic Interests and Global Linkage* (Ithaca, NY: Cornell University Press, 2002); Jenn-hwan Wang and Chuan Kai Lee, 'Global production networks and local institutional building: the development of the information technology industry in Suzhou, China', *Environment and Planning A* 39(8), (2007), pp. 1873–1888.

8. Eric Harwit, *China's Automobile Industry: Policies, Problems and Prospects* (Armonk, NY: M.E. Sharpe, 1995); Weidong Liu and Peter Dicken, 'Transnational corporations and obligated embeddedness: foreign direct investment in China's automobile industry', *Environment and Planning A* 38(7), (2006), pp. 1229–1247.

9. Weiping Wu, 'Cultivating research universities and industrial linkages in China: the case of Shanghai', *World Development* 35(6), (2007), pp. 1075–1093; Zhou, 'Synchronizing export orientation with import substitution'.

10. Evan A. Feigenbaum, 'Who's behind China's high-technology "revolution"?', *International Security* 24(1), (1999), pp. 95–126; Xielin Liu and Steven White, 'Comparing innovation systems: a framework and application to China's transitional context', *Research Policy* 30(7), (2001), pp. 1091–1114.

11. S. L. Gu, *China's Industrial Technology: Market Reform and Organizational Change* (London and New York: Routledge, 1999); Segal, *Digital Dragon*; C. Huang, C. Amorim, M. Spinoglio, B. Gouveia and A. Medina, 'Organization, program and structure: an analysis of the Chinese innovation system policy framework', *R&D Management* 34(4), (2004), pp. 367–387.

to establish high- and new-technology industry development zones in select cities that would create the environment for a linkage between R&D (universities and research institutes) and production activities in high-technology industries so as to raise the productivity of the national economy. Many MNCs also established their R&D centers in Beijing, Shanghai and Shenzhen to take advantage of tax incentives. It is against the above background that local governments everywhere in China have made an effort to develop their local economies through high-tech park projects. Due to their abundance of local intellectual endowments, the Beijing and Shanghai municipal governments have not only developed their own high-tech parks but also intended to utilize the elite universities and R&D institutes located in their cities to generate a linkage of R&D and local firms in order to facilitate so-called indigenous innovation.

The local state's role in helping the formation of a regional system of innovation has been theorized and intensively studied by many scholars.<sup>12</sup> In these studies, some common elements are stressed, including the state's role in building a friendly environment for innovation, legal framework for intellectual property rights protection, good infrastructure for firms to reside, comfortable living conditions for scientists and engineers, etc. In sum, what is needed is a milieu of innovation rather than the friendly environment for production.<sup>13</sup> Lundvall even stresses that innovation needs an environment that can generate collective learning, in which different actors can easily communicate and share ideas with others which may generate new ideas and innovation.<sup>14</sup>

In order to generate a milieu of innovation, the local state has a critical role to play. That is, it not only needs to become an active actor in building good infrastructure, but also has to attract capital to the area so as to take advantage of R&D institutes nearby. Many have already found that local states in China are very active in promoting local economic development.<sup>15</sup> Nevertheless, this local developmental state perspective mainly focuses on how a local state provides necessary and almost unconditional services to businesses, for instance, it provides specific service to returnees and foreign capital, so as to attract them to invest in the localities. This perspective, however, has not paid too much attention to the relationship among different levels of the local state and their roles in building infrastructure so as to facilitate an innovation milieu. Our case study on both Beijing's ZGC and Shanghai's Yangpu will show that the former's institutional arrangements have outperformed the latter in terms of creating a local innovation system.

12. Bengt-Åke Lundvall, ed., *National System of Innovation: Towards a Theory of Innovation and Interactive Learning* (New York: Pinter, 1992); R. Camagni, 'Introduction: from local "milieu" to innovation through cooperation networks', in R. Camagni, ed., *Innovation Networks: Spatial Perspective* (London: Belhaven Press, 1991), pp. 1-9; A. Saxenien, *Regional Advantage: Culture and Competition in Silicon Valley and Route 128* (Cambridge, MA: Harvard University Press, 1994); A. Malmberg and P. Maskell, 'The elusive concept of localization economies: towards a knowledge-based theory of spatial clustering', *Environment and Planning A* 34, (2002), pp. 429-449; H. Bathelt, A. Malmberg and P. Maskell, 'Clusters and knowledge: local buzz, global pipelines and the process of knowledge creation', *Progress in Human Geography* 28(1), (2004), pp. 31-56.

13. Lundvall, *National System of Innovation*; M. Castells, *The Rise of Network Society* (London: Blackwell, 1996).

14. Lundvall, *National System of Innovation*.

15. Oi, 'Fiscal reform and the economic foundations of local state corporatism in China'; Walder, 'Local governments as industrial firms'; Zweig, *Internationalizing China*; Segal, *Digital Dragon*.

### III. Institutional changes and local state dynamism

#### III.1. The Beijing case: ZGC and local state corporatism

Beijing's ZGC is described as the most innovative region in China. There are 68 universities (including China's most prestigious universities, Peking and Tsinghua), 213 state-sponsored R&D institutes (including the Chinese Academy of Science, CAS), and over 300,000 students in Beijing. Moreover, Beijing hosts over 36% of the honorary fellows of the CAS and Chinese Academy of Engineering. These figures all indicate that Beijing has more abundant science and technology personnel compared to all other cities in China. Together with the high concentration of R&D personnel and institutes in the Beijing area, ZGC has become the most important center for technology innovation in China. Even the biggest domestic firm, Lenovo, has established its R&D center in this area and moved its hardware production and assembly into the Suzhou and Shenzhen areas. Currently, many of China's most notable ICT companies, such as Baidu (百度) and UFIDA (用友) can be found in this area.

ZGC was originally a marketplace that existed in the Haidian District of Beijing. The emergence of this district was a completely historical incident rather than planned by the state.<sup>16</sup> In the early stages of economic reform, many non-state enterprises emerged and increasingly concentrated in Beijing's Haidian District. Most of these enterprises were spun off from state-owned units, either from the academic institutes or the SOEs.<sup>17</sup> By seeing the potentiality of further development due to the high concentration of prestigious universities and R&D institutes, in 1988, the Beijing government decided along with the central government to develop this area as the Beijing Experimental Technology Zone. Therefore, in contrast to other areas where the experimental zones were created by local states, ZGC was unique in that the Beijing government created the zone mainly in response to and after the rapid growth of non-state enterprises.

Nevertheless, while the Haidian District of ZGC emerged due to the increasing concentration of non-state technology enterprises, there are many other local districts which are also called ZGC and were well planned by the local states. In 1997, ZGC was expanded to three zones, including the Fengtai (豐台) and Changping (昌平) zones, at the same time that the ZGC administrative office, under the Beijing city government, was established to oversee coordination. In the process, the zones continued to expand. Currently, there are ten ZGC zones which are located around the Beijing municipality. These zones were created by local district governments for the purpose of attracting capital so as to create economic growth in the name of high-tech development. These zones, their locations and major economic functions are described in Table 1.

As zones in the ZGC have steadily increased from just Haidian to ten units, an obvious consequence is that the ZGC administrative office has had to bear the burden of coordination. On the surface, the functions of the ZGC administrative office are similar to other administrative offices in China, including setting up the target industries to develop, assisting firms in getting more information on financial support,

16. Segal, *Digital Dragon*.

17. *Ibid.*, p. 71.

**Table 1.** Economic zones of ZGC

Year	Zone	District	Specialization
1988	Haidian Park	Haidian	ICT, all high-tech types
1991	Fengtai Park	Fengtai	Headquarters
1991	Changping Park	Changping	All types including biotechnology
1997	Electronic Town	Chaoyang	Electronics and others
1997	Yizhuang Park	Daxing	Manufacturing for all types
1999	Desheng Park	West City	Cultural creativity
2006	Yonghe Park	East City	Cultural creativity
2006	Daxing CBP	Daxing	Biotechnology, pharmaceutical
2006	Tongzhou Park	Tongzhou	Electro-optical industry and others
2007	Shijingshan Park	Shijingshan	Media and cultural creativity industry

Source: ZGC administrative office website, available at: <http://www.zhongguancun.gov.cn/>.

bridging firms with R&D institutes, as well as mediating talents and firms, etc. In reality, what the ZGC administrative office has to do is to negotiate with district governments. One of these tasks has been to collaborate closely with district governments to set up specialized zones. The district government has its own motivation to set up a special zone for a science park, as stated above, but this has to be approved by the city government and ZGC administrative office. Therefore, the district government must convince the city government and ZGC administrative office that its plan can fit the level and types of technology that ZGC needs. Once these have been approved, the district government can then establish a special office run by a semi-governmental company to direct and manage the zone, which, in turn, is also partially monitored by the ZGC administrative office. Since the district government has the incentive to develop the local economy, it has the motivation to collaborate closely with the ZGC administrative office and follow its regulations.

Therefore, it is clear that the development of ZGC has been based on a similar local state corporatist development model to that described by Oi.<sup>18</sup> The responsibilities of the city government and ZGC administrative office are to set the required policies, to promote the ZGC label, and to attract domestic and foreign investments. The same measurements were also applied to universities.

### *III.2. The Shanghai case: local state initiatives and the realization of scientific parks*

Similar to Beijing and other areas, Shanghai also has created many science-based industrial parks in order to attract foreign and domestic high-tech investments. In the late 1990s, a new Yangpu project was installed, with the intention of imitating Silicon Valley (or ZGC) to create a new science park that is located in the area where the most prestigious universities and research institutes are based.

Yangpu is among the biggest administrative districts of Shanghai. In the 1960s, Yangpu accommodated more than half a million workers and became the major industrial center in China. The reform of Shanghai and the launch of the Pudong

18. Oi, 'Fiscal reform and the economic foundations of local state corporatism in China'.

project in 1991 marked the beginning of the decline of Yangpu District. By contrast, the traditional industries in Yangpu failed to upgrade and lost their competitive edge. In the late 1990s, Yangpu accommodated only around 60,000 workers. The economic output of Yangpu was among the lowest of Shanghai's ten metropolitan districts.

The major turning point for Yangpu was another attempt by the Shanghai Metropolitan government to rebuild Yangpu as the 'knowledge-based center' and 'innovation hub' at the turn of the century. The idea for transforming Yangpu was based on a design to utilize the intellectual resources of 14 universities (including Fudan and Tongji) and numerous research institutions located in the northern part of Yangpu. The Yangpu District developed the concept of 'tri-parties cooperation' to integrate academic institutions, high-tech parks and local communities. The tri-parties cooperation thus serves as the engine to boost the high-tech developments, amenities and urban development of Yangpu.

Given its special historical background and existing burden in urban development, Yangpu is not able to 'build' a science-based park like Zhangjiang in Shanghai's Pudong District. However, at least at the beginning stage, the local state still intends to take the lead in the tri-party cooperation framework. Reforming an area as complex and burdensome as Yangpu is a tough job. The Yangpu District government thus designs a new concept of a 'Central Intelligence District, CID' to distinguish itself from the existing CBD (Central Business District) of the Pudong District. The core of the CID is the integration of universities, high-tech human resources and community restructuring in the northern part of the Yangpu District. On the other hand, it is planned to transform the old factory buildings along the Huangpu River into enterprise incubators and recreation centers such as the Fishermen's Warf.<sup>19</sup>

The first institutional establishment as the symbol of a scientific park has been the birth of the Shanghai Yangpu Technology Business Incubator, SYTBI. Instead of direct intervention from the city or district government, SYTBI is the product of cooperation among the Shanghai Start-Up Center of the city government, Yangpu District government and the Scientific Center of Fudan University. The Shanghai State Property Company and Yangpu District government also created a joint venture, the Yangpu Knowledge Incubator Company, to shoulder major responsibilities in the construction of a new university town in Yangpu. This district-owned enterprise is a combination of constructors, investors and administrators. The Office of the Leading Group of Yangpu Knowledge-based Park is also located within the enterprise. The major task of this office is to coordinate various sectors to facilitate the growth of the start-ups.

In contrast to the outmoded top-down thinking of 'creating' a knowledge-based community, the Yangpu government perceived the need for fostering an innovative culture in the community. In the early stage of the tri-parties cooperation project, the Yangpu leadership indicated the adjustment of the role of the government to one of encouragement instead of guidance. In addition to the improvement of urban infrastructure, the improvement of the regulatory regime is also the core of perfection.

19. Jianqiang Li and Qiyu Tu, *Daxue Xiaqu, keji yuanqu, gonggong shequ liandong fazhan* [Cooperative Development between Universities, High-Tech Parks, and Local Communities] (Shanghai: Shanghai Shekeyuan chubanshe, 2007).



Another salient characteristic of the Yangpu case is the rising role of the district government in economic policymaking and implementation. In contrast to the ZGC and Zhangjiang cases with strong state directives, the district government took the initiative to push the Yangpu case forward. According to the authors' interviews, the Yangpu District government provided the grand design to reconstruct the region and introduced the concept of tri-party cooperation to elevate the knowledge-based economy.<sup>20</sup> Based on the blueprint of the Yangpu project, the Shanghai Metropolitan government offered related institutional support. In addition, the Yangpu District government enjoys more autonomy in public finance. Financially speaking, the metropolitan and district governments are in a situation of being 'upside down' (倒掛 *dao gua*). A leading scholar in a public think tank in Shanghai indicated that the Yangpu District government has even reached outside the Shanghai metropolitan area to expand its influence. Recently the Yangpu District government has reached a deal with Yancheng City in northern Jiangsu Province. According to the deal, Yancheng City will provide a large piece of land for start-ups from incubators in Yangpu District. This deal was solely negotiated between Yangpu and Yancheng, and the Shanghai Metropolitan government did not intervene.

#### IV. Universities, institutional innovation and local development

##### *IV.1. Beijing: alliances between top brains and business incentives*

In addition to efforts by district governments to build scientific parks, universities in Beijing are granted the right to develop and they are also interested in creating special zones for high-tech development. The universities, following the guidelines of the Torch Program, tend to establish their own high-tech industrial parks to generate university-firm relationships. They have their own interest and autonomy in developing a science park. Almost every prestigious university in Beijing has its own industrial park, including the most prestigious Peking and Tsinghua Universities. We can use Peking University as an example to see how the university develops its industrial park. For example, according to our interviews,<sup>21</sup> Peking University has its own incubation center and industrial park. The former currently has 40 small firms within its campus borders, many of which were started by professors from this university, while some of them were started by returnees, and the rest by people from other areas in Beijing or other localities in China. These start-up firms can stay in the incubation center for about three years. In the incubation stage, the center helps the firms look for knowledge and technologies in the university. In the process, the firm can also apply for a seed fund provided by the center (up to RMB 300,000, equivalent to US\$42,000; US\$1=RMB 7) in order to develop and to look for further investment from venture capitalists.

Peking University has established a science park on campus with investment that includes a five-star hotel. Our interviewees informed us that this investment amounted to about US\$250 million and was totally funded or borrowed from banks by the university. Many factors contribute to the university's ability to sustain such an

20. Yangpu interview, 20 February 2009.

21. Beijing interview (Peking University), 10 August 2009.

enormous investment. First, it was due to the Chinese government's ambitious policy in higher education that sought to bring China's elite universities up to the level of the world's best. Some of the elite universities, including Peking University, gained enormous financial support from the central government. Second, it was also due to the fact that many top universities have their own enterprises that can generate revenue in contributing to the universities' financial leverage. For example, Peking University has Fangzheng (方正) Electronics, while Tsinghua University has Tsinghua Unis (紫光) Corp. Third, it was also due to the fact that universities in China have the flexibility to receive loans from state-owned banks to aid development. In most cases, the state-owned banks like to loan money to universities due to the low risk of the universities' defaulting on repayment. Therefore, the banks were not very worried about their loans potentially not being paid back.

The university's activities in bridging R&D and industry have indeed created some positive effects. Many emerging firms have been created by the university's incubation center. The university's science park has also hosted many global and domestic firms, both small and large. The most successful example is Tsinghua Science Park, in which Google, IBM, Oracle and many others are located. The park, which is affiliated with CAS, is also home to Intel and AMD. ZGC has indeed attracted many domestic and foreign firms to take up residence; also, due to the abundance of R&D resources, many new firms have been created in this area to take advantage of these resources.

The achievement of ZGC in becoming the most innovative area in China has been a process of institutional evolution and learning. At the initial stage in the early 1980s, the area emerged spontaneously. As the state recognized it as the most important technology zone in China, ZGC adopted a local state corporatist model in developing high-tech industry in the process. When the existing areas were full, it also allowed other district governments to join in the high-tech zone development game. Therefore, ZGC has transformed from only one zone at first to three, and then finally to ten zones by 2007. In addition, it is also due to the financial incentives of district governments, universities and R&D institutes in promoting local and institutional development that ZGC has been able to expand at such a high speed. The synergy of state policies and local state initiatives has created an effect of booming high-technology in ZGC. We can use the development of the software industry, which up until now has been the most successful one in ZGC, as an example to illustrate the formation of its local innovation system.

The core area of ZGC in developing its high-tech industry was located in Haidian District where major universities and R&D institutes were located. As the ZGC science industrial park was created and universities' science parks were built, many multinationals (MNCs) and domestic firms moved into these parks to enjoy tax incentives and abundant human resources nearby. From the other side, firms have strong incentives to locate (or establish operations) in ZGC. The MNCs' motivations were to utilize the low-cost human resources from the top universities to lower their costs and to penetrate the domestic market. One reason for this is that, in contrast to IT hardware whose production procedures can be universalized, IT software products have to adjust to local language, special needs and customs. That is, the utilization of office and middleware software has to be indigenized. To fulfill this demand, the

MNCs have little option but to depend on local people and local firms to expand their market share. Therefore, all the major software MNCs, such as Oracle, Sun and Cisco, collaborate with local firms to sell their products. It is also through this collaboration that the MNCs have trained local engineers on related knowledge and through which knowledge diffusion has occurred.<sup>22</sup>

Secondly, those large state-owned firms also have incentives to locate in ZGC due to the convenience of consulting with top scientists in universities and R&D institutes. In general, these firms are mainly targeted at developing embedded software to be used in IC chips or software based on alternative systems such as Linux. According to our interviews,<sup>23</sup> although they may not be able to attract the most talented engineering graduates from top universities, due to level of salaries, they still offer highly competitive positions when compared to private firms. Moreover, Beijing's city government established a semi-official association based in the Haidian District to promote the collaboration of state-owned firms with universities to develop software jointly. One of the most significant developments was the Changfeng (長風) Open Standard Software Platform Alliance through which the Chinese state intended to use the collective resources to develop a Linux-based system that could compete with the Microsoft-dominated system.

Thirdly, big private-owned local firms also wanted to use the abundant human resources in Haidian District to develop their own products. There are a number of very successful firms in ZGC that originally were key agents for MNCs to distribute and install software products; for example, UFIDA (用友) was originally an agent for Oracle. In the Chinese market now, the high-end office software market is mainly dominated by MNCs. The lower end, however, is dominated by local firms whose technological capabilities have largely been learned from MNCs and from collaborating with local scientists. For instance, the most innovative local Enterprise Resource Planning firm, UFIDA, learned extensively from MNCs (mainly Oracle) in its formative stages and then began to develop its own office software that was targeted at enterprises in smaller cities or smaller enterprises in big cities. Since UFIDA was able to enter the market where MNCs were not operating or instead had chosen to ignore, it then began to take off and recently has become the biggest ERP software firm in China. In the process, UFIDA has collaborated with university professors to develop and improve new products, and in recent years it has begun to enter into the higher-end market with the intention of confronting MNCs head-on in big cities.

The transformation of ZGC has largely reflected the historical transition of China's innovation system since the early years of reform. The development of the software industry in ZGC has shown that the geographical proximity between firms and R&D institutes is indeed convenient for firms looking for scientific advice. The R&D institutes in ZGC have also played a role in nurturing new small scientific firms. Those factors, together with local states' endeavor to promote their local economies, have helped the formation of a local innovation system.

22. Zhou and Tong, 'An innovative region in China'.

23. Beijing interview (manager), 21 November 2008. We have conducted intensive interviews in Beijing during November 2008, August 2009 and January 2010. The total interviewees numbered about 30.

#### IV.2. Shanghai: reinforcing entrepreneur universities and the 'Tongji model'

As the preceding analyses on ZGC demonstrate, higher educational and research institutions play key roles in facilitating institutional innovation and change. The 'tri-party cooperation' is more than the creation of interface mechanisms between university and industry such as a liaison or transfer office to assist existing firms or create new ones. Most fundamentally, the faculty of universities view their research and teaching in a new light, looking to contribute to technology transfers and firm-formation as well as to the education of students and advancement of knowledge.<sup>24</sup>

Similar to ZGC, the anchor university of Yangpu has played a key role in promoting the emergence of start-ups through university-owned incubators. Fudan University, for example, hosts the national scientific parks and incubators located in Yangpu District. Tianchen, one of the Fudan-incubated companies, has successfully promoted itself as the leading firm in anti-counterfeiting and other related fields. Companies like Tianchen have used Fudan as a label to upgrade their status as high-tech companies. However, the major task of Fudan is to foster these start-ups and transform them into 'normal' instead of 'university-owned' enterprises.<sup>25</sup> Normally the Yangpu District government holds 20% of these university-based scientific parks. These university parks co-exist with other district-owned parks such as the Wujiaochang High-Tech Park. The major administrators of the latter are also former faculty members of universities within the Yangpu District. In other words, the 15 universities of Yangpu have provided ample human resources to connect the academics and new start-ups in the region.

However, there exists a gap between the 'ideal type' of university-led knowledge-based economy and the current situation in China. As the analysis on ZGC shows, China is strong in the basic research areas. However, only about 10% of its research outputs are transferred into industrial products with market values. Moreover, most of the Chinese universities establish links only with big enterprise groups. Small and medium-sized firms are excluded from such limited alliances. Universities in Yangpu District have begun to undertake the task of integrating with the local communities by spreading knowledge. Since 2006, prominent professors from Fudan and Tongji have established contacts with the local communities by organizing forums in the general fields of natural and social sciences. Topics at these forums include issues within the domains of environmental protection, international affairs, urban management, general physics and bioscience. These prominent professors have also visited local elementary schools and high schools to give talks. This extension education is a common practice of universities in the West. However, a closer interaction with local communities is still a new phenomenon in China at the current stage.

Our field research and interviews demonstrate that the Tongji experience has far-reaching effects for developing a knowledge-based economy in the region.<sup>26</sup> The cluster of design houses around the Tongji campus was not 'invented' by the university or the

24. Henry Etzkowitz and Chunyan Zhou, 'Regional innovation initiator: the entrepreneurial university in various triple helix models', paper presented at *Triple Helix VI Conference*, hosted by National University of Singapore, Singapore, (16–18 May 2007).

25. Ronghua Wang, ed., *Shanghai yangpuqu chanye fazhan yu minsheng wenti diaoyan baogao* (Shanghai: Shanghai Academy of Social Sciences, 2008), ch. 8.

26. Intensive field research in the Tongji University area was conducted in August 2009 and January 2011.

district government. Compared with its more prestigious neighbor, Fudan University, Tongji does not boast large-scale affiliated enterprises and incubators. The design cluster is purely bottom-up and grassroots oriented. The surrounding area gradually creates the spill-over effects to attract small firms from other areas. The regional amenities and culture of sharing still need a period of time to grow. However, the nascent atmosphere of a breeding ground of innovation has gradually emerged.

In contrast to the ZGC model of IT-oriented incubation, Yangpu has attempted multiple forms of fostering innovation and new industries. For instance, Tongji University identifies itself as the 'Silicon Valley of Design' in China. Tongji also emphasizes its strength in the fields of urban planning and architectural design. In the beginning stages of Yangpu's development about eight years ago, Tongji professors and graduate students established numerous small-sized design houses along Chihfeng Street outside the Tongji campus near Wujiaochang. The mushrooming of such small companies created autonomous, bottom-up dynamics of cluster formation in the region. The university and district government will intervene after the formation of a design cluster. For instance, Tongji University recently purchased a large piece of land along neighboring streets and attempted to transform it into a world-class design center for automobiles. After the realization of the Chihfeng Street experience, Tongji University has selected urban planning, environmental protection and industrial design as their three pillars of the university-supported incubator.

In the case of rejuvenating Tongji University and the surrounding areas, the Management Committee of Yangpu High-Tech Park (MCYHTP) coordinated with the district government to transfer the abandoned bus station on the Siping Road into a creative and innovation complex for the school of design. The alliance between Yangpu and Tongji even negotiated with the Shanghai Metropolitan government about the location of exits from subway lines. The new exit is now just outside Tongji Square, steps away from the creative and innovation complex. Another case of the Tongji Circle of Knowledge is the renovation and transformation of the existing city-owned design houses into a complex of Tongji Science Park. This project also accommodates the Shanghai International Design Center designed by famous Japanese architect Tadao Ando.

The Tongji Knowledge Circle provides a vivid case of combining district development and science park development. The formation of the cluster of design was more or less an unexpected result of the real estate investment. During our interviews and field research in Tongji University, we noticed that the most successful incubator on the Guokang Road adjacent to the Tongji campus was originally used as commercial residential housing for sale. Due to its design as small apartment units, small- and medium-sized design companies found it to be convenient and gradually formed a cluster within the apartment building. Hudong Science Park, located on the Chifeng Road in the southern rim of the Tongji campus, is now one of the most successful design clusters in the area. Siping Street Office of Yangpu formed a strategic alliance with the state-owned Fishing and Machine Research Institute to develop the old courtyard and transfer it into an office building. Because of its closeness to Tongji University, the commercial building gathered more than 50 design companies. The district government then undertook the improvement and renovation of the Chifeng Street area. A design cluster finally emerged after 2005.

## V. Coping with institutional weakness in supporting innovation

Both Zhongguancun and Yangpu are facing institutional constraints to enhance and deepen innovation. This relates to the following institutional constellations that generate the fragmentation of R&D systems and de-linkage of R&D institutes and firms. These institutional weaknesses could be analyzed using the following dimensions.

### V.1. Institutional embeddedness of the Chinese system

The two local cases discussed in this article are embedded in the existing institutional arrangements of China as a whole. As ZGC has evolved to become a local innovation system, though it nevertheless has its own weaknesses. For instance, the university–firm collaborations mainly occur in transferring existing knowledge rather than generating new knowledge through mutual collaboration and co-development. As Liu and White have stressed, the Chinese tapping of foreign sources has focused more on embodied and codified technology (instruments and equipment, drawings and software, production lines) rather than intangible assets.<sup>27</sup> This is because ZGC, in contrast with Silicon Valley and Hsinchu Science Industrial Park in Taiwan, lacks a friendly institutional environment in which favorable conditions for networking and deep technological learning can develop.

The Chinese national innovation system induces competition rather than collaboration between R&D institutes and industrial firms due to the fact that most R&D funding up until recently has been supplied mainly by state agencies.<sup>28</sup> Although there is a tendency for the state to encourage in-house R&D at the firm level, the major funding for R&D still comes mainly from the government's budget. In this case, state-sponsored R&D institutes, universities and firms that are applying for funding are largely overlapping, which, in consequence, results in competitive rather than collaborative relationships between R&D institutes and firms.

Furthermore, the R&D institutes tend to conduct research that is not directly related to the needs of industry.<sup>29</sup> The state-sponsored R&D institutes are targeting frontier technologies or basic research, however, what the local firms need are not these frontier technologies but the mid-level technologies which can support them to compete in the market. As a consequence, as our interviews<sup>30</sup> show, managers of local firms indicate that the local R&D institutes can only provide them with information and consulting functions rather than R&D collaboration. The purpose of local universities for them is essentially to supply them with cheap and good graduates, not product development.<sup>31</sup>

27. Liu and White, 'Comparing innovation systems', p. 1103.

28. *Ibid.*, pp. 1091–1114; Cong Cao, 'Technological development challenges in Chinese industry', in Elspeth Thompson and Jon Sigurdson, eds, *China's Science and Technology Sector and the Forces of Globalization* (Hackensack, NJ: World Scientific Publications, 2008).

29. *Ibid.*; X. L. Liu and N. Lundin, 'Toward a market-based open innovation system of China', paper presented at Orebro University and Research Institute of Industrial Economics, (10 September 2010), available at: <http://unpan1.un.org/intradoc/groups/public/documents/APCITY/UNPAN027030.pdf>.

30. Beijing interview (manager), 19 November 2008.

31. Zhou, 'Synchronizing export orientation with import substitution'.

## V.2. Bureaucratic hurdles to link universities with innovational mechanisms

In addition to the lack of cooperation between major research institutions and firms, the universities themselves fail to play the role of a bridge to integrate regional innovation interests with research capacities. Such constraints are rooted in the bureaucratic culture and hierarchies in Chinese universities. The case of Yangpu demonstrates such puzzles. The university, the scientific park and the district government have their separate calculations of interest. Policy supports to the innovation business are still limited to 'hardware' construction in the Yangpu District.

Our interviews show that among the three parties of interaction, the district government is still the most active.<sup>32</sup> In theory, Yangpu is home to 'four bigs'—big enterprises, big universities, big hospitals and big research institutions. These 'big' institutional settings provide rich resources and human power to buttress Yangpu's economic development. In practice, however, these 'big' have their own administrative affiliations with the central government. They operate according to 'national' instead of local interests.<sup>33</sup> In other words, they are 'enclaves' instead of integrative components of Yangpu. The 'spill-over' effects from these institutions to the local economy are therefore limited.

In practice, 'localization' is not high on the agenda of prestigious universities like Fudan. There exists a huge gap in capacities, resources and enthusiasm between major universities and the Yangpu District government. In addition, universities like Fudan enjoy a prestigious status under the Ministry of Education at the central level. Yangpu is a metropolitan district, and the status of the leader of Yangpu is equivalent to the 'bureau' level in China's bureaucracy. However, Fudan recognizes itself as being in the 'central' instead of the local level. It even focuses on its status as a 'global university' or 'top university in China'.

The top-down decision-making process at the highest level within the knowledge-based networks may encounter distortion during the process of implementation at the grassroots level. Silicon Valley grew up from the incentives of engineering schools and individual departments at Stanford University to transform basic research projects into innovative spirits. In the case of Yangpu, decisions from the top leadership of the universities could guide the general direction, but fail to provide enough incentives for individual departments and research faculty to descend from the ivory tower.

In brief, the district government is indeed in urgent need of utilizing the alliances of innovation to upgrade and rebuild the outdated city landscape and infrastructure. According to the preceding analyses, the universities have visible and invisible walls to isolate themselves from the other two parties. Practically speaking, a substantial 'scientific park' does not exist in Yangpu District. The district government has to cope with numerous small- and medium-sized enterprises (SMEs), MNCs and development complexes like KIC. In the case of Yangpu, the scientific park is an abstract entity, not a concrete one. Moreover, the Yangpu District government is short of providing substantial financial support to these SMEs. Large construction projects are supported by the Shanghai Metropolitan government. The linkage between the district government

32. Yangpu interview, 13 August 2009.

33. Jianqiang Li and Qiyu Tu, *Daxue Xiaogu, keji yuanqu, gonggong shequ liandong fazhan*, p. 148.

and enterprises becomes ambiguous. The three parties have separate institutional constraints. Ideas and calculations by these three parties are also different.

### *V.3. Culture factors of institutional innovation in ZGC and YP*

Our study also finds that the innovation system in China seems to have a feature of low levels of trust and shows little interest in building local networks. This can be shown in ZGC's innovation system. The interest of MNCs in setting up R&D centers in this area is to recruit the most talented people without showing any interest in networking with local firms. The universities and research institutes are interested in applying for grants out of the state's science budget and have little interest in building local industrial networks. Moreover, the local firms are more interested in seeking opportunities to expand their market share in this booming economy rather than in cooperating with other firms to deepen their technological capability. As Zhou shows in her field research, 'When we asked the manager of a Chinese hardware company about the company's partnership with other Chinese firms, the immediate response was blunt: ZGC firms do not cooperate with one another'.<sup>34</sup> Our field research in ZGC shows similar findings. Zhou attributes this lack of networking among local firms to the institutional roots of Danwei (單位) mentality, or the so-called 'big and complete' or 'small and complete' systems.<sup>35</sup> We suggest instead that it is also due to the legacy of the socialist system that generates distrust among people on the one hand, and the high competition among firms due to their similar level of technologies which engenders horizontal competition, rather than collaboration, on the other.

The problem of a low-trust society also influences the innovation mechanism in Yangpu. However, the case of Yangpu reflects the emerging culture of social networks between SMEs and second-tier universities. Instead of the traditional style of strong intervention by central and local states in providing preferential treatments, the Yangpu District relies on more flexible social networks to attract start-ups and local firms. During our field research, employees of Wujiaochang Science Park (WSP) indicated that the major focus of their networks was embedded in the existing social capital with SMEs. Some of these smaller firms have prior connections with university faculties and alumni. The general manager of WSP, for example, was a professor at Shanghai Ocean University. Adopting a relatively low profile, the WSP and local Yangpu cadres have developed a network of co-existence to develop new connections with SMEs. Currently, within the two humble buildings of WSP, about 1,000 small firms have developed their bases for further expansion.

### *V.4. Urban development as the core of institutional innovation of local states*

Both ZGC and YP are undertaking dual tasks of institutional innovation and urban district reconstruction and development. In some aspects, these two tasks may have conflicts of interest. Similar to other rapidly developing regions in China, the leaders of the local state in ZGC put economic growth in the area as their major political

34. Y. Zhou, 'The making of an innovative region from a centrally planned economy: institutional evolution in Zhongguancun Science Park in Beijing', *Environment and Planning A* 37, (2005), p. 1127.

35. *Ibid.*, p. 1128.



mission in order to enhance their future political career prospects. In an urban area such as the Haidian and Fengtai Districts, the real estate sector naturally becomes the major target for promoting economic development. The urban restructuring of the area and the emergence of blocks of high-rises indicate the booming economy, which in turn becomes the basis for the local state to persuade MNCs to locate R&D centers to the area. The strategy has been very successful indeed. However, the downside of this rapid development of the real estate sector in recent years is that it has pushed up the rent costs to a level that is not conducive to the survival of start-ups or smaller firms in this area. According to our interviews,<sup>36</sup> many smaller start-ups have already moved out of this expensive area and sought cheaper places on the outskirts of the city in order to survive. The local state's pro-growth strategy has greatly improved the image of this area. This, however, is a strategy that pursues short-term growth at the expense of long-term innovation investment.<sup>37</sup>

The culture factor and the learning curve are two important components for a new model of innovation to emerge. Since Deng Xiaoping's southern tour in the early 1990s, Shanghai has accumulated experiences in the manufacturing industries and transformed the Yangtze River Delta region into the 'world's factory'. District governments in Shanghai have learnt how to attract foreign direct investment to boost manufacturing capacities in the region. Local governments are also adept at building development zones and technology parks to host foreign as well as domestic enterprises. However, promoting a knowledge-based economy is a novel idea for most of the district governments in Shanghai. Most of the local districts in Shanghai have launched their programs of 'innovative industries' and adopted attractive slogans like 'modern service industries'. However, they are only copying experiences from the manufacturing sectors and trying to apply them to the service sector. District governments endeavor to 'rebuild' facilities for innovation and, in so doing, raise the prices in the real estate market. As the district governments get rich and apartment buildings become more luxurious, the goal of becoming an innovation hub becomes more remote.

## VI. Conclusion

The cases of Beijing and Shanghai provide two contrasting models of innovation development in China. Zhongguancun, the hub of China's IT software industry, is characterized by the interaction among the administrative office, elite universities and clusters of IT companies. Although the ZGC administrative office has limited power to intervene and control university-based science parks, these parks nevertheless have created a 'cluster effect' that is buttressed by the geographical adjacency of IT firms and China's top research units. Our research also indicates that due to the overlapping fund sources and the missing linkages between basic research and applied sciences, ZGC is handicapped by the lack of trust among firms. Such institutional weakness is worsened by the fact that local leaders put economic development ahead of innovation as their top priority to protect their political futures.

36. Beijing interview (manager), 15 November 2008.

37. J. H. Wang, 'Divergent routes from catching up toward innovation: South Korea and Taiwan compared', *The Journal of Development Studies* 43(6), (2007), pp. 1084–1104.

In contrast, the development of Shanghai's Yangpu District provides another case of attempts at creating a local innovation system in China. We argue that the Yangpu case symbolizes a hybrid model of reforming the innovation system. Similar to ZGC, major universities operate their own science parks in the district. However, the Yangpu District government actively promotes the formation of a 'tri-parties cooperation' among university campuses, scientific parks and local communities. The district government has even established its own scientific parks and incubators to facilitate the transition to a knowledge-based economy. Nonetheless, while we have witnessed a prestigious university like Fudan endeavoring to build national-level labs and incubators, other leading universities such as Tongji are also helping to breed small- and medium-sized indigenous design houses, but the institutional barriers between district government and universities are still too huge to bring them together to form an active innovation system. Instead of promoting the combination of homegrown IT firms and MNCs as we have observed in ZGC, the Yangpu District government until recently has better performed in building infrastructure and the real estate sector than in creating networks among universities, firms and R&D activities. There are huge institutional hurdles to be overcome (Table 2)

In contrast to the traditional approaches of treating the city government as a whole, our research relegates the level of analyses and focuses on urban districts in two of China's centrally administered metropolitan areas. Our research also finds that capacities and autonomy of the ZGC of Beijing and the Yangpu District of Shanghai differ in various aspects, but both regions are struggling to upgrade the real estate market and enhance economic development. The 'high-tech cluster' provides a useful instrument or label to achieve goals other than innovation and R&D. Elite universities are regarded as engines for network formation, but visible and invisible walls of Chinese universities discount efforts to foster a university-centered innovation hub. Last but not least, the innovation cultures of mutual trust, sharing and tolerance are absent in the two regions under study. In this sense, capacities of urban

**Table 2.** Comparison of ZGC and Yangpu's innovation system

	ZGC, Beijing	Yangpu, Shanghai
The major promoter	District governments, then city and central state	District government
Inter-firm relations	Increase	Limited
Relationship between universities, R&D institutions and firms	Incubation, consultation and science parks	Incubation, consultation and science parks
Government	Vertical guidance by ZGC administrative authority	Mainly by district government with little authority on universities and R&D institutes
Appearance	Strong performance in attracting high-tech firms and leading to the booming of real estate sector	Weak in terms of luring high-tech industry, but shows strong performance in urban re-development
Local innovation system	Stronger	Weaker

districts to promote innovation and institutional change reach their limits. Removing these institutional constraints requires continuous efforts of social engineering and political maneuvering. Bottom-up dynamics of major metropolitan areas and top-down political will of institutional changes will collectively shape the future path of China's development of innovation industries.