

Please cite this paper as:

Zhao, M. (2010-09-14), "Policy Complements to the Strengthening of IPRS in Developing Countries - China's Intellectual Property Environment: A Firm-Level Perspective", *OECD Trade Policy Papers*, No. 105, OECD Publishing, Paris. <http://dx.doi.org/10.1787/5km7fmtw4qmv-en>



OECD Trade Policy Papers No. 105

Policy Complements to the Strengthening of IPRS in Developing Countries - China's Intellectual Property Environment

A FIRM-LEVEL PERSPECTIVE

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Unclassified

TAD/TC/WP(2010)12/ANN/FINAL

Organisation de Coopération et de Développement Économiques
Organisation for Economic Co-operation and Development

14-Sep-2010

English - Or. English

**TRADE AND AGRICULTURE DIRECTORATE
TRADE COMMITTEE**

Working Party of the Trade Committee

**POLICY COMPLEMENTS TO THE STRENGTHENING OF IPRS IN DEVELOPING COUNTRIES:
ANNEX**

CHINA'S INTELLECTUAL PROPERTY ENVIRONMENT: A FIRM-LEVEL PERSPECTIVE

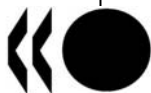
OECD Trade Policy Working Paper No. 105

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JT03288213

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**TAD/TC/WP(2010)12/ANN/FINAL
Unclassified**

English - Or. English

ABSTRACT

Along many dimensions, China has made progress in strengthening the protection of intellectual property (IP) and expanding its research and development (R&D) base over the past two decades. Meanwhile, people's understanding of IP has gone beyond a mechanical interpretation of patent law or copyright law. Instead, with years of experience in innovation, imitation and knowledge management, firms have begun to realize that IP protection is part of a complex business environment including various cultural, economic and strategic factors. This study takes a firm-level perspective and addresses two related topics. First, the paper examines the IP environment faced by various firms. In particular, the importance of IP protection and the strength of protective measures vary widely depending on the firms' ownership structures and industry characteristics. Second, the paper analyzes firms' strategic responses to the perceived IP environment. Firms not only adjust their R&D strategies, but also product and marketing strategies based on their assessment of the IP environment, which may have significant implications for China's economic development in general. The paper concludes that momentum for IP reform is related to the economic potential in China. Such reform is an on-going system project involving not only patent, trademark and copyright laws, but also privatization policies, trade and FDI policies, as well as the role of the government in China's innovation strategy.

Keywords: intellectual property rights, China, innovation, patents, copyright, trademarks, policy reform, economic development.

ACKNOWLEDGEMENTS

This study was prepared by Minyuan Zhao, consultant to the OECD Trade and Agriculture Directorate.¹ The paper has benefited from helpful comments from delegates to the Working Party of the Trade Committee and from editorial review by the OECD Secretariat. The Working Party of the OECD Trade Committee has agreed to make this paper more widely available via declassification.

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TABLE OF CONTENTS

CHINA’S INTELLECTUAL PROPERTY ENVIRONMENT: A FIRM-LEVEL PERSPECTIVE 4

1. Introduction 4

2. The Status Quo 5

3. Intellectual Property Environment and Firm Heterogeneity 8

4. Strategic Responses to the Intellectual Property Environment 12

5. Conclusion and Discussion 15

REFERENCES 17

Figure

Figure 1. Chinese Patent Grants to Domestic and Foreign Applicants 19

CHINA'S INTELLECTUAL PROPERTY ENVIRONMENT: A FIRM-LEVEL PERSPECTIVE

1. Introduction

1. In recent years, China has developed into one of the most attractive investment destinations, not only for labour-intensive manufacturing but also for innovative and high-tech industries. However, the uncertainty around the protection of intellectual property (IP) is still an important deterrent for foreign as well as domestic firms engaging in research and development (R&D)-related activities. Despite the tremendous progress in the legal system, IP protection in China is associated with a series of cultural, economic, and political factors that significantly affect the incentives and outcomes of innovation efforts.

2. Unlike the legal system, the complementary forces behind IP protection vary across different types of firms. Small, private enterprises, for example, will find more constraints in financing R&D and retaining talents compared with the large state-owned enterprises (SOEs) or multinational enterprises (MNEs). Meanwhile, SOEs' R&D agendas are directly affected by the government's push for "indigenous" IP², less so for those of private firms. The type of R&D activities also matters: While firms aiming for frontier technologies are concerned about the legal enforcement of patent rights, firms focusing on reverse engineering and manufacturing excellence would find other factors, such as market access and local protectionism, much more relevant. Thus, it is important to look into the heterogeneity of firms and firm strategies in order to have a comprehensive view of the IP environment in China.

3. Two unique features of the Chinese economy further highlight such heterogeneity. First, culturally, it is a celebrated effort to learn a trade from others and bring it to perfection. Fernandez and Underwood (2006) tell of stories dating from the 1650s in which the Chinese would produce and perfect most things to the extent that these counterfeited goods were impossible to differentiate from the original European products! In the 21st century, the "Tomato Garden" (a pirated version of Microsoft's Windows XP) and the HiPhone (a counterfeited version of Apple's iPhone) have large followings in China, not only because of their relatively low costs, but also because of the imitation skills embraced by the society. Second, in the current political economic structure of China, it is important to recognize that policy-making at the level of the central government is not always consistent with the enforcement at the local level. With economic success – represented by GDP growth – as a criterion of compensation and promotion, the local officials have strong incentive to maintain a discretionary intellectual property rights (IPR) policy despite the numerous national campaigns to crack down piracy. This is especially true for regions where the local economies rely heavily on imitation (Lieberthal and Lieberthal, 2003).

4. Given these two features, economic integration in the world economy often plays a larger role in driving reform of the IP environment in China than international political pressure or lecturing from the Western powers. While IPR enforcement varies across regions in China (Lin *et al.*, 2009), authorities in areas with a high level of foreign investment are more aware of IP issues and are usually more proactive in protecting IP for the sake of local economic development (Ordish and Adcock, 2008).

5. As more and more Chinese firms develop their R&D capacity and accumulate IP, the general public's perception of IP will change and a greater domestically-driven push for stronger IP protection is expected. Although China only accounts for 3.5% of triadic patents – patents filed in Japan, the US and major European countries – China aims to increase R&D spending to 2.5% of GDP and join the top five

² Indigenous IP is a reference to IP that is developed and owned by Chinese entities.

countries receiving triadic patents by 2015.³ To get ready for global competition, Chinese companies are also consciously building up their IP portfolios. When the Shanghai Automotive Industrial Corporation (SAIC) acquired Britain's MG Rover, Beijing Automotive Industry Holding Group (BAIC) agreed to buy relevant assets from SAAB, and Geely Auto negotiated for the takeover of Volvo from Ford Motors, access to technology, brand name and other IP assets was the main motivation.

6. This report will analyze the current IP environment from a firm-level perspective. After a brief review of the current literature, I discuss the complementary factors in the IP environment and how they are relevant to the different types of firms. I further examine the various strategies firms apply to meet the changes in – or take the opportunities offered by – the current IP environment. Implications for China's future economic and social development will also be discussed. The report is based on interviews conducted with managers from more than 50 firms, as well as with researchers in China. Specifically, the interviewed managers represent a wide spectrum of firms across geographic regions (*e.g.* coastal cities vs. inland towns), ownership structures (state owned enterprises, small and medium size enterprises, and multinational enterprises), and industries (*e.g.* pharmaceutical vs. electronics).

7. At this point, it is worth mentioning that there are three limitations of this report. First, the formal legal and institutional aspect of IP protection in China has been well documented in academic research (*e.g.* Bird, 2006 and Yu, 2006) as well as in public media. This report will only give a brief description of the legal background while giving more emphasis to the complementary factors in the environment related to IP protection. Second, in a country with such rapid economic and social changes, it is often hard to draw a clear boundary between innovation and imitation. Hence, the following analysis will not explicitly categorize the two. Finally, given the size and diversification of the country, it is impossible to be all-comprehensive in this report. Instead, it will focus on cases representing several key sectors of the economy and thereby highlight examples of the most important complementary factors.

2. The Status Quo

2.1 *Intellectual Property Laws and Enforcement Mechanisms*

8. Chinese IP legislation has come a long way since the early 1980s, when the first major trademark and patent laws came into existence. China's desire to join world organizations seemed to accelerate the progression of its IPR laws. China signed up for the Paris Convention for the Protection of Industrial Property in 1985, the Berne Convention for the Protection of Literary and Artistic Works in 1992, and the Geneva Convention for the Protection of the Producers of Phonograms in 1993. After minor amendments throughout the 1990s, China revamped its IPR laws in 2001 in line with the Agreement on the Trade-Related Aspects of Intellectual Property Rights (TRIPS) when bidding for WTO membership. Trade scuffles with the United States have also heavily influenced the amendments in China's IPR policies in recent years.

9. Through these rounds of amendments, the coverage and strength of IP protection in China saw significant progress from a very low starting point. For example, the State Intellectual Property Office (SIPO) dramatically increased the number of patent examiners, adding hundreds of well-trained examiners to the payroll, which increased the speed of patent examination and, to some extent, the quality. The typical cost of patent applications is significantly lower than in the U.S or EU, and the wait time between patent application and patent grant in approximately the same range as in other major economies. Figure 1 illustrates the fast increase of patent grants in the past decade, to both domestic (Panel A) and foreign applicants (Panel B).

³ Triadic patents are considered as representing relatively high quality in terms of content since they represent novel ideas in the developed world. Moreover, because patents protect the owners' IP rights within the granting countries, applying for triadic patents is often an indication of future entry into these markets.

10. The enforcement of intellectual property rights in China is carried out in two parallel systems: the administrative system and the judicial system. Typically, minor infringements are solved administratively while the more serious cases are brought to China's tiered court system.

11. In most cases, administrative settlements are favourable over a judicial ruling. However, two problems linger in the administrative system. First, local authorities are not necessarily motivated to act toughly towards IP infringers. The Chinese saying "the sky is high and the emperor is far away" vividly captures the autonomy that is enjoyed (or rather, abused) by some local authorities. Second, the administrative system is highly fragmented with too many "bosses" to achieve better coordination. For example, around the State Council reform in 1998, the Patent Office became part of the State Intellectual Property Office. The Trademarks Office is still under the authority of the State Administration for Industry and Commerce. The Copyright Office falls within the State Administration for Press and Publication. The China Intellectual Property Rights Protection website ("IPR in China"), meanwhile, is sponsored by the Ministry of Commerce (MOFCOM).⁴ A similarly fragmented system exists at various levels of local governments. Enforcement of IPRs in the administrative system is assisted by police from the local Public Security Bureau (PSB), while the Administration for Industry and Commerce (AIC) and Quality Technical Supervision Bureau (QTSB) are the two main government agencies that levy fines and confiscate/destroy counterfeit goods (Mertha, 2005).

12. The legal system has its own problems. The quality of the lower level courts varies widely across regions, and local governments' protectionist influences still exist to various degrees. In addition, corruption remains a problem at the local courts. To establish confidence in the Chinese legal system, the State Council of China released the "National IP Strategy" in June 2008, which calls for a specialized IP court that deals with all IP-related civil and criminal cases.⁵ In March 2009, China's Supreme Court announced detailed guidelines about the tribunals dedicated to IPRs disputes. On a trial basis, a 3-in-1 system was established that combines the handling of civil, administrative and criminal IP cases in one chamber of each competent Chinese court. However, this trial system is not yet applied nationwide, pending an eventual evaluation. Nevertheless, for companies that have properly laid out their IP strategies, it is now quite feasible to defend a patent or trademark through the Chinese court or administrative systems. While difficulties remain, multinational companies are now generally able to pursue legal cases against patent infringement and often they win (though in many cases, the infringements were pretty obvious).

2.2 Cultural and Social Factors behind Intellectual Property Protection

13. Two decades ago, the biggest barrier to strong IP protection would have been the lack of awareness in the general public. For one, "book stealing" (stealing for the purpose of learning) traditionally carried less of a stigma than stealing of other physical properties; in addition, low levels of economic development and standard of living made the consumption of imitated goods a pragmatic choice for many people. After all, when one's material life was limited, there was little room for the respect of intangible properties. However, IP awareness has improved significantly in recent years, particularly in big cities and coastal areas. IP educational programmes are being carried out in primary and secondary schools, universities, and corporations, as well as government agencies.

14. Chinese companies have begun to realize that IP-related issues are an inevitable part of business. Contracts throughout the supply chain have begun to contain more detailed specifications on IP: Who owns the technologies resulting from collaboration? How and when should they be licensed to a third party, and

⁴ The China IPR website can be found here: <http://www.chinaipr.gov.cn/>.

⁵ Previously, special IP courts had already been established in some cities and provinces. At the level of the Higher People's Court in Beijing, Shanghai, Guangdong, Fujian and Hainan, IP courts had been separated from the economic division. Beijing, Shanghai and Tianjin have also established IP courts within the Intermediate People's Court. In 1992, the Supreme People's Court established an IP division.

at what costs? What happens to the IP upon the termination of the contracts? Such sophistication is the direct result of IP education and increasing interactions with the global players. In the increasingly rampant collaborations between universities and industry, IP has become a crucial tool in regulating relationships and guarding against appropriability risks.

15. A recent concern is the surging popularity of China's "Shanzhai Culture" (山寨文化), a culture that embraces copying or cloning. Imitators of electronics and popular TV shows proudly introduce their Shanzhai versions to the market, emphasizing their excellent value propositions. The phrase "Shanzhai", which literally means "mountain villages" in Mandarin, in fact portrays the mixed feelings that today's Chinese public have towards IP infringement. On the one hand, "mountain villages" are typical locations of pirates in the traditional folk literature, so the phrase contains the negative message of grabbing valuables without pay. On the other hand, the pirates in the literature usually raid rich tycoons or corrupted officials in order to help the sick and poor, often in a heroic fashion. In that sense, the adoption of the phrase "Shanzhai" implies that the imitators are rebellious against state authority or foreign monopolies, and that somehow the pirates have outwitted the law enforcement officials.

16. Government crackdown on Shanzhai products is unlikely to be effective. Last April, Tian Lipu, director of SIPO, publicly condemned the Shanzhai culture in a press conference. He emphasized that the Shanzhai products violated others' IP and hence should be regarded as piracy rather than innovation. Without paying for the original R&D, Shanzhai producers are engaging in an unfair competition, taking incentives away from true innovation. Such criticism from the government has little impact on Shanzhai's supporters, who tend to defy authorities and take pride in circumventing the law. Furthermore, many supporters argue that Shanzhai products often incorporate new features or higher cost-efficiency. If anything, their existence reflects advanced reverse engineering skills and manufacturing capabilities. For example, the Shanzhai versions of Apple's iPhone often enable multimedia short messages, radio, and user interfaces more friendly to Chinese users. Advocates of stronger IP protection in China surely have reason to worry about such public tolerance of imitation.

17. Employee mobility, which is common in an economy experiencing fast development, is another factor complicating IP protection. Roberts (2006) detailed many high-profile talent hunts in the Chinese auto industry. For example, when SAIC, the joint venture partner of Volkswagen and General Motors (GM) in Shanghai, decided to push for its own proprietary brands, it relied on some key talent from the joint venture partners and subsidiaries. Former GM executive Philip Murtaugh was hired to run the overseas operations, while former Shanghai Volkswagen (SVW) veteran Wang Xiaoqiu served as the general manager of SAIC Motor. Chery, a private automaker specialized in low-cost compact cars, has a former Ford executive heading its R&D division and a former DaimlerChrysler executive running its international operations. While labor mobility is completely legitimate, and is often helpful with efficiency gains and economic growth, high levels of labor mobility also undermine the companies' incentive to groom talent and complicate IP management and negotiation of deals concerning IPRs.

18. Information asymmetry in the product market constrains healthy competition and discourages firms that are serious in innovation. For example, in the market for health food and nutrition supplements, there is almost no effective regulation against fraudulent advertising. As a result, the market is filled with "new products" that can "make miracles happen." Confused consumers withdraw from purchases, and true quality products get plagued by competition from the "lemon's" market. To many firms in the industry, unregulated competition can be more damaging to innovation than weak legal enforcement of patents.

19. Finally, China's drive to achieve technology independence also adds complexity to its IP policies. After being constrained by the dominance of western technologies for so many years, China is eager to obtain its own proprietary IP and introduce its own "flagship" industries. From magnetic levitation (maglev) trains to oil-drilling gears, from wireless communications to commercial aircraft, national pride often gives legitimacy to behaviours that are at the border of IP laws. Of course, as explained below, this will affect different firms to different degrees.

2.3 Implications for Firm Strategy and Economic Development

20. Low confidence in the Chinese IPR regime, uncertainty in the rule of law, bureaucracy and complication in human resource management are often cited by business representatives as barriers to R&D. In a 2004 survey conducted by the Economists Intelligence Unit (EIU), 84% of executives cited inadequate IP protection in emerging economies as a challenge for R&D globalization. For example, weak protection against IP infringement creates serious concerns among MNEs that intend to enter China (Ordish and Adcock, 2008). Even if they enter, the strategies they choose can be significantly affected by the IP environment. According to Hagedoorn *et al.* (2005), the protection of IP is fundamental in international partnering arrangements related to R&D.

21. Domestic firms are not immune to the uncertainty in the IP environment. In particular, entrepreneurial firms that do not possess the organizational capacity to overcome the adverse external environment tend to be the most vulnerable (Zhao *et al.*, 2010). Meanwhile, government interference in SOEs, via direct decision making or appointment of top management teams, also discourages innovation (Lin *et al.*, 2009). Although some would argue that most of the domestic firms are still beneficiaries of lax IP regulations at this stage, the opposite effect is emerging quickly.

22. Thus, the comprehensive IP environment will affect not only the level, but also the composition of R&D activities in China. The gradual improvement of IP protection in recent years should boost the innovative roles of small businesses and pure R&D firms. Of course, the IP environment is often endogenous. In the U.S., federal policies towards patent protection changed significantly around the 1920s with the emergence of large corporate R&D centres. The 1980s again saw significant changes in the patent law in response to the global competition with Japanese manufacturers (Fisk, 2009).

3. Intellectual Property Environment and Firm Heterogeneity

3.1 Reasons for Firm-specific Environments

23. While the macro environment is important, most firms are primarily concerned about the micro environment that is directly relevant to them. Depending on the corporate status, organizational structure, and type of research conducted by the firm, the actual IP environment can be quite different.

24. First, effective access to the legal system can vary widely across different types of firms. While it is true around the world that legal enforcement requires deep pockets and sophisticated legal expertise, climbing the learning curve about the operation of the system can be an even greater barrier, thus deterring many firms that do not have the resources or experience with IP laws.

25. Second, imitators will not be in trouble as long as the IP holders do not take any action, either because of high costs or because of low returns. On the cost side, it can be an uphill battle against some well connected companies, *e.g.* SOEs in strategic industries, MNEs in monopolistic positions, etc. On the return side, the gains from winning a case against a small firm in a specific niche market – often too small to achieve the economies of scale – are so trivial that the IP holder decides to leave it alone. As a result, not all firms face the same constraints even though they are facing the same law.

26. Third, the scope of R&D activities matters. Product innovation is often more vulnerable to immediate imitation than process innovation, and innovations with highly visible features are easier to defend than those aiming for efficiency gains. This is consistent with findings from enterprise innovation surveys – the Yale Survey (Levin *et al.*, 1987) and the Carnegie Mellon Survey (Cohen *et al.*, 2000) – that different industries and different types of R&D activities call for different aspects of IP protection.

27. Finally, IP is only one of the many considerations when managers balance their strategic priorities, and firms sometimes have to compromise on the defence of their IP for the purpose of achieving other strategic goals. For example, an auto component manufacturer eager to join the supply chain agreed to

work with an original equipment manufacturer on a new design, knowing that confidentiality may be breached in the future.

28. The following sub-sections describe the IP environments from the perspectives of three types of enterprises: small private firms, large SOEs, and MNEs with global R&D networks. The purpose is to illustrate the commonality as well as variations across firms, and prepare for the discussion on the IP strategies adopted by various firms.

3.2 *Perspectives from Small Private Enterprises*

29. The conversations conducted by the author with numerous small business owners all lead to the same set of challenges in R&D and IP protection: attracting and retaining talents, establishing trust in the high-tech field, and overcoming bureaucracy and policy uncertainty.

30. First, R&D is a long-term commitment, which needs a stable workforce. The new Labour Law, which took effect on January 1, 2008, has given employees much more freedom to switch jobs while imposing tighter restrictions on employers. With relatively small R&D forces in small enterprises, departure of a key engineer can be highly disruptive or even detrimental to an R&D project, discouraging serious pursuits of innovation. Take the example of a software company in Guangzhou. After the departure of a team leader early last year, the managers decided to keep certain degree of redundancy in the workforce in order to maintain the continuity of R&D. Of course, such a practice significantly increases the product development cost.

31. Second, patents as certifications of exclusive rights to technologies usually come late in the innovation process. As a result, small businesses find it difficult to obtain trust from their clients and business partners before patents are granted. In the case of a manufacturer of high-end machinery in Zhejiang province, the company had to rely on strategic alliances with universities and R&D centres at large corporations to obtain the necessary credential in market competition. However, this was at the cost of less control of information and less control of the whole development process. By the time the necessary test results for the patent application became available, the alliance partners may have taken the information somewhere else. According to the managers, such vulnerability will remain despite the increasingly strong legal protection for IP and enforcement of IPRs.

32. Interestingly, the feeling of vulnerability is often mutual. A biotech lab established by two recent returnees with U.S. degrees would love to offer R&D services to local small businesses. They have cutting-edge equipment and years of experience to expedite the development process. However, the local small businesses are concerned about knowledge appropriation by R&D service providers, and are reluctant to seek help. As a result, the biotech lab mostly serves large multinational R&D centres that have developed trust through repetitive project assignments and interpersonal ties. In fact, as with other business interactions in China, interpersonal ties still play an important role in establishing the necessary initial trust.

33. Third, on the policy side, most small businesses welcome the government support for R&D. For example, tax incentives to high-tech firms in Economic and Technology Development Zones or subsidies for R&D expenditures are a tremendous help for small firms scrambling for cash. However, one of the biggest challenges is the lack of transparency in competition. Unlike manufacturing firms, where quality can be measured by objective criteria such as defect rates or continuous running time, the competitive advantage of high-tech firms is often intangible. Thus, a level playground with fair competition and equal market access becomes even more important. “Unfortunately, we do not always have that,” said a manager of GD, a 10-year-old firm that offers software solutions for information security. For example, the company did not know about a large public project open for auction bids until after the deadline. It turns out that the invitation was never widely publicized. The manager had to spend a large amount of time and effort just to connect to the project insiders and convince them of GD’s unique technological capabilities.

34. Bureaucracy and barriers to market access can be a challenge too. GD has to obtain all kinds of certifications in order to participate in certain projects, but the guidelines for obtaining these certifications are never transparent. There are certifications from the military, certifications from the various ministries, and certifications from various levels of the government, each of which could easily cost tens of thousands of *yuan*. To a certain extent, these certifications are not so much about technical qualification. Rather, they are part of the cost of doing business in an opaque competition environment. Similar situations can be found in the pharmaceutical industry. With the distribution channels still opaque and sometimes distorted, the market is beyond the reach of small players. Good products may never reach the market without going through the multiple levels of marketing channels, often involving kick-backs to local regulators, doctors, sales representatives, etc.

35. Without incentives in conducting long-term R&D, a lot of industrial firms have diverted resources to real estate. “Younger,” a brand-name apparel designer and manufacturer, has become a real estate investor while making clothes on the side. Among the thousands of serious manufacturers in NingBo, “Shan Shan,” an apparel producer specialized in high-end suits and shirts, is among a handful of companies still doing R&D, although it is in a totally unrelated industry, lithium batteries. Many observers consider such investments highly opportunistic.

3.3 *Perspectives from Large SOEs*

36. Unlike small businesses dealing with unstable workforces and uncertain market access, the large SOEs often enjoy preferential treatment from the government, which is eager to promote China’s technological independence. Therefore, the SOEs face a different set of opportunities and challenges in developing and managing proprietary IP.

37. In the strategic industries, innovation efforts are often focused in areas where “nationalization”(i.e., development of domestic technology supply) is a priority. For example, in the commercial aircraft industry, the Airbus A320 Family Final Assembly Line China (FALC) is a newly-established joint venture between Airbus and a Chinese consortium comprising Tianjin Free Trade Zone and China Aviation Industry Corporation (AVIC), charged with the task of meeting the increasing demand for commercial aircraft in China. In June 2009, it delivered the very first China-made aircraft to Sichuan Airlines. Also in June 2009, China’s first low- to medium-speed magnetic levitation (maglev) train with proprietary IP came off the production line at CNR Tangshan Railway Vehicle Company. This is significant given the reliance on German technologies for China’s first commercial maglev line in Shanghai. To increase technological independence in the wireless telecommunications industry, the Chinese government pushed for the home-made TD-SCDMA standard alongside the two mature global standards WCDMA and CDMA2000. The state-owned DaTang Telecom Technology Co., LTD, part of the DaTang Group, played a central role in carrying the mission forward.

38. One of the most prominent factors affecting innovation is the incentive system. Because the performance of R&D managers is measured by the number of breakthrough technologies and patents that fill national or international research gaps (“填补国内外空白”), the R&D activities are not always guided by market needs. Small innovations that aim at cutting waste, increasing efficiency, or improving quality and user friendliness are not as appreciated as they should be if considered from an economic perspective, even though such incremental changes can be critical in improving the firms’ market competitiveness.

39. In a new book, Breznitz and Murphree (2010) took a critical view at China’s technology initiatives, and argue that pursuit of global leadership in innovation happens to be the wrong prescription for the current need of the economy. Unfortunately, the “Run of the Red Queen” type of innovations – those that enhance the quality and efficiency of the manufacturing process, for example – are not properly rewarded in the SOE-led R&D system. When it is apparent that development of a cutting-edge innovation will entail a long delay, the companies would rather pay a high premium to acquire the newest foreign technologies than making marginal but valuable technological improvements. However, the value of such acquisition strategies is still up to debate. When SAIC took over part of MG Rover, it kept 150 former MG Rover

employees to develop SAIC cars for the European market. Whether or not it is a worthwhile move depends on the integration process that converts the development capability of the 150 employees to that of SAIC.

40. The second challenge for SOEs is shared by many large multi-unit firms. Innovation strategies set at the headquarters are sometimes detached from the specific implementation contexts at the subsidiaries, R&D centres, and joint ventures within the firm. Coordination efforts are further complicated by frequent executive turnover at various levels within the firm, as the executive positions at SOEs often serve as just a temporary stop in the career path of a government official.

41. Finally, because of their size and status, it is also more difficult for SOEs to avoid the limelight. In the past few years, ShangTex Holding Corporation, a large textile manufacturer in Shanghai, achieved two significant R&D milestones: a heat-resistant synthetic (PSA) fibre in direct competition with Dupont's Nomex fibre, and a Lyocell fibre serving a product market previously dominated by Austria's Lenzing Group.⁶ Given the significance of these two projects, ShangTex's progress was under close watch by the multinationals. In such circumstance, not only was patent violation impossible, ShangTex also had to face a fierce price war with the foreign exporters early in the commercialization process. One would imagine that their smaller counterparts would be subject to less scrutiny.

3.4 *Perspectives from MNEs*

42. MNEs have come a long way since their first interactions with China. Today's MNEs are much more sophisticated in laying out comprehensive IP strategies, managing information flows, and adapting to local institutions. As evidenced in Figure 1, MNEs account for the majority of invention patents in China. They are also more aggressive in using the court system to assert their IPRs. Nevertheless, the overall IP environment is still challenging for many MNEs.

43. First, there is still tremendous uncertainty about business relationships, including those of joint venture partners, suppliers and customers. Although firms are spending a large amount of effort crafting detailed contracts, they are not always effectively binding. On the management of supply relations, Chinese companies have great manufacturing capacities and are experienced in producing a wide variety of products; some of them are more than willing to release their own pirated versions while working on the supply contracts. One case in point is the fake "iPhone Nano" sets available for sale in some Asian countries in late 2008, even though Apple has never officially released the model. It was not clear whether these sets came from an Apple supplier, but many observers suspect that was the case, given how "authentic" the phones look.

44. Contracting relations with clients can face similar problems. A large multinational auto parts manufacturer had a tough time working with some of the Chinese assemblers. Because the assemblers did not possess advanced design capabilities, they had to rely on close collaboration with the supplier to develop the highly integrated components. However, despite large initial investments from both sides, the assemblers would terminate the collaboration upon the delivery of the very first product, and then take the same design to a cheaper local supplier. In the case of a leading supplier of oil and gas pumps based in the United States, a Chinese customer even sought their help in reverse-engineering the million-dollar pumps purchased from them! With China representing such a large percentage of the growing market, it is always a tricky balance to defend IP in front of the customers.

45. Frustration with production control is also behind the termination of many joint venture relationships. Due to policy restrictions as well as unfamiliarity with the local market, most of the MNEs in the automotive industry and elevator/escalator industry entered China with joint ventures. However, very few remain today. The MNEs are eager to take full control of the process when local R&D becomes

⁶ Partly out of IP concerns, Dupont and Lenzing have been relying on export rather than local production to meet the demand for these two products in China.

increasingly important, and they do not want their joint venture partners to produce similar products “on the side.”

46. The second concern is on high labor mobility. A Europe-based developer of cell phone games saw fast growth in its Chinese operation in the past decade. The Chinese teams have been performing exceedingly well, winning various awards and delivering excellent products to the headquarters. However, the company also has an honour that it accepts with much reluctance: the “West Point” of Chinese cell phone gaming industry. Many of former employees became key developers of competing companies or started their own companies. It was not a big problem when the products are mostly marketed in the U.S. and Europe, and when China was mostly a cost centre. But when China emerges as an important market, the company will see many familiar faces among the competition.

47. Finally, while courts are now much more accessible, results are still unpredictable and subject to occasional state interference. For instance, in 2004, China's patent review board sided with a group of Chinese generic drug makers and invalidated Pfizer's patent on sildenafil citrate, the main chemical in its anti-male impotence drug Viagra. Two years later, following President Hu Jintao's visit to the U.S. and his pledge on IP protection, a Beijing court backed Pfizer's patents. Of course, winning the patent battle has little to do with winning the market back, given the wide availability of Viagra knockoffs in China.

48. Another example is the “IP Case of the Year” in 2005, when Intel brought Shenzhen-based Dongjin Technologies to court, claiming that Dongjin had copied the header files from one of Intel's software products for communications cards. Intel asked for US\$7.96 million in compensation, the same amount as Dongjin's annual revenues in 2004. Three months later, Dongjin filed a counter-suit against Intel in a Beijing court, alleging that Intel was exercising its monopoly power in China. However, the bitter fight came to an abrupt halt in 2007 when two parties decided to settle the case and drop all legal proceedings against each other, a week before Vice-Premier Wu Yi headed for Washington to talk about Sino-US trade relations and economic issues including the protection of IP. Some analysts believed that Intel had successfully checked Dongjin's growth with the lawsuit when the market was in fast expansion, and it was no longer worth the effort to pursue the case after that. Others consider the case an indication of strong state influence in legal disputes.

49. Of course, as in many other areas, MNEs face liabilities of foreignness in developing and managing IP. In the cases of 3G wireless standards and the localization of aircraft production, for example, competition is on technological excellence as well as negotiation powers.

4. Strategic Responses to the Intellectual Property Environment

4.1 Literature on R&D Strategies under Imperfect Intellectual Property Protection

50. A large literature has shed light on firms' ability to profit from innovation despite imperfect external protection of IP. Teece (1986) emphasizes the possession of specialized and co-specialized complementary assets. Firms with strong manufacturing or marketing capabilities, for example, can maintain the lead even if technologies leak out to competition over time. Similarly, Anand and Galetovic (2004) illustrate how connections to related products or services are critical under weak IP protection. Sometimes the sheer complexity of strategies can deter imitation (Rivkin, 2000) as it is nearly impossible to replicate the whole picture despite the information drawn from individual pieces. Even market structure helps: The possibility of disclosing information to multiple buyers will give IP sellers an advantageous bargaining position and enable them to appropriate rents from innovation (Anton and Yao, 2002).

51. Based on the above theoretical frameworks, empirical studies have found strong evidence that firm capabilities play an important role in IP protection, beyond what the legal IP environment has to offer. In the Yale Survey (Levin *et al.*, 1987) and the Carnegie Mellon Survey (Cohen *et al.*, 2000), firms consistently report that secrecy and lead time can be the most important strategic tools for knowledge

protection, while patent protection was reported as critical only in the chemical and pharmaceutical industries.

52. In the research of global strategies, Zhao (2006) argues that MNEs' ability to conduct R&D in weak IPR countries stems from their efficiency in transferring, integrating, and quickly building on technologies developed in various IPR regimes. By keeping complementary resources well protected, MNEs can actually leverage the institutions in strong IPR countries for their operations worldwide. Based on a large sample of U.S.-headquartered MNEs, Feinberg and Gupta (2009) find strong evidence that firms respond to high risks in the host countries by increasing the extent of internal transactions among subsidiaries. One specific form of internalization is to establish a modular internal R&D structure, and place an emphasis on protecting the most valuable components (Quan and Chesbrough, 2008). Firms go about this by physically securing facilities, requiring identification, and providing information on a "need-to-know" basis.

53. The following subsections describe the strategies firms adopt to manage IP in China. Given the limited scope of this study, the examples cannot possibly cover the whole landscape. They may not be the most well-known cases either, but they do provide illustrations from various sectors of the economy.

4.2 *Managing Human Capital and Information Flows*

54. Von Zedtwitz (2004) notes that in managing R&D in China staffing issues can be a big concern. Global Chinese and expatriates can be trained to develop awareness of cultural differences and facilitate intercultural communication between the international management and the local Chinese research staff. This human linkage makes R&D more effective by increasing the ability to use local skills and knowledge in R&D and bringing the result of the R&D to the MNEs' global operation (Gassmann and Han, 2004). At the same time, it is also important that staffs are only given access to sensitive information on an as-needed basis (Thorpe, 2008). This limits the number of people that have access to critical IP and reduces the risks of information outflow.

55. Most MNEs in China today follow strict rules in managing human resources and capital flows. At Intel, researchers sign non-disclosure documents with the company, which specify the number of years in which the research cannot work for a competitor upon leaving Intel. Internal documents feature four levels of confidentiality: Red, Orange, Yellow, and White, with Red being the highest level and White being the lowest. The development teams need licenses to access the colour-coded documents. For the Chinese teams, it's usually up to the Yellow level. At IBM, the hiring and firing processes are carefully cleared from a security angle in order to avoid potential IP complications; employees also go through intensive training on IP. The information infrastructure in the company is such that the most sensitive source codes are kept in the United States. The employees' access rights have to be approved by supervisors and reviewed every six months.

56. The problem with the management of information flows is most obvious in joint ventures, especially those formed upon the requirement of the government. Researchers from these joint ventures often complain that they are treated as "second class" when trying to access core technologies of the parent companies, although for understandable reasons. Fortunately, with the removal of mandates for such "arranged marriages" and increasing trust over time, joint venture situations have been significantly improved.

57. Small businesses that do not have a sophisticated internal personnel network have to build employee loyalty through years of on-the-job training and personal attention from the management team. An entrepreneur in the high-precision machinery industry said that he knew every family member of his engineers, and he guaranteed R&D funding for the team in good times and bad. It is not an easy task. Those who cannot make such commitments have to leave labour mobility – and the subsequent information outflows – to luck.

4.3 Leveraging Unique Technologies or Market Positions

58. In the light of the strategic considerations outlined above (Teece, 1986, and Rivkin, 2000), firms can rely on their unique technological architecture or market presence for the appropriation of their technologies. Conversations with the biggest players in China's elevator industry reveal significant differences in their technology architectures. Large elevator and escalator products are comprehensive packages of equipment and professional services, with technologies ranging from mechanics to electronics. As engineers are specialized in just one of the many areas in the comprehensive package, a firm's potential vulnerability is limited; none of the individual engineers plays a decisive role in the competitiveness of the firm. Moreover, companies differ in their design logic. While Japanese companies (*e.g.* Mitsubishi and Toshiba) are good at static point optimization, European companies (*e.g.* Otis and Schindler) tend to focus on continuous and dynamic programming, a difference that constrains employee mobility across different types of firms.

59. While many MNEs meticulously design their internal information flows and strategically manage their local work force, some others can afford to limit their local presence altogether. For example, despite the large revenue stream from China, Qualcomm keeps a relatively small workforce there, and most of the local employees are engaged in sales, technical support, and localization. Decision-making related to R&D is almost exclusively carried out at headquarters. With its dominant position in all the major wireless telecommunications standards, Qualcomm is not eager to expand its local presence.

60. The leverage of unique market position can also play a strategic role related to IP, and not only for large companies. For instance, in the long and stable supply chain of power transmission equipment for state-run projects, small businesses feel comfortable licensing technologies and paying for the designs once their supply relationship is established. After all, securing a slot in the supply chain is often more difficult than obtaining the technology, so the slot can provide exclusivity better than the IP laws. Of course, such positions can be abused too, to the extent that outsiders will have less incentive to hold these suppliers accountable for IP violations; even if an outsider wins a case, it is hard to replace the incumbent and profit from it.

4.4 Keeping It Flexible

61. Government intervention can make the value of IP portfolios highly uncertain, adding difficulty to the long-term planning of R&D activities. Maintaining a certain degree of flexibility may become an important strategy for many firms in uncertain environments.

62. When the Chinese government pushed hard for a home-grown standard for 3G wireless telecommunications, both western MNEs (*e.g.* Motorola and Nokia) and domestic firms (*e.g.* Huawei and ZTE) tried to take advantage of the flexibility in their strategies. First, the stronger players followed the strategy of "wait and see". Confident in their strong R&D capabilities in China, they were aiming for the second-mover advantage once all the uncertainties cleared up. Instead of betting all the resources on one of the three competing standards, the large players put stakes in small joint ventures and industry consortia as hedging strategies. Second, almost all these firms have large 3G markets overseas, and they can utilize the Chinese facilities for other markets while waiting out the uncertainty. Motorola's 3G Centre in Beijing played a crucial role in the development of 3G network solutions globally. Ericsson took its first WCDMA base station product, which was developed completely in China, to Europe. This is in line with the "operating flexibility" argument raised by Kogut and Kulatilaka (1994): The unique advantage of an MNE is the ability to manage uncertainty by shifting production across a network of geographically dispersed locations. Thus, the MNEs' 3G investments in China, which were made under significant uncertainty, can be considered real options owned by these firms.

63. Firms can also be flexible in addressing the relationship between competition and collaboration. Lin *et al.* (2009) suggested a strategy to turn competitors into collaborators in the face of IP violations. When Honda found out that a local firm had copied Honda's product and manufactured it at a lower cost in

China, Honda formed an alliance with the firm, and leveraged the latter's low-cost platform to penetrate the local market.

64. Admittedly, flexibility has its downside too. The availability of alternative strategies softens the firms' negotiating positions and takes the signalling effect out of their moves, sometimes pushing the equilibrium to the opposite direction. In the case of 3G in China, although organizational flexibility enables the MNEs to manage uncertainty at lower costs, it also allows them to take a more accommodating position in the early stages, which gives breathing room to the nascent home-grown standard (Zhao, 2010).

4.5 Complementary Networks

65. Firms increasingly learn how to confront local challenges by leveraging their global capabilities. In the Zhang Jiang Hi-tech Park in Shanghai, hundreds of biotech ventures have been established by returnees with overseas connections, many of them contract research organizations (CROs). For those that face doubt from their clients in terms of information confidentiality or IP protection, their overseas connections often come in handy. Medicilon, a young venture established by several returnees, specializes in conducting preclinical research for global pharmaceutical companies. Besides its main R&D facility in Shanghai Zhang Jiang, it also keeps a branch in Chicago, which plays an important role in coordinating with clients and establishing trust through face-to-face communications. Over time, Medicilon has been able to enhance its project management skills and win confidence from the big clients through repeated transactions.

66. The complex nature of the products can also be the tool against potential loss due to information leakage. It is much more costly for a local competitor to imitate a product if the complementary knowledge is under strong IP protection somewhere else, either because of the strong IP laws there or due to the challenge of learning across distance (Zhao, 2006). In the IBM example, most of their projects in China involve the provision of industrial solutions, which requires a significant amount of customization and after sales services. Furthermore, the projects are so large that it depends on thousands of components dependent on one another. Leakage of the individual components will not create big concerns to IBM's competitiveness. Similarly, despite the increasing scale of Intel China Research Centre, most of the teams are still working on carved-out projects from the headquarters, and most of the communications are vertical – between R&D managers in the U.S. and teams in China. Thus, without the complementary knowledge embedded in Intel's global R&D network, the local projects will have little appeal to the potential imitators.

5. Conclusion and Discussion

67. This paper takes a firm-level perspective and attempts to highlight the multi-dimensional nature of China's IP environment. Rather than viewing IP protection in China through a specific index, firms tend to look into the complementary factors beyond the legal system and craft an IP strategy that is consistent with its unique competitive position, technological capability and organizational structure. In a sense, firms conducting R&D in China are facing two sides of the same coin. On the one hand, with rapid economic growth, there is tremendous demand for innovation and an increasingly active R&D community, which creates great opportunities for technology-oriented businesses large and small. Large firms find it much easier to implement their strategies with competent partners and suppliers, and small businesses can move fast on the learning curve with unprecedented access to information and markets. On the other hand, the increasingly sophisticated local players and their supporting systems present a challenge to any firm that hopes to guard against imitation and secure returns from R&D investments.

68. The multi-dimensional nature of China's IP environment also has important policy implications. First, while the legal side of IP protection has been increasingly formalized and centralized, cross-regional and cross-industry differences will likely remain given the inertia of the complementary factors. Second, IP reform is a system project, involving not only patent, trademark and copyright laws, but also privatization policies, trade and FDI policies, as well as the role of the government in China's innovation strategy. It will

be ineffective, for example, to promote a healthy market for IP while allowing government agencies to handpick “flagship” projects. Finally, momentum for future IP reforms depends on the economic structure of the whole economy. In fact, the longer the policymakers wait, the more “skilled” the firms become in working around the system or using internal capabilities to fend for themselves. As argued in Zhao *et al.* (2010), if the majority of firms have either withdrawn from innovative activities or have invested in alternative strategies of IP protection, then the pressure for future reforms will be subdued.

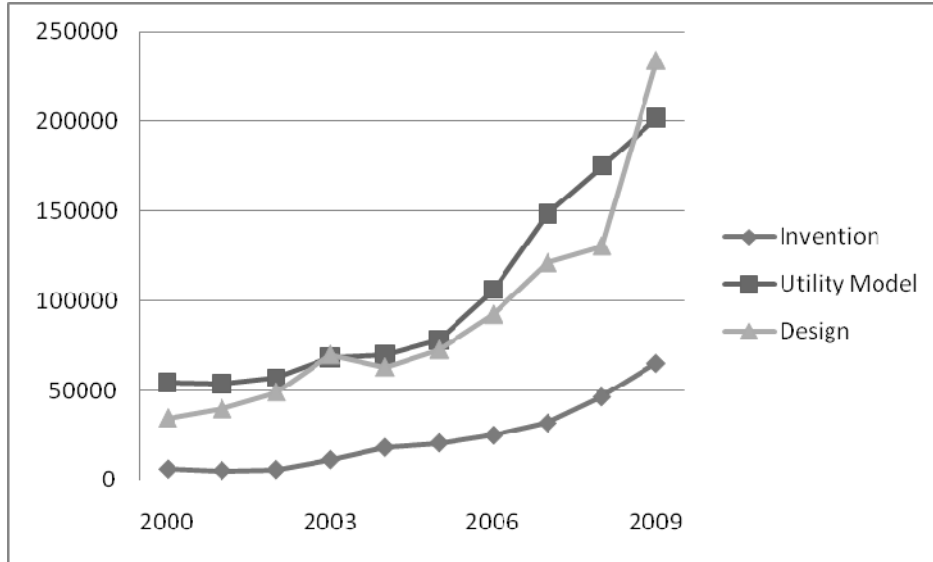
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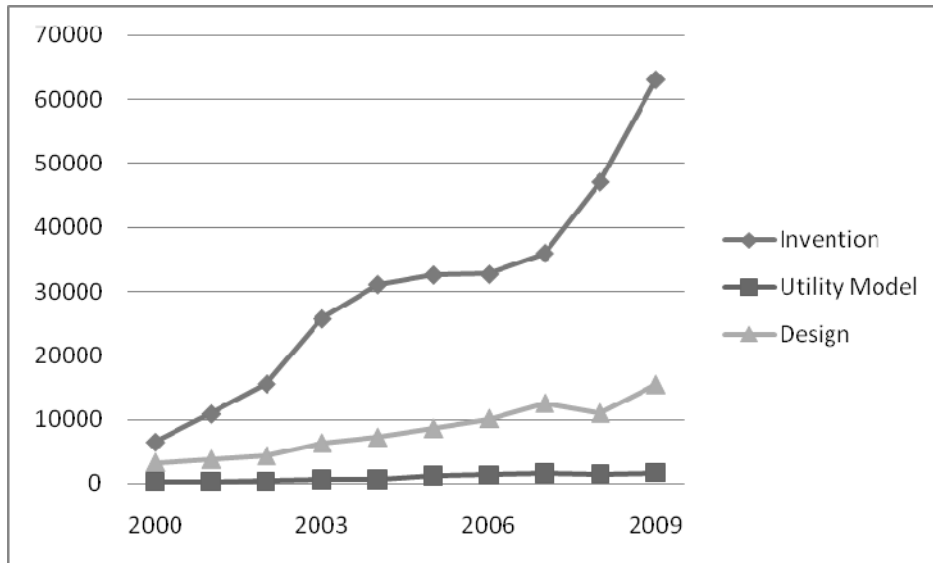
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Figure 1. Chinese Patent Grants to Domestic and Foreign Applicants

Panel A. Patents Granted to Domestic Applicants



Panel B. Patents Granted to Foreign Applicants



Source: State Intellectual Property Office of the People's Republic of China.