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Open Innovation in China: Policies and Practices

Xiaolan Fu[a] and *Hongru Xiong*
[a] *Oxford University;*[b] *Tsinghua University*

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Xiaolan Fu[a] **and** *Hongru Xiong*
[a] *Oxford University;*[b] *Tsinghua University*

[Abstract]

This paper reviews the evolution of policies and practices concerning open innovation in China. Based on evidence from firm-level case studies, it analyses various practices of open innovation in indigenous Chinese companies. It finds that the Chinese firms have in practice employed a variety of open innovation models since the reforms of science and technology system in mid-1980s. Policies introduced by Chinese government in respect to acquisition of foreign technology, industry-university collaboration and the 'go global' strategy have in particular encouraged Chinese firms to adopt certain types of open innovation model. All this has promoted the diffusion of open innovation in China. Areas for future research are also discussed.

[Key words]

Open Innovation, Policies, Practices, China

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1. Introduction

China has experienced a substantial transformation in the innovation landscape since the economic reforms and opening up in 1978. The past decade, in particular since the entry into WTO in 2001, has witness a rapid internationalization of innovation activities in China by both foreign and indigenous firms. On one hand, many transnational corporations from developed economies are increasingly globalizing their innovation activities (Ernst, 2006; Dunning, 2002; Cantwell & Odile, 1999; UNCTAD, 2007) and actively entering Chinese market to source low-end value chain activities and also seeking plentiful R&D knowledge and human capital (OECD, 2008; Fu and Gong, 2010). On the other hand, more and more indigenous firm are attempting to go abroad to globalize themselves to acquire external R&D resources and improve innovation capabilities. Some have emerged as major players in certain technology intensive sectors (Mathews, 2002; Dunning, et al., Buckley et al., 2002), especially after the financial crisis and economic recession in developed countries.

The new imperative of open innovation, which explores a new innovation paradigms and a new model for organizing technological innovation, argues that "firms can and should use external ideas as well as internal ideas; and internal and external paths to market, as the firms look to advance their technology" (Chesbrough, 2003) have been reflected and emerged in Chinese innovation activities. Companies increasingly rely on outside innovation for new products and processes and have become more active in licensing and selling results of their own innovations to third parties. Some growing Chinese firms begin to learn about how to utilize the external R&D resource or technological knowledge because of weakness in technology accumulativeness, via introducing foreign technology or equipments, joint-venturing, collaborating with users, suppliers and public or private research institutions, and so on (Chen, 2009). Besides, many Chinese scholars argues that domestic firms are gradually experiencing the third wave of innovation named "indigenous innovation in open era" as to the great opportunity coming from global industrial restructuring, compared to the former two waves of innovation, which respectively are "indigenous innovation in closed era" and "all-around introduction in open era" (Chen, Ning & Si, 2006). Thereby, some outstanding domestic firms start the globalization process, via setting overseas R&D center or directly acquire foreign technology-intensive firms through M&A, in order to integrated global R&D resources and quickly enter into the high value-added industrial part (Bai, 2009). In addition, some others, in possession of technological advantages, also attempt to use licensing, IP selling, spin-off and even corporate venturing to exploit the external commercial paths, such as the example of commercialization of TD-SCDMA.

Is Open Innovation a new phenomenon in China, or it is 'old' in practice and 'new' in concept? Chinese government and firms have encouraged firms to source external knowledge by acquisition of foreign technology and, since 2000, to 'go global'. Some pioneering Chinese firms have also practiced to various modes of open innovation to different extent (Chen Jin and Chen Y.F, 2008). What are the past and

existing policies and practices and future trends towards open innovation in China? What is the role of open innovation in innovation performance and technological upgrading in emerging economies such as China? What are the major research questions that have significant policy and managerial implications are in need of investigation? Although the era of open innovation has come to a reality for most Chinese firms, we still lack a systematic understanding of the context, environment and mechanisms, inside and outside of the organization, when and how to fully profit from the new model for late comer firms in emerging economies. More importantly, there is a pressing necessity to understand the overall landscape and development of open innovation in China to launch any in depth on these important topics. This paper aims to fill in the gap in literature by providing a systematic review of the evolution of the policies and practices of open innovation in China. It also explores the implications of open innovation strategy for latecomers in global innovation networks and for indigenous innovation in emerging economies. As far as we are aware, this is the first systematic review of open innovation policies and practices in the emerging economies context.

The rest of the paper is organized as follows. Section 2 provides an overview of the current situation in openness in innovation in China. Section 3 discusses the theoretical framework especially the role of government policies in shaping innovation mode and practices in firms. Section 4 examines the policies introduced by Chinese government in the past three decades which affected the development of open innovation in China. Section 5 reviews the evolution of the practices of open innovation adopted by Chinese firms. Section 6 discusses the trends and challenges for open innovation in China. Section 7 concludes.

2. Openness in innovation in China: an overview

Although open innovation is a new concept introduced by the seminar work of Chesbrough in 2003, a recent firm-level national innovation survey carried out by the National Bureau of Statistics of China and Research Center for Technological Innovation of Tsinghua University suggests a relative wider adoption of open innovation among Chinese manufacturing firms[1]. **Table 1** and **Table 2** give us a descriptive structure of the source of product and process innovation within our survey sample firms. Two indexes towards 'firm itself' and 'collaboration with other firms or research institutes' significantly take up the majority of source of product and process innovation. Taking product innovation as an example, on one hand most Chinese firms develop new product or new process heavily based on their own resource and capability (which shows 75.9% firms innovate on themselves). On the other hand, not a few of them can acquire new innovations from cooperation (which shows 37.0% proportion of all) but not merely dependent on those external sources (which shows only 4.1%). Although the phenomenon of so-called 'closed innovation'

shows a relatively higher proportion, we still cannot ignore some surprising differences. Over one third product innovations are stemmed from industrial collaboration or research alliance (projects), which shows collaborative innovations should also be an important part of all types of innovation activities in China. In addition, some firms' innovations are still dependent on their affiliated domestic or overseas groups. This mainly reflects the situation of those joint venture (JV) firms in China. An interesting finding can be detected by the evidence that domestic group's resource used has a relatively higher proportion than that of overseas group. It refers to those joint venture begin to be inclined to use domestic resource to develop new innovations in Chinese market. What's more, the condition of process innovation is quite similar to that of product innovation while the latter relies less on 'closed innovation'.

Table 1: The Source of Product Innovation

The Source	Number of firms	Proportion (%)
Internal	732	75.9
Affiliated group (domestic)	130	13.5
Affiliated group (overseas)	101	10.5
Collaboration with other firms or research institutes	357	37.0
Other firms or research institutes	40	4.1

Note: firms are allowed to make multiple choices

Table 2: The Source of Process Innovation

The Source	Number of firms	Proportion (%)
Internal	820	86.8
Affiliated group (domestic)	123	13.0
Affiliated group (overseas)	81	8.6
Collaboration with other firms or research institutes	351	37.1
Other firms or research institutes	46	4.9

Note: firms are allowed to make multiple choices

Secondly, following the introduction of primary source of product and process innovation, the role of various channels of information or ideas inside or outside the firm, in terms of 'innovation search', shall be paid great attention. The underlying reason is that it implies the importance and relationships of which inputs from external sources flow into the innovation process. There is strong empirical evidence to indicate that successful innovators employ a range of external source during the innovation process, from users and suppliers, to competitors and universities (Hippel, 1986, 2006; Chesbrough, 2003). We use the survey data to illustrate the importance of different types of information (or ideas) for our firms (see **Table 3**). Although this is quite a subjective data collection, it can still show consistent attitudes towards internal and various external channels for sourcing innovation information.

Table 3: The Importance of Information Sources in Innovation Activities

Information sources		Proportion of firms which regards the source with high importance (%)	Mean of importance
Internal	Firm itself or its affiliated group	41.7	3.09
Market information sources	Suppliers of equipment, raw material, component or software	17.9	2.63
	Users or consumers	52.5	3.25
	Competitors or other firms within the same industry	34.3	2.96
	Consultants or private R&D institutes	5.7	1.96
Institution information sources	Universities	8.3	2.06
	Government or public R&D institutes	10.0	2.12
	Government S&T Plan	14.4	2.21
Other sources	Trade or sales program, academic conference	22.5	2.61
	S&T Journal or literature, Trade or patent literature	9.7	2.30
	Professional industry association	18.6	2.52

Note: firms are allowed to make multiple choices

Not surprisingly, more than 40% firms regard internal source (itself or its affiliated group) has a relatively higher importance compared to most of the other sources, which complies with the heavy dependence on internal resource for developing new products or processes mentioned above. Towards various external sources, the differences among them are very significant. Undoubtedly, users (clients or consumers) are placed as the first ranking of importance for innovation search which has 52.5% proportion in all, together with the highest degree of importance (3.25). In particular, the index of degree of importance suggests more about the depth of one specific information source while the proportion of importance only measures the breadth or popularity of one source adopted by firms. Therefore, we can find that both users and competitors (including other firms within the same industry) can be viewed as the most important sources for searching innovation. In addition, another important source can also be traced to those trade (or sales) programs and academic conferences (which shows a 22.5% proportion), and even industrial association (which shows a 18.6% proportion). Furthermore, we find most important external sources are market channels or information (including users, competitors, suppliers, and so on), while institutional information being regarded as less important respectively. To sum up, the external sources play a very crucial role in the innovation process and present a relatively high scale for most domestic firms

while still a large proportion of domestic firms employ internal channels for sourcing innovation.

Finally, we refer to the funding sources of innovation activities in order to review the general structure of financial capital funding for innovation towards Chinese firms, particularly in the past three years. **Table 4** tells the descriptive statistics of funding sources based on our survey. Compared to other sources, the majority of our sample firms claim that they use internal financial inputs to fund innovation activities (nearly 90%). However, while quite a few firms acquire funding from government or public support, the amount of finance capital still takes up a smaller proportion of all innovation funding (with 318 firms involved but merely 13.5% total capital). In addition, financial institutions for providing loan, capital markets and even cooperative partners (domestic and overseas) still play a significant role of supplying abundant capital to innovation activities, although the number of the firms which can get access to these two sources is not as big as that of using internal sources. This implies an crucial implication that the importance of capital markets and partners should be not ignored for their great influences on promoting innovation.

Table 4: The Proportion of Funding Sources for Innovation Activities (2006-2008)

The proportion of sources for funding innovation	Number of firms	mean	Max.	Min.	S.D.
Internal capital	1235	88.3	100	1	20.79
Government funding	318	13.5	100	1	16.00
Loans from financial institution	274	33.6	100	1	22.63
Capital market	32	26.2	100	1	29.00
Cooperative partners (domestic and overseas)	60	22.9	100	1	24.06

3. The role of government policy in shaping innovation practices of firms

Much prior literature in innovation studies regard the emergence of open innovation raises significant policy issues. While open innovation is essentially business-driven, it has implications for science, technology and innovation policies (OECD, 2008). Insofar as open innovation is about 'open' business models for innovation, countries' framework conditions (*i.e.* product and labor markets, IPR and competition policies, a strong public research base, etc.) are extremely important policy levers (OECD, 2008). Here implies an important question that how government policy can efficiently facilitate firm-level open innovation practices. Besides, for emerging economies, it also implies how latecomer firms could acquire make use of favoring policy environment to construct complimentary innovation capabilities during their catching-up process. In this paper, we will cover

Generally, a government can play various roles in framing and promoting a credible innovation policy. In theory, three major roles for government can be identified: a role as a broker, a role in demand articulation and a role in stimulating innovations (Rothwell, 1986; Faber, Kemp and Van der Veen, 2008). In this paper we intend to dig these three roles towards favoring open innovation practice.

As a broker, government commits itself in bringing together different players in the innovation system. Open modes of innovation activities need various players or platforms cooperating and complementing in acquiring mutual benefits. In particular, national framework conditions and the public infrastructure for research cultivated by government policy play a major role. To some extent, this responds to the environmental side of public policy which can greatly influence the firm-level behaviors. For example, one particular policy issue, related to IPR, may be paid much attention to. Till now, the immature intellectual property protection regime in China has been long-running criticized by many foreign companies which enter into Chinese market. However, the globalization of R&D and the emergence of open innovation strategies in firms clearly raise intellectual property issues. The shift towards 'IPR-sharing' in open innovation strategies may require different kinds of management tools in universities and public research organizations. While strong IP protection can attract R&D-related FDI, excessively strong protection can act as a barrier to open innovation strategies that rely on knowledge sharing and access (OECD, 2008). It is suggested by many scholars that the platforms and repositories for the "intellectual commons" are greatly required, which can be facilitated by government regulations and investment in a strong ICT infrastructure. Another example which needs to be highlighted is the building efficient technology transaction markets. Most firms are sourcing knowledge in various ways but licensing and purchasing technology and knowledge embodied in patents or other forms of IP are important. Creating rules and conditions that facilitate the development and transaction of technology can facilitate open innovation (OECD, 2008).

Second, government can play a role in demand articulation. This amounts to the creation of markets for open innovations by setting relevant standards. For instance, markets can be created through the use of economic incentives and special agreements with industry. In general, it is possible to pull open innovation in a way that benefits economic and political circumstances and the theory behind this is usually related with the work of Michael Porter, who argued that countries may increase their competitive advantage by setting strict entry or environment standards (Porter, 1990). This idea is of great importance that the market shall be competitive and open to innovative newcomers, which actually implies the competition policy towards open innovation. Designing competition policy that does not preclude co-operation is an important challenge, especially in industries where excessive competition can show innovation (OECD, 2008). Besides, when government builds more commercialization channels (like science parks as incubators, industrial technological strategic alliance), most firms, particularly new entrants in high-tech or emerging industries, would be more inclined to adopt open modes of technological exploitation activities.

The third role of government takes effects on the supply side of the national innovation system. This is exactly embodied in various structural public policies (S&T policy, fiscal policy, capital markets and so on). Most OECD countries' S&T policies are

predominantly national in scope, but it is becoming clear that policies designed for geographically circumscribed knowledge-based activities or for vertically integrated value chains of firms need to be reviewed (OECD, 2008). For example, policies to promote networking and clusters can have a great influence on promoting firms to adopt an open mode of technological exploration in their R&D process. Another prominent example can be seen in government's fiscal policies which mainly supply a large number of tax incentives, fiscal subsidies, preferential credits, as well as direct capital input, in order to stimulate innovation collaboration activities. Besides, policies related with dynamic capital markets supported by government also do matter since a free and flourished financial environment can greatly stimulate open innovations. Insofar as corporate venturing is one channel through which firms add value internally and externally, capital markets that allow for corporate venturing and exit to secondary markets are much important for open strategies (OECD, 2008).

Furthermore, government policies favoring open innovation also can help many latecomer firms to catch up in technological innovation. Whatever normative or regulatory styles, policies have had a strong influence in the catching up process (Li and Kozhikode, 2009). Hobday (1995) observed that governments in emerging economies often protected local firms from initial failures and encouraged them to learn from MNEs. Kim (1997) observed that the intellectual property regime in Korea supported local firms by allowing them to imitate the technologies of global players during the early stages of catching up. However, this support was only available until the Korean firms began to develop their own innovative offerings. Although the initial innovations of the latecomers were not ground breaking, over time and with increased investment in R&D, both internally and in collaboration, these firms gradually were able to develop more innovative offerings (Hobday, 1995). In addition, open innovation practice can also influence the changes in the governance of innovation policies sometimes (OECD, 2008). On one hand the challenge for government is to help firms adjust their innovation strategies to a changing environment; on the other hand many firms, in particular latecomer firms, also actively respond and react to the changing of government policies. Hence understanding the typical patterns of open innovation practices in China would supply significant implications to government policies.

On all accounts, we are tentative to claim that it would be a feasible way to exploit government policies and firm practices towards open innovation, in order to describe and analyze the background and evolution of open innovation in China in the past several decades. Specially, we mainly pay attention to the government policy issues affecting open innovation practices in Chinese transitional economy. Then we also summarize various types of open innovation practices done by Chinese indigenous firms. Reviewing these two modules shall construct the basic framework of overviewing Chinese open innovation evolution, which naturally instructs our discussion on possible trends of open innovation in China.

4. Policies affecting open innovation in China

The governments of a growing number of emerging economies have played an active role in making their respective economies attractive to global R&D

investments in recent years (UNCTAD, 2005). In the past several decades, Chinese policy-makers have attempted to lead the entire innovation environment more open and cooperative since reforming and opening up in the late 1970s, although open innovation is not regarded as a clear national strategy. It is expected that effective policy support could help most Chinese firms to overcome many pressing obstacles in order to cultivate a highly open condition in the era of indigenous innovation in China. For instance, open innovation can be considered a private-collective innovation model. Instead of the private investment model of innovation with Schumpeter's temporary monopolistic profits, the free revealing of inventions, findings, discoveries and knowledge is a defining characteristic of the open innovation model (von Hippel and von Krogh, 2003, 2006). This implies the corresponding role of government in stimulating the free and efficient flows of knowledge and technology in domestic market. On the other hand, the cultural issues related with open innovation have been emphasized greatly in academia in recent years. The seminal work on the not-invented-here syndrome by Katz and Allen (1982) was a starting point within the field. Specially, many Chinese tradition cultures are extremely intrinsic and unique for facilitating or encouraging opening up innovation process. It is a reality that research should draw more from the psychological field, in order to better understand the influence of all those cultural aspects affecting open innovation.

The core development strategy of Chinese government is to encourage indigenous innovation and to build an innovation-oriented economy in the new century. Many science & technology (S&T), industrial, macroeconomic policies are paid much attention to stimulate technological innovation and improve competitiveness. As we know, open business model emphasizes absorbing external knowledge and exploring external paths to commercialize (Chesbrough, 2006). Accordingly, although open innovation is not regarded as a clear national strategy, Chinese policy-makers have all through kept on leading domestic market and institutional environment more open and favorable for innovation flows since 'reforming and opening up' policy enacted in the late 1970s.

In the past three decades, Chinese S&T policy has gone through four important milestones in its development (Liu, 2008). In other words, the evolution starts from "catching-up strategy and closed innovation in planned economy" before 1978, to the new paradigms of "economic development *relying on* S&T and S&T *being oriented to* economic development" around 1985, then to "revitalizing S&T and education, enhancing national innovation system" after 1995, finally to the most recent national strategy of "indigenous innovation". The most recent 'indigenous innovation' policy are stemmed from two revolutionary documents, i.e. "*the Decision of the CCCPC and the State Council about Implementing the Outline of the Scientific and Technological Plan and Enhancing the Independent Innovation Capacity (No. 4 [2006] of the CCCPC)*"[2] and "*the National Guideline for Medium and Long-term Plan for Science and Technology Development (2006-2020)*"[3] (Fang, 2007; Wang & Liu, 2007; Liu, 2008). The open-oriented innovation ideology has revealed clearly in the initiating of the national strategy of indigenous innovation within the two policy

documents above, which regard "integrated innovation" and "innovations on the basis of introduction, digestion and absorption" as two basic forms of indigenous innovation. In fact, these two innovation forms are both emphasizing the utilization and integration of external R&D resources and commercial paths.

Regarding the development of relevant public policies for open innovation in China, many significant innovation policies are indeed involved, although specific still lack. We classify them into three main policy clusters with evolutionary perspective.

4.1 All-around external sourcing: since 1980s

Early in 1980s, most Chinese firms introduced an extremely large number of foreign technologies and equipments to attempt shortening the huge gap in R&D and also manufacturing capacity. This open strategy of 'technology introduction, digestion and absorption' is primarily profited from the encouraging import policy of government. In actual, "*Regulations of the People's Republic of China on the Administration of Technology Acquisition Contracts*" (1985) and later ''*Regulations of the People's Republic of China on Administration of Import and Export of Technologies*" (2001)[4] show,

'*the state encourages the import of advanced and useful technologies …… but the technology to be imported must be advanced and appropriate and shall conform to develop new products, or to improve quality and performance and reduce cost and lower consumption of energy or raw materials, or to favor the improvement of management and contribute to the advancement of scientific and technical levels*'.

After that, Ministry of Finance, State Development and Reform Commission and General Administration of Customs also co-made the "*Regulations of Promoting Technology Introduction, Digestion and Absorption (1986)*"[5] to further reinforce and complement the technology introduction policies. Correspondingly, the recent "*Notice of Taxation on Issuing the State Industrial Technology Policies* (2009)" issued by Ministry of Industry and Information Technology, Ministry of Science and Technology, Ministry of Finance and the State Administration, also clearly emphasizes on making extensive efforts in international cooperation and exchange and reinforcing technological introduction, digestion and re-innovation, in particular together with many necessary fiscal and tax policies to support the external sourcing. For instance, introducing key components which are difficult to achieve localization could take 50% to 70% tax incentives when their percents of introduction under 40%. Specifically, some more favorable measures are listed as following,

'*for key technologies and equipment unavailable in China, the state will provide guidance for foreign merchants to tender bids jointly with domestic enterprises, introduce advanced designing and manufacturing technologies at the same time when importing equipment products, and guarantee that domestic enterprises enjoy an adequate subcontracting proportion……*'

'*Enterprises which undertake key scientific and technological projects of the state shall be exempted from import duty and import value-added tax for the domestically unavailable key scientific research apparatus, facilities, raw materials and components imported by them……Key*

components and raw materials of key technological equipment and products which enjoy the state support shall be exempted from import duty and import value-added tax if their import is really necessary……'

Importantly, opening the firm's boundaries to external inputs in a managed way enables companies to realize radically new production innovation (Gassmann, 2006) and external sources of knowledge and innovation have become increasingly relevant (Porter & Stern, 2001). Most of those supporting policies help domestic firms effectively break technology barrier in the early stage and improve manufacturing and technology application capability in a relatively short time. External absorption of advanced technology from foreign rivals, to some degree, broadens the source of innovation knowledge for indigenous innovators.

In addition, Chinese government is always encouraging foreign investment and foreign companies to do business in China since the opening policy advocated in late 1970s. In order to attract more foreign capital, encourage the introduction of advanced technologies and equipments, enhance the capability of utilizing foreign capital, and also promote the industrial re-structuring and technological progress, a large amount of stimulating policies have been issued to attract foreign companies and protect common interests of cooperation between foreign and domestic firms. Early in 1980s, the State Council issued "*Provisions on the Encouragement of Foreign Investment*"[6], in order to better facilitate the absorption of foreign investment, and to introduce advanced technology. Importantly, greatly favorable financial measures were served in terms of taxation and some others.

'*After the expiration of the period for the reduction or exemption of enterprise income tax in accordance with the provisions of the State, Products Export Enterprises whose value of export products in that year amounts to 70% or more of the value of their products for that year, may pay enterprise income tax at one-half the rate of the present tax …… After the expiration of the period of reduction or exemption of enterprise income tax in accordance with the provisions of the State, Technologically Advanced Enterprises may extend for three years the payment of enterprise income tax at a rate reduced by one half……*'

Furthermore, "*Circular on Further Encouraging Foreign Investment (1999)*"[7], issued by General Office of the State Council, the Customs General Administration, and Ministry of Foreign Trade and Economic Cooperation, again emphasized on encouraging foreign-funded enterprises to make technological exploitation and innovation and enlarge their domestic purchase. More financial incentives were issued to stimulate cooperation of foreign and domestic firms. For instance,

'*Where a foreign-funded enterprise which purchases any Chinese-made equipment within the total amount of investment, if the aforesaid imported equipment falls in the scope of the tax exemption catalogue, the value-added tax on the domestic equipment may be refunded in full amount and the enterprise's income tax may be deducted or exempted according to relevant regulations…… For any foreign-funded research and development center, the import customs duties and the taxes incurred in the import link may be exempted…..*'

'*Where a foreign enterprise transfers any technology into the domestic territory, if the technology is advanced or the terms are favorable, the business tax and enterprise income tax may be exempted upon the approval of the administrative department of taxation of the State Council. The income as generated from the technology transfer shall be exempted from business tax*.....'

Besides taxation incentives, many relevant policies also emphasized on strengthening the financial support for foreign-funded enterprises, and encourage foreign investors to invest in the mid-western regions, together with guiding them to be invested in key industries and important fields. What's more, the "*Catalogue of Industries for Guiding Foreign Investment*"[8] has been adjusted according to the economic development in a timely manner, in order to further improve the administration and services to foreign-funded enterprises.

Generally, no matter polices supporting technology introduction or encouraging foreign investment, a long history of favoring all-around external sourcing for acquiring technology and capital has been the most crucial reality in the evolution of Chinese policies promoting innovation in an open way.

However, some Chinese scholars heavily argue and criticize this fatal disadvantage of sourcing external knowledge blindly (Chen, 1994; Zhang, 2003). Indeed, some critical problems and risks gradually come into explosion and greatly damage the sustaining growth and capability development. On one hand, most foreign companies would not like to sell or spill over their core competitive technologies to latecomers, because of concerning on more intense global competition of technological innovation and challenges from new emerging competitors or new disruptive innovation (Christensen, 1997). On the other hand, most Chinese indigenous companies have complained that those technologies by introducing are typically out of date and extremely difficult to digest and learn because of weakness in absorptive capacity. After all, it is a reality that companies investing in open innovation activities face risks and barriers that hinder them from profiting from their initiatives (Enkel, Gassmann & Chesbrough, 2009). This dilemma of open innovation, in terms of technology introduction and foreign investment, greatly forces most Chinese firms stay in hot water in recent years.

4.2 Diversifying channels of commercializing innovation: since mid-1990s

Another primary objective and important reality of Chinese innovation policy is to accelerate industrialization of high-tech, together with achieving effective commercialization of emerging technology, besides sourcing and absorbing external technology to accumulate knowledge and reinforce technological basis. In the recent twenty years' high growth of macro-economic, government has conducted various measures to broaden the channels of achieving innovation, in terms of commercialization and industrialization of high emerging technology and also upgrading of traditional industries.

After the important speech in 1992, of Xiaoping Deng, a former leader of state

and hereby institutional transformation towards building market economy, government clearly pointed out the relevant policies for releasing the paths of commercialization and industrialization of S&T achievements, which means diversifying the innovation channels. An initiating policy document issued by the CPC Central Committee and State Council, named "*the Decision on Strengthening Technical Innovation, Development of High-tech and Realization of Its Industrialization* (1999)"[9], constructs the foundation for enriching various business models for developing high-tech. The "*Law of the People's Republic of China on Promoting the Transformation of Scientific and Technological Achievements* (1996)"[10], issued by Standing Committee of the National People's Congress, clearly and creatively demonstrated the strategic principles and plentiful modes of commercial and industrial innovation knowledge. Referring to the modes of implementation, government suggests,

'*Holders of S&T achievements may have their knowledge commercialized or industrialized via besides investing themselves, but also transferring them to another, or allowing another to use, or working together with another for transformation with their achievements as the conditions for cooperation, or investing with their achievements as trade-in, as converted shares or as proportions of contribution to the investment……*'

'*an enterprise may, for purpose of adopting new technology, publish information on its own or entrust an intermediate institution engaged in trade of technology to solicit the S&T achievements…… an enterprise shall have the right to conduct transformation of S&T achievements independently or jointly with domestic or foreign enterprises or institutions or other collaborators……*'

What's more, government also issued a series of policy support of taxation, finance, infrastructures, talent incentive mechanism to promote processing of those commercial and industrial modes. Concretely, of the funds the government allocates to scientific and technological undertakings, to investment in fixed assets and to technological updating, a certain proportion shall be used for transforming scientific and technological achievements. The State also adopts a preferential tax policy regarding transformation of scientific and technological achievements. Additionally, The State encourages establishment of funds or risk funds for transformation of scientific and technological achievements, such funds shall be raised by the State, local authorities, enterprises, institutions and other organizations and individuals and shall be used to aid transformation of such scientific and technological achievements as need substantial investment, involve considerable risks and promise high yields and to accelerate the application of major scientific and technological achievements in industrial production.

Specifically, several important national programs or plans of accelerating industrialization needed to be highlighted. First is about encouraging "establishing the production-study-research combination system that centers around the enterprises and jointly bear the risks" and "establishing the open technological innovation service systems replying on cities", suggested in "*State Industrial*

Technology Policies"[11], issued by Ministry of Science and Technology, Ministry of Finance, State Economic and Trade Commission (repealed) and State Administration of Taxation in 2002. Towards this document, government greatly advocate to establish the production-study-research associations of enterprises, universities and research institutions, form a market-oriented R&D system and an open production-study-research mechanism, according to the comparative advantages and strategic needs of China, select the areas of independent development and advance, explore new technology routes through system integration and mutual absorbing, and develop the technology with independent intellectual property right. Second is about exploring diversified investing channels and building multiform business models for profiting from innovation. It is suggested that government will greatly develop venture capital market to finance innovation.

'*Expand financing channels, absorb the social capital, establish and develop the social industrial investment fund aiming at reforming the traditional industries by high-tech", as well as "build a venture capital mechanism, develop public venture capital institutions, attach importance to the fostering of talents for management and operation of venture capital, gradually establish the venture capital system and venture capital funds composed mainly of social investment, and for the multi-input structure of venture capital……*'

Furthermore, large amounts of innovation policies on "*Vitalizing trade by science and technology (1999)*"[12] implemented mainly by Ministry of Commence and Ministry of Science & Technology, since 1999, together with "*Supporting the National Development Zones for New and High Technology Industries*" issued by Ministry of Science & Technology, both have facilitated and boosted the broadening of industrial paths for profiting from innovation.

In all, the institutional environment of supporting external commercialization for innovation has been greatly improved in the past years. Based on various channels to catch opportunities of commercializing new products or industrializing new inventions, both indigenous and foreign firms could benefit from the policy support for open innovation. But admittedly, the actual level of market environment to advocate open innovation still stays at a relatively lower degree, compared to other mature economies. More open and more reliable environment of marketing innovation would be a long focus for policy makers in China.

4.3 From 'introducing' to 'going global': since 2000s

With the increasing globalization of innovation and the rising of many indigenous firms in China, the orientation of innovation policy has been apt to be more aggressive and more open. In practice, more and more globally R&D cooperation projects or international strategic alliances start to emerge in China and also more and more domestic firms begin to go globalized in the recent decade. Generally, an obvious transformation of open innovation focus from absorbing to acquisition, or from 'introducing' to 'going global' is emerging. In fact, this is a more comprehensive form or a higher level of implementing open innovation strategy, both for governments and also most domestic enterprises.

This is based on two aspects of consideration. On one hand, China is facing a highly open environment and we are experiencing so-called "indigenous innovation in open era", with the obvious trends of R&D internationalization and globalization of innovation. On the other hand, as the focus shifted from purely internal R&D activities, the academic community started emphasizing that the firms should be open to outside innovation (e.g., Rigby & Zook, 2002; Christensen et al., 2005). Firms which do not cooperate and which do not exchange knowledge would reduce their knowledge base on a long-term basis and lose the ability to enter into exchange relations with other firms and organizations (Koschatzky, 2001). Indeed, with Chinese firms growing bigger and stronger, some of them begin to take advantage of R&D resources overseas to carry out innovation.

In order to support those creative forms of open innovation, Chinese government has also implemented some relative policies and here we attempt to introduce two representative groups among them. Firstly, policies of "*International Cooperation Projects in Science and Technology*" are advocated and implemented by Ministry of Science & Technology more and more often in recent years. Two plans on developing international cooperation projects in S&T were issued in 2000 and in 2006, emphasizing the strategic forms' transition from project-oriented to integrated "project-talent-base" oriented, and also from technology absorption to integration of "introducing" and "going global". In addition, Ministry of Science & Technology and Ministry of Finance have firstly set up the special funds on promoting domestic firms participating international R&D cooperation since 2000. Till 2007, the total amount of this fund has over 0.4 billion *Yuan*, more than ten times of that in 2001. What's more, as to the big challenge of managing intellectual property right effectively, Ministry of Science & Technology specifically made "*the Interim Provisions on the Administration of Intellectual Property Right Relating to International Cooperation Projects in Science and Technology (2006)*", which advises that,

'*to conclude an international inter-governmental science and technology treaty, international science and technology cooperation agreement between a relevant department of the State Council and a department of a foreign country or between a provincial people's government and a foreign state, the Chinese party shall make an advance arrangement on the intellectual property right problems relating to the international science and technology cooperation, shall negotiate with the foreign cooperator and stipulate an intellectual property right clause or reach a separate intellectual property right agreement, which clarifies the basic principles for the ownership and utilization of intellectual property rights relating to the research achievements, so as to ensure that our country can effectively grasp and reasonably share the cooperative research achievements and the rights and interests of the related intellectual property rights…….*'

More importantly, relevant policies of supporting indigenous firm "going global" become more and more popular in recent years. In fact, government are always support "going global", from promoting technology and product export in the past to encouraging overseas investment and acquisition now. Ministry of Commence, State Development and Reform Commission, State Import & Export Bank, State

Administration of Foreign Currency and some other relevant department of government have all participated in the process of further implementing the development strategy of "Going global", promoting the business and trade with overseas countries. For instance, the *special loans for overseas investments*, issued by State Import & Export Bank since 2004, are mainly used for supporting these overseas investments, including,

'*①overseas resource development projects which can make up for the relative insufficiency of domestic resources; ② overseas productive projects and infrastructure projects which can give impetus to the export of domestic technologies, products, equipment, and labor services, etc.; ③ overseas research and development centers which may utilize internationally advanced technologies, management experiences and professional talents; ④ overseas enterprise acquisition and merger projects which can improve the international competitiveness of enterprises, and accelerate exploration of international markets……*'

Furthermore, '*Opinions on Encouraging Technology Export (2009)*', issued by Ministry of Commerce and Ministry of Science and Technology, clearly encourage technical enterprises to "go abroad". Government greatly support technical enterprises to engage in foreign-related cooperation by investing abroad, undertaking overseas projects and contributing technologies and intellectual property rights to become shareholders. Besides, technical enterprises are encouraged to merge and acquire overseas high-tech enterprises and establish overseas R & D institutions to drive China's technology and service export. Government also give play to the role of economic and commercial, educational and scientific & technological institutions stationed abroad in guiding enterprises to "go abroad", to carry out cooperative research and development and to establish overseas R & D bases and industrial bases.

To sum up, policy supporting environment of open innovation in China has been introduced for some years, and is still undergoing development. Till now, indigenous innovation in a highly open era is the mainstream for most Chinese domestic firms. Accordingly, there is a pressing necessity to build a much more comprehensive policy system for open innovation in China.

A recent report of researching on evolution of Chinese S&T, economic and innovation policy (Wu, Wang and Xiong, 2009), has collected and identified 2593 policy documents, from 1979 to 2008, and found that open innovation oriented policies were embodied to a quite high proportion. Based on their collections of Chinese innovation policy in the past three decades and previous analysis, we hereby select and list some relevant representative policies, with the exploration-exploitation dichotomy, to illustrate a simplified evolution of public policy for open innovation (see **Table 5**).

Table 5: The main public policy for open innovation in China

Time	Policy document	Issuing Dept.	Policy focus and main measures
1986	*Regulations of Promoting Technology Introduction, Digestion and Absorption*	Ministry of Finance; National Economic Council; General Administration of Customs	Technology exploration; tax incentives to import advanced technology and learning, localization
1986	*Provisions on the Encouragement of Foreign Investment*	The State Council	Technology exploration; tax incentives for foreign-invested firm technology-intensive sector. For example, *technologically advanced ente extend for three years the payment of enterprise income tax at a rate red half.*
1993, 2007	*Law of the People's Republic of China on Science and Technology Progress*	Standing Committee of the National People's Congress	Coupled; various measures to guarantee S&T progress, such as overall leve input, R&D expenditure as cost, credits and loans, open to dome organizations or individuals to fund S&T, build information exchange and n security systems to protect IP…
1996	*Law of the People's Republic of China on Promoting the Transformation of Scientific and Technological Achievements*	Standing Committee of the National People's Congress	Technology exploitation; support measures including initiation funds, dis subsidy funds, venture capital and other specially establishment funds, a tax policy, loans, venture funds, build data bank of S&T achievements …
1999	*Plan of Vitalizing trade by science and technology*	The State Council; Ministry of Commerce	Technology exploitation; tax and export preferential support for high-tech p
1999	*the Decision on Strengthening Technical Innovation, Development of High-tech and Realization of Its Industrialization*	CPC Central Committee; The State Council	Technology exploitation; R&T input, tax preference, loans and credits and financial input for commercialization of S&T and innovation products, n reform of domestic S&T institutions
2002	*Measures for the Administration of Technological Innovation Plans of the State*	State Economic and Trade Commission (repealed)	Coupled; this innovation plan include such developing industrial technologie experiments, the popularized application and demonstration of new techno development between industrial and academic institutions, key t equipments, technological centers and a service system for technological and the trial production of new products, etc.
2002,	*The State Industrial Technology Policies*	Ministry of Science and Technology; Ministry of	Technology exploitation; fiscal, tax, investment, financial and government p

2009		Finance; Ministry of Industry and Information Technology	policies to provide support for enterprises to increase investment innovation and form a market-oriented innovation system
2006	*The Decision about Implementing the Outline of the Scientific and Technological Plan and Enhancing the Independent Innovation Capacity*	The CCCPC; The State Council	Technology exploitation; implementing the intellectual property strategy (selling IP and multiplying technology by transferring ideas to outside), independent innovation and the innovative talent strategy, cultivating large-size enterprises, enterprise groups and technical alliances which have edges in the international market…
2006	*the National Guideline for Medium and Long-term Plan for Science and Technology Development (2006-2020)*	The State Council	Coupled; tax, loans and credits measures to support introducing extern innovation, together with government procurement specially for indigenou products
2008	*Notice on Printing and Distributing the Outline of the National Intellectual Property Strategy*	**The State Council**	Technology exploitation; Improving the intellectual property law enfor administration systems, through finance, investment, government p industry, energy and environmental protection policies to support the mar to create and utilize intellectual property, preventing abuse of intellectual p build IP protection culture
2009	*Opinions on Encouraging Technology Export*	Ministry of Commerce; Ministry of Science and Technology	Technology exploitation; encouraging IP exchange (out-licensing and technology) and high-tech export
2008, 2009, 2010	*Notice of Promoting on Industry Technological Innovation Strategic Alliance*	Ministry of Science and Technology; Ministry of Finance; State-owned Assets Supervision and Administration Commission; National Development Bank	Coupled; encourage domestic enterprises to form technical R&D institut China by way of joint venture, cooperation, merger, etc., set up R&D al utilize overseas superior forces in various forms and through various develop industrial technologies with independent intellectual property achieve industrialization.

4.4 The development of technology transaction market

The development of technology transaction market is another important policy and institutional factor that facilitates the flow of technological knowledge across firms and other organisations. Technological transactions include technology transfer, technology consultation, technical service, technical training, technology-equity share exchange, technology intermediation and various research-production co-operations.

At all times, active technology equity exchange and transaction market also play a significant role in creating open innovation environment in China. Compared to some developed economies, Chinese technology markets were underdeveloped relative to most product markets, and technology transactions were not very common because of high transaction cost and managerial challenges in the past. Fu (2008) find that the role that technology transaction market has played in China's regional innovation system is not significant over the 1998-2004 period. China set up its first technology stock exchange market in Shanghai in 1999. Since then and gradually large-scale technology equity platforms has emerged in Beijing, Chengdu, Shenzhen, Wuhan, Tianjin and Shenyang, and accelerated the outbound trading of technological innovation, in particular promote the development of corporate venturing in commercialize internal new technology, products and large amounts of patents.

Moreover, a better developed market system and frequent transactions may constitute a facilitator of additional inter-firm technology transfers (Teece, 1998). And a higher rate of technological transactions likely increases the benefits from outbound open innovation (Arora & Ceccagnoli, 2006). Using Beijing area as an example, the total technology transaction amounts have arrived to 130 billion (RMB) in 2009, from only less than 10 billion (RMB) five years ago. These transaction markets, played as the immediate innovation service institutions as well as science parks and incubators, greatly help indigenous firms broaden both their commercialization channels and external technology resources all together.

5. Practices of open innovation in China

5.1 Modes of open innovation in China

The primary modes of open innovation in China represent some basic characteristics of those indigenous firms in opening their innovation processes. The closed and open models of innovation are typically presented as two extremes of a spectrum ranging from doing everything in house (vertical integration) to outsourcing everything to external partners (OECD, 2008). Generally, we conclude our collected evidence of open innovation practices into three types, outside-in, inside-out and doubled process, according to general categorizing methods suggested by Chesbrough (2009) and some relevant literature.

'Outside-in' process can be regarded as enriching the company's own knowledge base through the integration of suppliers, customers, and external knowledge sourcing. This process can increase a company's innovativeness (Laursen and Salter, 2006). The outside-in process reflects companies' experience that the locus of knowledge creation does not necessarily equal the locus of innovation. In accessing and sourcing external technologies and knowledge (i.e. the outside-in process of open innovation), EIRMA (2004) distinguished the following modes: purchase of technology; joint venturing and alliances; joint development; contract R&D; licensing; collaborations with universities; equity in university spin-offs; equity in venture capital investment funds. Secondly, there is an inside-out process which shows more and more importance. It refers to earning profits by bringing ideas to market, selling IP, and multiplying technology by transferring ideas to the outside environment (Enkel, Gassmann and Chesbrough, 2009). Thirdly, with integrating the above two processes, the 'coupled' process also become prominent in practice. It refers to co-creation with (mainly) complementary partners through alliances, cooperation, and joint ventures during which give and take are crucial for success.

By using a firm's process perspective, the developments of open innovation and their relevance in practice can be illustrated through a large sample of firm cases in China. According to our collection of relevant literatures for Chinese firms with open innovation, a table has made to show some typical open innovation cases of Chinese firms, in particular their characteristic process modes (see **Table 6**).

Table 6. Selected Cases of Open Innovation of Chinese firm

Modes	Main Forms	Company	Industry	Source
Coupled process	1. Knowledge sourcing from domestic universities, private research institutions and consultancy; 2. Cooperation in R&D with overseas partners;	ChunLan (in Taizhou, Jiangsu Province)	Electric equipment	Wang (2006)
Coupled process	1. Absorption of foreign technology 2. Setting up overseas R&D centers 3. Selling IP and spin-off internal know-how 4. Joint-venture with MNEs	FeiYue (in Taizhou, Zhejiang Province)	Electric equipment (sewing machine)	Zhu &Chen (2007)
Outside-in process	1. Production-study-research combination in particular with universities 2. External networking with suppliers	Little Swan Co., Ltd (in Wuxi & Hangzhou, Zhejiang Province)	Electric equipment (washing machine)	Li (2007)
Outside-in process	1. Outsourcing R&D 2. Production-study-research combination in particular with universities and private research institutions	JiangHuai Auto(JAC) (in AnHui province)	Automobile	Tang &Zhao (2007)
Coupled process	1. Absorption, digestion and innovation 2. Building globally distributed R&D centers 3. Cooperation with leading giants	International Marine Containers (Group) Ltd. (CIMC) (in Shenzhen)	Equipment Manufacturing (Machinery)	Zheng, He, Chen et al., (2008)
Outside-in process	1. Outsourcing R&D 2. Knowledge sourcing from other industries and leading universities	Neusoft (in Shenyang, Liaoning Province)	Software (Medical, Service)	Liu (2008)
Coupled process	1. Cooperation through Production-study-research combination 2. Building overseas R&D center	Shenyang Machine Tool (Group) Co., Ltd	Equipment Manufacturing (Machinery)	He (2008)
Coupled process	1. Participating Strategic Technology Alliance	Dongbei Special Steel Group	Steel	Liu & Hou (2008)

	2. Production-study-research combination	Co., Ltd (in Liaoning Province)		
Coupled process	1. Transnational Merge &Acquisition (M&A)	Nanjing Automobile	Automobile	Yu & Wang (2008)
Coupled process	1. External networking 2. Outbound commercialization with restructuring industrial value chain 3. Joint venture to market globally	Guizhou Special agriculture, i.e. Yanhuang Shiye Co. Ltd	Agriculture	Zhang &Liu (2008)
Outside-in process	1. Supplier and Competitor integration and also user innovation 2. Production-study-research combination 3. Distribute R&D centers globally	BOE Technology Group Co., Ltd (in Beijing)	Supplier of display products	Jiang (2009)
Coupled process	1. Absorption, digestion and innovation 2. Transnational M&A 3. Strategic Alliance 4. R&D outsourcing	Shenhua Group Corporation Limited (Shendong Mine Group, in Neimenggu Province)	Coal	Sun & Xu (2009)
Coupled process	1. International Cooperation for Synergic R&D 2. Building overseas R&D centers	Weichai Power Co.,Ltd. (in Shandong Province)	Automobile (supplier)	Hou (2009)
Inside-out process	1. Corporate Venturing 2. Spin-off	Lenovo Venturing (Beijing), Tsinghua Ziguang (UNIS, Beijing), B&H Investment (Shenzhen)	Venture Capital	Xu, Chen & Ke (2009)

Source: classified by the authors and referenced to relevant literatures above.

Based on the review of these typical cases, we come to three findings. One finding is that the proportion of outside-in process, or technology exploration modes, shows a relatively higher degree. This implies that most Chinese domestic firms are inclined to acquire advanced technology or knowledge through external sourcing, networking, cooperation or acquisition. Not surprisingly, most Chinese firms, as latecomers in global innovation network, greatly expect to acquire complementary assets and enhance innovation capability with methods of technology exploration. The second finding is that the proportion of inside-out process, or technology exploitation, still stays at a lower extent. As to broadly weakness in technological accumulation and innovation capability, it is difficult for many domestic firms to adopt licensing or corporate venturing (includes spinning in, spinning out and spinning off). Limited knowledge resource makes business models gradually outdated, and the immature venture capital market in China does not facilitate the growth of those new business models. The third finding shows that there is one interesting character needed to be emphasized, which relates to differences between sectors and firm size issues. Generally, faster and medium clock-speed companies actively use the inside-out process, although to a much lesser degree than they use the outside-in process (Gassmann, Enkel and Chesbrough, 2009). However, many firms in traditional or lower clock-speed sectors also use inside-out modes of innovation in China. In particular, this phenomenon turns more often while production-study-research combination programs highly being built or participating. In addition, it is expected that only large multinationals have an active out-licensing strategy to which they allocate substantial resources (Lichtenthaler and Ernst, 2007; OECD, 2008). But in China, some start-ups in high-tech or emerging industries would be apt to out-license their new inventions with forms of contractual collaboration to speed up the commercialization of new technology.

5.2 Innovation collaboration in China

According to our review of various modes of open innovation in China, we find the characteristic of 'collaborative innovation' shows the prominent popularity and represents most of those various modes. Enterprises may engage in collaboration to acquire missing knowledge, complementary resources or finance, to spread risks, to enlarge its social networks, or to reduce costs (Hoffman and Schlosser, 2001; Mohr and Spekman, 1994). In addition, one firm's innovation strategies combine characteristics of both innovation models and the degree of openness depends on factors such as the importance of the technology, the firm's business strategy, the industry's characteristics, etc. Companies traditionally seek to retain their core capabilities and decide what to outsource or with whom to collaborate on innovation on that basis (OECD, 2008). Here we still use evidence from our survey data set to empirically explain the content of innovation collaboration in China.

Table 7 gives us the frequency results of different innovation types. Due to most innovations, together with their funding and information sources, are developed and sources internally to a larger extent as previous overview shows, the proportion of internal R&D activities accounts for the majority (those firms which do internal R&D

mostly takes up nearly a half in our sample and merely less than 10% firms do not). Besides, purchasing equipment, machines or software also occupies quite a few amounts (with 32.7% firms claim to do this). What's more, it is necessary to highlight that the external R&D activities do not employ an expected popularity since over 50% firms admit that they never conduct external R&D activities. Similarly, effective acquisition of external technological knowledge is also quite difficult for many sampling firms, with nearly a half express they never do innovation by using external technological knowledge. These results can reflect, to some extent, that the innovation types of many domestic firms still are simply independent innovation and most of others are introduction-oriented or learning-oriented innovation. The frequency of using external technological sources generally stays at a low level.

Table 7: Types of Innovation Mode and Frequencies

Types of Innovation mode	Never		Sometimes		Very often		Sum total
	No. of Firms	Proportion (%)	No. of Firms	Proportion (%)	No. of Firms	Proportion (%)	
Internal R&D	90	9.1	418	42.4	477	48.4	985
External R&D	465	52.2	356	40.0	70	7.9	891
Purchasing machine, equipment and software	165	17.2	482	50.2	314	32.7	961
Acquiring external technological knowledge	436	48.6	374	41.6	88	9.8	898
Training and marketing activities	302	33.3	454	50.1	150	16.6	906

Table 8 describes the situation of collaborative innovation for all the sampling firms in China. The proportion of firms which claim to have participated in collaborative innovation shows a little higher than that of the others. Besides, **Table 9** concretely illustrates the types of collaborators and their regional distribution. Different types of collaborators possess of quite similar amounts and many of them come from advanced countries or regions such Europe, US and Japan, while the majority of them are still from domestic. Therefore, we can find many domestic firms are likely to and do participate in collaborative innovation. The wideness of collaboration applies to most types of collaborators while cooperating with foreign universities or research institutes do not have a high degree.

Table 8: Result of Collaborative Innovation

Whether or not have joined collaborative innovation	No. of Firms	Proportion (%)
Yes	668	48.2
No	717	51.8
Total	1385	100

Table 9: Types of Collaborators and Regional Distribution

Types of Collaborators	Mainland China	Hongkong, Taiwan, Singapore and South Korea	Europe, US and Japan	others	Do not have collaborations	Total
Other firms within affiliated group	315	42	67	10	223	615
Suppliers of equipment, raw material or software	316	34	105	23	204	606
Users or consumers	291	36	103	48	217	594
Competitors or other firms within the same industry	222	14	71	21	318	600
Consultants or private R&D institutes	223	16	28	4	362	616
Universities or public R&D institutes	473	12	20	3	157	649

Note: firms are allowed to make multiple choices

6. Trends and Challenges of open innovation in China

6.1 Trends of open innovation in China

While open innovation is not totally new in global networks, the organization of innovative activities (technological as well as non-technological) across firm boundaries is clearly on the increase, with more balance between internal and external sources of innovation (OECD, 2008). Geographical distance has never been a limitation to globalization of innovation networks. In order to build an inimitable competitive advantage, many multinational companies globally integrate complementary technology, capital, branding, channels and also low-cost labor resources. Transnational innovation becomes more popular, especially the globalization of transnational enterprises R&D has been the main force of world economy growth (Fagerberg et al., 2005).

Compared to those leading MNEs mainly from mature economies, most firms from emerging economies have always been regarded as latecomers in globalization of innovation Networks. These latecomer firms shall face the much different situation while adopting open strategies due to their unique policy institutions and innovation practices discussed above. Therefore, we need to understand how open innovation evolves in the long run and how latecomer firms could efficiently use open

innovation to catch up effectively.

Undoubtedly, the new opportunities faced by emerging players are obvious with the emergence of trends of globalization of innovation. The World Investment Report 2005 illustrates that some developing countries has an enhancing position of attracting transnational R&D investment and many more indigenous companies based on developing countries have taken part in the majority of internationalization of R&D. Under such a highly open condition, latecomer firms could globally integrate all the potential resources of technology, manufacture, raw materials, channels and brand, which means that Chinese firms should acquire the knowledge resources distributed globally (Jiang, 2004; Xiong and Li, 2008). Roman was not built in a day. Due to the weakness of S&T foundation in China, the formation of innovation capability generally need to pass though technology learning process and extroverted technology learning cannot get away from international cooperation. In fact, most Chinese enterprises have begun much earlier to take advantage of R&D resources overseas to carry out indigenous R&D. In 1990s some Chinese companies in Shanghai have been the forerunners of Chinese overseas R&D investment and since 2000 this phenomenon became generally popular especially in ICT industry. As to relationship between contemporary science and technology, and even different industries is closer than before, companies feel much more dependent on outer resources. Given Chinese high-tech industry with high monopolization as an example, it is really harder for them to acquire critical technology from TNEs in China and this make them have to go out to look for suitable R&D resources by themselves. At the same time, it will be a new choice for Chinese enterprises to make great use of globalization of innovation and comparative advantage to reorganize international resources. Gassmann (2006) recognized some specific trends, including globalization, technology intensity, technology fusion, new business models and knowledge leveraging, are he factors that drive higher performance of open innovation models. In fact, these above trends are equivalently prominent in today's China. Hence it is increasingly accepted that 'the era of open innovation' has flourished in Chinese market.

What's more, it is important to understand some inherent status quo in the on-going practice of open innovation strategy. In fact, many Chinese enterprises have not developed their technology in a close way to enhance their indigenous innovation capability. On the contrary, they have learned to take advantage of global R&D resources, for example, they can make it by introducing, digesting and absorbing advanced foreign technology and then further study it. In addition, they can actively participate in international scientific and technological exchanges and cooperation for the realization of open innovation. Japan and South Korea are two representative successful examples among late-comer countries and these two countries' governments and enterprises have accumulated abundant experiences of making good use of global R&D resources. GAO and LI(2007) specially conclude seven primary experiences, which are technology import and purchase of advanced facilities; attaching great importance to international R&D person with ability; encouraging employees to attend in a overseas advanced studies; setting up R&D organization overseas; collaborating with foreign companies; not neglecting internal R&D; government's effective intervening. A large of facts illustrate that there have been some Chinese enterprises make great improvement through cooperation. A

good example is that ZTE, a Chinese leading IT company, via building R&D organization overseas, is in the wake of industry's technology and product developing trend, do the architectural R&D overseas and do the final product innovation at home, which produces outstanding effect.

6.2 Challenges of open innovation in China

Admittedly, there are a number of challenges for latecomer firms to benefit from openness. First, as China's economy has been highly opened and the degree of domestic competition has become increasingly high, most of the Chinese firms need to learn how to and build up the competence to make good use of global innovation resources under such a highly open condition. Moreover, as regards international R&D cooperation which generally refers to reorganization of R&D personnel, R&D expenditure, R&D facility and R&D information distributed across different countries or regions, it is also difficult for them to share the R&D harvest and even the interact-influence between collaboration and local politics, economics, culture and military. Till now, many leading Chinese enterprises choose to do M&A deals as efficient methods. However, M&A is not very suitable for all Chinese enterprises especially to achieve technology absorption due to much limited technological capability themselves; for example, it is hard to make the foreign R&D personnel, cross-national managers stay. What's more, some social organization in developed countries and customers are lack of identity with Chinese corporations. For instance, TCL, a leading Chinese transnational manufacture company, once fell across a series of difficulties. On one hand, it is almost impossible for TCL to get into local association of producers or industry guild so that it cannot get relative service and information support. On the other hand, it also lack of persons with ability that know the rule of local business operation, be familiar with local language and laws. Although TCL has invited foreign consulting company to help it promote its brand, the results are quite unfavorable because there is no brand loyalty connection between overseas customers and TCL.

Besides, we have to hold a cautious attitude towards recognizing and conducting open innovation in different contexts, in particular for catching-up economies. Admittedly, open innovation is not an imperative for every company and every innovator (Gassmann, 2006). Openness is not strictly a choice for the firm but an outcome of capabilities, industrial organisation and wider innovation systems (V. Acha, 2008). Existing literatures also argue that latecomer enterprises cannot rely too much on global R&D resources. In fact, the development of Chinese automobile industry obviously proves this point. Most of joint ventures are unwillingly share their core advanced technology know-how and invest too much on developing key technology or radical innovation in China due to their worries about losing leading advantage. For example, in the past several decades, the vehicle models, introduced by those joint ventures in their early time of entering Chinese market, are always the outdated ones from those foreign cooperators. Except the matter that the overall market demand is relatively low-end, the more intrinsic reason is attributed to the worry and unwillingness of those foreign partners. Mostly Chinese cooperators are just do little incremental improvements and then have to be plunged into the old technological path and also merely focus on the low value-added manufacture, which embarrass them to be in hot water, like negative path-dependent of

manufacturing and high sediment cost or transformation cost. Therefore, latecomer firms should have a clear and rational estimation when choosing appropriate partners, especially foreign entrants. Having an effective management mechanism to deal with potential conflict or to address potential risks, when adopting open innovation, is of great significant meanings for those latecomer firms.

7. Conclusions and discussions

Open innovation has been a new innovation paradigm and a future trend widely accepted and adopted by scholars and practitioners in the increasingly globalization era. This paper provides the first systematic review of the policies and practices of open innovation in China. In general, open innovation is not a new phenomenon in China. In fact, it has been a long-evolving and on-going innovation mode adopted by Chinese firms in the past three decades. In other words, open innovation is a 'new' concept towards innovation strategy based on a mix of 'old' and 'new' practices in China. Although OI is a recent concept, both Science & Technology and economic policies in china have to a great degree incorporated the creation and facilitation of open market environment and innovation atmosphere and the encouragement of external knowledge sourcing and acquisition as well as the commercialization of scientific research discoveries and inventions. Although the implementation and execute of the policies at national, regional, especially the firm-level varied greatly across regions and firms depending on the interpretation of the policies and the capabilities of local government and firms, the Chinese firms have no doubt moved to the direction of making good use of external knowledge for indigenous technological capabilities building. As a strong developmental state which is widely accepted in the literature, the Chinese government has played a crucial role in the national innovation system in initiating and coordinating a wide set of institutions and incentives. All the innovation related financial, tax, industry, trade and S&T *policies* have served as effective *linkages* that linked all the relevant players at various levels of the national innovation system and ensure that national innovation strategy is passed on from the top to the firms at the lower level.

The evolution of the orientation of the policies and hence the practices adopted by the Chinese firms echoes the different stage of economic and technological development in China. From encouraging all-around external sourcing since 1980s, policy makers have diversified channels of commercializing innovation in the mid-1990s. Since 2000s, with the increase of the globalization and the growth of technological capabilities of Chinese firms, the policy orientation has become more open and aggressive to incentivize indigenous companies to acquire advanced external knowledge through 'going global'. All this reflects the Chinese government's objective of promotion of indigenous innovation in a highly open era. Despite the strong government policy support to open innovation, however, some critical institutional challenges, such as the lack of a strong intellectual property rights regime to protect and facilitate 'knowledge-sharing', still need effective efforts to

address for greater diffusion and adoption of open innovation in China.

Increasing globalization and changes in global innovation landscape as it applies to emerging economy firms have been driven the shift to more open innovation mode. Our review of the practices of OI adopted by selected domestic firms suggest that Chinese firms have adopted a variety of OI practices, for example, the outside-in mode, the inside-out mode and the coupled mode have all been used by Chinese firms in different industries and at different stage of technology development. Therefore, future research should explore systematically as to why and how latecomer firms can efficiently use open innovation for catch-up. In particular, what is the role of OI in emerging economies? How can the emerging economies make best use of open innovation for indigenous capabilities building? These are important questions for in-depth understanding of open innovation in later comer and emerging economies.

On the other hand, technological learning is regarded as a necessary process for latecomers to improve their technological capabilities, skip the repeated technological manufacturing cycle, and thus avoid the huge investments in technological system in the initial stage, and to catch up with the developed countries (Hobday, 1995). The ability to use inside-out and outside-in strategies is facilitated by frameworks that allow for the purchase or sale of intellectual assets that can create value and opportunities for firms inside or outside their core businesses. Therefore, technology markets and IPR protection regime matter in fostering open innovation.

Moreover, firms may differ in their modes of learning. Some learning modes are superior to others in terms of the learning outcome in a particular situation (Li and Kozhikode, 2009). While firms might have a variety of sources to choose from, the path dependency of learning and the learning outcome makes it difficult to gauge the value of a given learning source a priori. Hence, the other revenue for future research should concern what are the best learning strategies for latecomers to deal with various technology or organization challenges in opening their innovation processes. More in-depth industrial or firm-level case studies or relevant large-scale empirical surveys should be carried out in the future.

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Footnotes:

[1] This survey - China Innovation Survey - was conducted in October 2008 and co-implemented by National Bureau of Statistics of China and Research Center for Technological Innovation of Tsinghua University. The scale of this survey covers all industrial sectors of Chinese economy, including 1408 firms spreading 42 cities country-widely (which refer to all the effective questionnaires received). The main content of this survey is to investigate firms' situation of general innovation in the recent three years, from 2005 to 2007, which contains plentiful items to measure various indexes of innovation activities for those indigenous firms in China. The method and types of questions used in this innovation survey are primarily based on the Olso Manual (OECD, 1997, 2005) and also the core Eurostat Community Innovation Survey (CIS) of innovation (Stockdale, 2002; DTI, 2003), although with some adaptive adjustments because of the different survey context.

[2] 《中共中央国务院关于实施科技规划纲要增强自主创新能力的决定》

[3] 《国家中长期科学和技术发展规划纲要（2006 - 2020 年）》

[4] 《中华人民共和国技术引进合同管理条例》（1985），《中华人民共和国技术进出口管理条例》（2001），

"第七条　国家鼓励先进、适用的技术进口";"第三条　引进的技术必须先进适用，并且应当符合下列一项以上的要求：（一）能发展和生产新产品；（二）能提高产品质量和性能，降低生产成本，节约能源或材料；（三）有利于充分利用本国的资源；（四）能扩大产品出口，增加外汇收入；（五）有利于环境保护；（六）有利于安全生产；（七）有利于改善经营管理；（八）有助于提高科学技术水平"。

[5] 关于印发《关于推进引进技术消化吸收的若干规定》的通知（1986）

[6] 《国务院关于鼓励外商投资的规定》（1986），

"第一条　为了改善投资环境，更好地吸收外商投资，引进先进技术，提高产品质量，扩大出口外汇，发展国民经济，特制定本规定。"第八条　产品出口企业按照国家规定减免企业所得税期满后，凡当年企业出口产品产值达到当年企业产品产值７０％以上的，可以按照现行税率减半缴纳企业所得税。"第九条　先进技术企业按照国家规定减免企业所得税期满后，可以延长三年减半缴纳企业所得税。"

[7] 《国务院办公厅转发外经贸部等部门关于当前进一步鼓励外商投资意见的通知》（1999）

"一、鼓励外商投资企业技术开发和创新，扩大国内采购；(二)对外商投资企业在投资总额内采购国产设备，如该类进口设备属免税目录范围，可全额退还国产设备增值税并按有关规定抵免企业所得税。(三)外商投资设立的研究开发中心，在投资总额内进口国内不能生产或性能不能满足需要的自用设备及其配套的技术、配件、备件，免征进口关税和进口环节税。对其转让技术比照国内科研机构免征营业税。(四)外国企业向我境内转让技术，凡属技术先进或者条件优惠的，经国务院税务主管部门批准，可以免征营业税和企业所得税；外商投资企业取得的技术转让收入免征营业税。";"二、加大对外商投资企业的金融支持力度";"三、鼓励外商向中西部地区投资";"四、进一步改善对外商投资企业的管理和服务"

[8] 《外商投资产业指导目录》（每年由商务部、发改委、海关总署等机构联合发布、更新）

[9] 1999 年中共中央国务院颁布了《关于加强技术创新、发展高科技、实现产业化的决定》。该《决定》包括四个部分：1）加强技术创新，发展高科技，实现产业化，实现社会生产力的跨越式发展；

2）深化科技体制改革，促进技术创新，促进高技术研究成果的商业化和产业化；3）采取有效措施，建立有利于技术创新、发展高科技，实现产业化的政策环境；4）加强党的领导。

[10] 《中华人民共和国促进科技成果转化法》（1996）

“第九条　科技成果持有者可以采用下列方式进行科技成果转化：（一）自行投资实施转化；（二）向他人转让该科技成果；（三）许可他人使用该科技成果；（四）以该科技成果作为合作条件，与他人共同实施转化；（五）以该科技成果作价投资，折算股份或者出资比例。”；“第十条　企业为采用新技术、新工艺、新材料和生产新产品，可以自行发布信息或者委托技术交易中介机构征集其所需的科技成果，或者征寻科技成果转化的合作者。”；“第十一条　企业依法有权独立或者与境内外企业、事业单位和其他合作者联合实施科技成果转化。”

[11] 国家经贸委、财政部、科学技术部、国家税务总局关于印发《国家产业技术政策》的通知（2002）

“建立以企业为中心，风险共担的产学研结合机制：建立企业与大学、科研院所的产学研联合体，形成以市场为导向的研究开发体系和开放式的产学研合作机制，根据我国技术比较优势、战略需要，选择独立开发、自主发展领域，通过系统集成，相互融合，探索新的技术路线，开发具有自主知识产权的技术”；“以市场为导向，加强技术创新，发展高科技，实现产业化。做好技术引进工作，支持鼓励国内企业在境内外建立合资合作技术研发机构，鼓励外商投资企业在国内建立研究开发中心，促进技术扩散”；“建设风险投资机制，发展社会风险投资机构，重视培养风险投资管理营运人才，逐步建成以社会资本为主体的风险投资体系与风险投资基金，形成风险投资的多元投入结构。对国内外风险投资机构向高新技术产业进行风险投资实施鼓励政策。支持高新技术企业在证券市场融资，促进中小型科技企业的发展。”

[12] 《科技兴贸行动计划》（1999）