Not Just a TRIP! Two Cases of Business Strategy and Economic Incentives to Patent in Beijing

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April 29, 2009

ABSTRACT

In order to explore the utilization of IP law in Beijing, I have conducted quantitative analyses of the propensity to patent (using financial investments and patent filings), as well as qualitative analyses of the rationale and incentives in place through interviews with corporate, legal, and patent office personnel. Domestic patents will be an indicator of how much the Chinese people rely on the formal, legal protection of their property right. Throughout this paper, patent law will serve an indicator for "utilization" of IP law, since patents are the most vigorous of formal IP protectionisms. Moreover, IP law represents a purely Western, imported ideal – that is being pushed by the U.S. and by the WTO through trade integration – it will be interesting to see, empirically, how individuals incorporate this Western legal construct. My paper centers on the legal, economic, and sociological aspects of patent filings, disputes, and resolutions from the grassroots (that is, among the Chinese people) in order to analyze the social understanding and "inclination" toward IP law.

In particular, I have conducted in-depth research via patent filing statistics, company data, and interviews at two firms in Beijing: Potevio and Dawning. Potevio is a telecommunications company and Dawning is a supercomputer manufacturer. Both firms represent industries that heavily rely on innovative technology, so patent protection is a highly relevant decision for these firms. Furthermore, these firms are both currently state-owned enterprises, which are very responsive to national incentives and policies. Since statistical significance did not support the hypothesis that private firms differed from non-private (government-derived or supported) firms in their strategies for R&D investment and propensity to patent, it may be as the Chinese firms claim: "SOE's bear the same strategies for growth and innovation as any other corporation."

ACKNOWLEDGEMENTS

I am grateful to the following professors, graduate student, and visiting scholars at UC Berkeley and the UC Berkeley Boalt Hall School of Law for their advice, time, and help in various stages of research, data analysis, and composition: David Roland-Holst, Brian D. Wright, Robert C. Berring Jr., Lanchih Po, Alexander D. Rothenberg, Lynette Chua, and Yang Ming. I am also indebted to the many who have aided in and consented to interviews. Although the list is long and remains in confidence, their hospitality, kindness, and time spent are most appreciated.

Above all, I must thank God and my family for their faith and support. Without them, I would not have had the opportunity to carry out this project.

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I. ***Introduction***

Accelerated forces of globalization and trade integration have transformed China from a relatively backward country to an export power in the course of this past century. Yet, China's role as the "workshop of the world" tantalizes its trade partners: on the one hand, cheap production costs draw them in, while on the other hand, problems of counterfeit and pirated technologies vex them.[1] This long-standing concern for intellectual property (IP) protection has been emphasized in the WTO's terms of membership for China in accordance with the 1994 agreement on Trade Related Aspects of Intellectual Property Rights (TRIPS).

Global trade and opening require shifts in legal design and implementation in developing and in developed countries, according to international trade governances such as the IMF, WTO, World Bank, and the Washington Consensus. On the other hand, Daron Acemoglu and Ufuk Akcigit (2006), Richard Posner (1998), Douglass North (2001), Kenneth Dam (2006), and other scholars question whether establishing rule of law is essential for economic growth. In particular, Dam cites China as an international "test case" for whether rule of law is as necessary as international trade bodies emphasize. All the same, established WTO member countries do require political, legal, and economic reforms in applicant countries in order to remove trade barriers and to align with modern, internationally recognized legal systems. However, these "modern" and "internationally recognized" systems generally have been standards set by Western developed countries.[2] For example, IP is a concept that arose from Western developed nations, thus, the IP law is among the legal constructs that Western nations demand as a protection for their own products. Therefore, even though China is instituting IP laws, one wonders whether the pace of TRIPS demands corroborate with the Chinese realization of the need for such protectionism.

[1] Gewirtz, Paul. (2003, pp. 2)
[2] Lubman, Stanley. (2006, pp. 1 – 92.)

Problem Statement

The theme of my research is to explore the domestic attitudes toward and the spread of IP law through the use of patent protection in China. In particular, I seek to analyze the propensity to patent as a private business decision: whether patent protection is commensurable with private sector strategies, as well as whether economic incentives are effective in reinforcing the patent decision.

Typically, the decision to patent is measured as one's "propensity to patent," or the likelihood of filing a patent for one's innovations.[3] However, as mentioned before, the propensity to patent is not a natural discipline or inclination of the Chinese. Rather, because China is a late developing country and one that accedes to international bodies of standards (e.g. GATT / WTO), the decision to patent is primarily affected by external pressure and top-down administration. Therefore, the patent decision is a dual decision on the part of the private individual or company, and on the part of national government. As a corporate or private investment, the decision to patent is – positively – based upon profitability of the innovative product (via through selling the product itself or through licensing of the technology) and competitiveness of the industry (whether the product is substitutable or threatened by competition and copying). The decision is – negatively – affected by R&D and opportunity costs of the innovative and patenting processes and opportunity costs of disclosure (as opposed to secrecy). Nationally, institutions must be introduced or reinforced to bolster IP laws and rights.[4] On the national level, the decision to patent has been primarily affected by external pressures and foreign criticism.

[3] Hall, Bronwyn and Adam Jaffe, Manuel Trajtenberg. (2001, pp. 22)
[4] Tebaldi, Edinaldo and Bruce Elmslie. (2008, pp. 2)

Hypothesis

Particularly interesting to me is the question of whether external and top-down forces shape the private decision into one that reflects rationality. After all, individuals and private firms base their research and development (R&D) investment decisions on whether or not they expect a net positive return. Then, the patent decision follows if individual inventors or firms believe that the patent will be a positive guarantor of production rights, licenses, and profits for the duration of 20 years. This private decision to patent and whether IP law registers as rational and functional to the private individuals and firms would indicate the actual utility of IP law in China.

So, in conducting my research, I sought to answer: "Is the propensity to patent a rational decision for innovative firms in Beijing today? Or, if the patent decision is not as rational and entrepreneurial, then what incentives and inducements are offered institutionally to encourage patenting?" I hypothesized that if the decision was not rational, this would be apparent from outright breach of patents – e.g. counterfeiting – because the propensity to patent is more strongly an external inducement, rather than a private inclination or regard of patents as functional. However, if this decision rational, then patenting will be a proactive individual decision – based more on profitability than on government incentives and top-down inducements – but revealing correlation between R&D expenditures and patent investments. (Granted, there are top-down incentives and inducements, since there is naturally a lag between legal adoption of IP and social register of IP.[5]) China had officially legally adopted IP into its constitution in 1984, following the Paris Convention, however, the social register (domestic inclination and use) of IP has been criticized to this day. So how commensurate is patent protection with private rationale? Are the Chinese businesses inclined or incentivized to file for patent protection and / or to bring this legal protection to court?

[5] Posner, Richard A. (1998, pp. 3)

Approach

Given the diverse conditions of legal, institutional, and economic development in China, I recognize that industrial sectors have different propensities to use patent protection, based on their different strategies for innovation. Thus, I chose to narrow my study to the highly innovative sectors of mobile telecommunications (also denoted as "telecom") and computer manufacturing (also referred to as "computer") firms in Beijing and their propensity to patent domestically (that is, within China). These sectors were chosen primarily for their high prioritization and high turnover of innovative technology, which would make them more and faster to rely on patent system for protection. While gathering financial and patent data on samples of telecom and computer firms, I focused on a specific firm in each sector from which I conducted qualitative interviews.

In order to explore the utilization of IP law in Beijing, I will conduct quantitative analyses of the propensity to patent (using financial investments and patent filings), as well as a qualitative analysis of the rationale and incentives in place through interviews with corporate, legal, and patent office personnel. Domestic patents will be an indicator of how much the Chinese people rely on the formal, legal protection of their property right. Throughout this paper, patent law will serve an indicator for "utilization" of IP law, since patents are the most vigorous of formal IP protectionisms. Moreover, IP law represents a purely Western, imported ideal[6] – that is being pushed by the U.S. and by the WTO through trade integration[7] – it will be interesting to see, empirically, how individuals incorporate this Western legal construct. My paper centers on the legal, economic, and sociological aspects of patent filings, disputes, and resolutions from the grassroots (that is, among the Chinese people) in order to analyze the social understanding and "inclination" toward IP law.

[6] Posner, Richard A. (1998, pp. 5)
[7] Stephenson, Matthew. (2008, pp. 1)

II. ***Background***

IP is driven by law on the books, enforcement, private demand, national objectives, and international pressure. Historical cases, academic studies, and empirical research on the matters of written IP law, its enforcement (via court records and so on), and international pressure formulate the background of my study. I highlight that there is insufficient study of private demand and utilization of IP law (patent law, in particular). This is a shame because law should exist for its functional purpose, such that legal protection will be utilized and applied.

The function of patent law is to protect intellectual property, and its utilization is shown through application for patent protection, among other means. In order to approximate the functionality and utilization of IP law in Beijing, I will focus on the private demand (that is, application for) patents. Here, I distinguish the utilization of patents as the application for patent protection – as opposed to the official grant of patent protection – because applications are filed for by anyone in society (reflecting private demand, whereas grant of a patent reflects the patent bureau's supply of patents). Also, in my study, I will address national objectives that drive IP development in China because the Chinese Communist Party (CCP) is administratively robust so far as governments go, and law, legal enforcement, and legal implementation are top-down, "rules-first" processes.[8] Thus, the private demand is, to some degree, directly or indirectly influenced by government. In my study, I will discuss direct government implementation of IP law via economic incentives offered toward patenting.

Arguably, the functionality of law is implicit in any discussion of law enforcement and utilization, which essentially ask whether or not the law works in practice. It is the question of

[8] Posner, Richard A. (1998, pp. 4)

having "law on the books" or actually having "rule of law." [9] However, domestic, private utilization of IP law is questioned when international opinion of China has been of a notorious counterfeiter. Therefore, I seek to trace the question back the basics: because utilization of law is necessary before enforcement can be practiced. My study is restricted to domestic demand for patents – called "utilization" in the legal field, and called "propensity to patent" in the economics field – but in order to engage this topic, I will identify historical context, relevant literature, and fundamental and recent research.

Historical Context

When the 3rd Plenary Session of the 11th Central Committee decided to adopt a policy of opening to the outside world to pursue modernizations, Deng Xiaoping promised the nation economic progress, but made no promises as to institutional or legal developments. After all, the first 30 years of the PRC were ruled by the CCP without legal code – according to Stanley Lubman – "many, if not most laws and administrative regulations were not even promulgated and were for internal circulation only." [10] Since 1978 and Deng's issuance of economic reforms and policies, China has continued a decade of economic boom and has drawn the eye of global investors. Economic reforms have led industry and enterprise to flourish, yet the legal system has not quite flourished. In fact, since Mao's shut down of the nation's law schools in 1949 – calling for people of revolution over people of expertise – legal institutions and structure have not been definitive. The rewriting of law since then has been a vast and challenging task, described by Lubman as follows:

> Law had to be used to define and govern nothing less than new relationships, economic actors, and transactions among persons and organizations outside the state apparatus (many formerly forbidden).

[9] Kaufmann, Daniel, and Aart Kraay, Massimo Mastruzzi. (2003, pp. 3)
[10] Lubman, Stanley. (2006, pp. 6)

> As a result, whole areas of law such as civil law appeared for the first time since the Nationalist codes were abolished in 1949. Chinese law reformers had to construct core elements of a legal system in an astonishingly sorter period of time than the centuries which similar Western legal institutions had to develop.[11]

As foreign companies and individuals rushed to China, they have expressed more or less frustration regarding the Chinese legal system. Yet, milestones in China's refinement of law have ensued: Deng's re-opening of law schools by 1978, Deng's restructuring of property rights, the CCP's adopting principles of Western laws from the Paris Convention in 1984, China's accession to the WTO, and Beijing's commitments to lawful developments with the 2008 Olympic Games.

In fact, China had joined the World Intellectual Property Organization (WIPO) in 1980, and the central government had added IP law to its constitution, in order to conform to the standards of the Paris Convention in 1984. Such protections served the primary need to guarantee confidence to investors in China.[12] However, much to this day, the law on the books is purported to not be fully enforced, so many investors may doubt the enforcement of law in the courts. In reality, the legal code was less regarded and even less enforced by Chinese government, entrepreneurs, and laymen.

Literature Review

Relevant studies in or on China

Property rights and incentives have been highly centralized throughout the PRC's early history. In 1955, land and property rights had been stripped from individuals and became pooled

[11] Lubman, Stanley. (2006, pp. 7)
[12] Gewirtz, Paul. (2003, pp. 2)

for collective ownership.[13] According to Lay Hong Tan, property rights in the Mao-era suffered four main constraints:

1. Direct exercise of ownership rights by state blurred the distinction between state and private enterprise.
2. Heavily centralized planning system subordinated private enterprises to state government.
3. State investment was disconnected from investment returns and incentives; since firms had no independent property rights, they naturally neglected the gains and losses of their capital.
4. The state absorbed all losses and liabilities of enterprises – again, disconnecting business activity from incentives.

Over thirty years' after Chairman Mao, the CCP is still trying to resolve issues of property rights, interlinked public and private ownership, and state oversight.[14] Mostly, the stakes point to market discipline: that is, firms that are unable to manage their own property resources and to function efficiently will suffer market consequences in being out-competed. Tan argues that, "a modern enterprise system must be established to function within a market economy and in which the property rights as well as rights and responsibilities of enterprises are clearly defined, and government administration and enterprise management is separated." [15] Furthermore, "if intellectual property rights are contributed as capital, they shall not exceed 20 per cent of the total registered capital." Beyond institutional failures to ratify laws on IP protection, Tan remarks that there have also been failures by Chinese businesses and by the private sector to abide by legal standards. Tan

[13] Naughton, Barry. (2006, pp. 114)
[14] Naughton, Barry. (2006, pp. 147)
[15] Tan, Lay Hong. (2007, pp. 2 – 7)

highlights problems of corporate governance, weak institutions, and poor market discipline as leading impediments to the effectiveness and penetration of IP law.

When China acceded into the WTO in 2005, there was emphasis on TRIPS (for the establishment of international standards on intellectual property across nations and developing nations). The development of law in the evolution of China's economic and political structure has been the subject of scholarship and of this research paper. Kenneth Dam of Univ. of Chicago looked at China as a "test case" for whether development of law must precede development of economy. In China – as was the case with most of the Asian Tiger nations (Japan, Singapore, Hong Kong, Taiwan) – the development process has much been economy-driven. The concern, however, would be that as growth slows down and institutions are too weak, there will be threat of crisis much like the Asian Financial Crisis of the 1970's.

Yet, that is not to say that the PRC lacks legal structure: it has a relatively high rank for substantive law among international bodies.[16] According to the World Bank's studies, China's substantive law procedures rank 24th in efficiency, among the 155 countries surveyed in 2006. In contract litigation between private parties, the World Bank had ranked China as 47th. Generally, it is not the existence of legal structure in China that is the problem, but rather the enforcement of legal structures, as many foreign entrepreneurs would attest to. The enforcement problem is twofold: on the one hand, it should be called to court by a plaintiff who feels his property infringed upon. Of course, the plaintiff would only rationally pursue the matter if he felt that it will profit him to sue (either to receive payment in damages or to gain license fees later). Usually, the experience has been that infringers are too many and too small to be profitable in suing. On the other hand, enforcement could be carried out by government directly through confiscation of infringements. Informally, the defense has been made that government officials and locals are both more

[16] Dam, Kenneth W. (2006, pp. 4 – 6)

sympathetic to infringers who engage in this "technology transfer" without completely understanding the legal ramifications. After all, patent law had only been instituted since 1984, when China adopted the principles of the Paris Convention for the protection of IP. In the beginning of this paper, I had speculated whether the lack of adherence to law was a cultural disconnect due to the importation of law and lag in discipline and register of the law. As China rises in economic power and stability, however, its trade partners, the WTO, and the World Bank all expect to see more rigorous developments and stringency in China's legal system and in legal enforcement. So far, this expectation has been fulfilled as China's ranking in "enforcing contracts" has risen from rank 21st in 2008 to rank 18th among 181 countries in 2009. China's legal rights index has risen from 3 (in 2007) to 6 (in 2009), now ranking it 59th in the World Bank's book.[17]

Relevant studies outside of China

In the more liberalized markets of Italy, Germany, and the U.S., economic studies focus on the rational decision of whether or not to patent. In a 2008 study of innovation and productivity of Italian firms, it was found that the size of firms is negatively associated with the intensity of those firms' R&D expense, but positively associated with their likelihood of achieving product or process innovation.[18] This seems to be an inherently contradictory notion: that bigger firms would spend relatively less on R&D, but reap greater product and process innovations. However, Hall, Lotti, and Mairesse credit this to the dual nature of R&D, which is characterized by: (1) a minimum level of activity to generate benefits from spillovers and public knowledge, and (2) the suitability of innovation without research to certain enterprises. Identified demand-side causes of under-investment in technology include perceptions of market size, consumer tastes, and other factors.

[17] World Bank. (2008, pp. 16 – 34)
[18] Hall, Bronwyn H. and Francesca Lotti, Jacques Mairesse. (2008, pp. 16)

On the supply side, high costs of capital and other inputs, availability of inputs, and the regulatory environment are cited as influencing the investment decision of innovative firms.

In a 2000 study by Duguet and Kabla, in industries strategies and priorities vary by industry or sector. For example, industries of computers, electronics, and aircraft emphasize the prevention of imitation, while imitation is of less importance in industries of drugs, instruments, and motor vehicles.[19] Overall, the survey results of Duguet and Kabla show that firms patent in order to: (1) prevent imitation, (2) avoid litigation, (3) earn license revenue, and (4) reward and evaluate researchers. In particular, the French telecommunications and computer sector surveyed consider the following in their patent decision:

Reasons for Patenting				
Rank	Benefits		Deficiencies	
1	Preventing imitation	0.92	Does not prevent imitation	2.19
2	Avoiding trials	0.65	Costly to get and to maintain	2.14
3	Technology negotiation	0.65	Too much disclosure	1.89
4	Rewarding researchers	0.35	Costly to defend	1.86
5	License fees	0.25		
6	Entering foreign markets	0.21		

Adapted from Duguet and Kabla, 2000.

For the French computers and electronics industry in 2000, average industry propensity to patent is 38.6%. Primarily, the inclination (or propensity) to patent an innovation is influenced by patent disclosure and R&D expenditures. A third factor – decision to postpone a patent application – is weakened by the introduction of industry effects. The results from this study were interesting because, despite what the companies reported as reasons to patent or not to, none of the above reasons of benefit were found to be significant in the propensity to patent; and only the patent deficiency of "disclosure" was found to be significant.

[19] Duguet, Emmanuel and Isabelle Kabla. (2000, pp. 267 – 305)

In another study by Buzzacchi and Scellato in 2008, patent decisions can also be affected by recognition of market failures such as asymmetric information. In their study, Buzzacchi and Scellato sought to improve the enforceability of patents through litigation insurance.[20] They found, as a result, that this underdeveloped market of litigation insurance could be presently substituted with higher screening ability of the patent office, and with proper level of punitive damages.

According to Yang in a 2003 study of foreign patents' effect on Taiwan's technological development and learning, there is reason to think that patented property disadvantages innovation for Taiwanese firms in the short run. Specifically, Yang says that, "more invention patents granted to foreign inventors will decrease the island's domestic invention patents, while they increase the amount of utility patents in the same technological fields." [21] However, foreign patents necessarily disclose their technologies, so this helps to disseminate technical know-how amongst Taiwanese in the long run. For developing nations or those that do not lead in the patent race, it is a trade off of basic research and technological applications.

Empirical Background

IP is handled by three government offices in Beijing: the State Intellectual Property Office (SIPO), the Trademark Office (CTMO), and the National Copyright Administration of the PRC (NCAC). The largest of these offices is SIPO, which handles applications and grants patent rights. From a source within this bureau, I have obtained data on provincial and national patents filed and granted from 2000 to 2008. Patent filings represent one aspect of Chinese utilization of IP law and reliance on legal protection of IP.

[20] Buzzacchi, Luigi, and Guiseppe Scellato. (2008, pp. 1 – 9)
[21] Yang, Chih-Hai. (2003, pp. 231)

On the other side, the Chinese use of IP law courts has shown a growing number of litigation in China, according to data gathered from the World Bank. That is from 1985 to 2004, there is certain increase in the number of court cases that took place in China as a whole. Furthermore, it is notable that the types of plaintiffs do, in fact, include an array of joint- or private sector businesses.

Law has an economic role to protect against "good capitalism" and "bad capitalism." That is, firms' behavior will always be profit-maximizing, however, antitrust policies in many nations – including in the PRC – curb firms' actions against unfair market competition. In fact, market rights in the scope of competition are central to IP because IP protections basically grant an innovator the sole rights to produce for a period of time. As a result, there is a clear balance to be struck between market power granted to a firm and the incentives in place to reward and encourage innovation. In China (as is in the U.S.), patents give an innovator the sole right to utilize, sell, or license his invention for 20 yrs. from the date of filing. After the 20 yrs., this knowledge enters the public domain, and the innovator (patent holder) no longer has the sole right to his invention.

Companies' Background

CASE I: *China Potevio, Ltd.* (中国普天 信息产业服份有限公司)

As a state-owned enterprise (SOE), China Potevio Co., Ltd. (hereafter called "Potevio") leads the nation in provisions for radio network control, transmitters, mobile access codes, and media processing. As is typical of an SOE, the firm provides a very specific product or service for the strategic development of the industry – here, telecommunications – as a whole. Potevio remains under the direction of the State-owned Assets Supervision and Administration Commission of the State Council (SASAC). The general information technology sector was overseen by the Ministry of

Posts and Telecommunications since 1978, and is now overseen by the Ministry of Information Industry, established in 1998.

Traditionally, the telecommunications sector has been highly regulated and all major players in the telecom market have been reared by central government. After all, when the People's Republic of China was founded in 1949, there was only 0.05% telephone density[22] and the telecom industry was rudimental, unstable, and dependent on foreign technology. From 1978 to 1984, the first of now four periods of deregulation, government has undertaken to develop national competition. In 1978, this began with the establishment of local manufacturers and provincial branches of major telecom companies to diffuse knowledge and technical know-how that they had cultivated. From 1984 to 1989, development was production driven and pursued market liberalization, although the government was and still is wary of the national telecom industry.[23] Telecommunications have always represented major information transfer, communication infrastructure, and modernization for society from telegraphs to landlines to wireless communication. From 1989 to 1997, competition was driven by technology, focusing on standards of transfer such as TCP/IP. Even now in the fourth period, government still cultivates the telecom market with state-owned enterprises to fulfill a niche in the national market.

China's accession to the WTO meant that 2002 was a deadline to remove direct government assistance to firms. The Chinese telecommunications market is still only partially liberalized with the coexistence of SOE's and private domestic firms and foreign competitors. Although there has been sustained effort to privatize (that is, to publicly list the company and to trade shares), the company founders usually retain majority share. Only a few companies have striven for privatization in the capitalist style: complete change of ownership and management, change from soft budget constraint to real market discipline, and going public with public shares, accountability, and so forth. Such

[22] Brun, François. (2003, slides 2 – 8)
[23] Low, Brian. (2005, pp. 100 – 107)

telecom firms that have undertaken this path of privatization include: China Mobile (中国移动通信集团); China United Netcom (中国联合网络通信公司), which merged from China Unicom (中国联通) and China Netcom (中国网通); Huawei Technologies (华为技术有限公司); and others.

On average, the above listed private telecommunications firms have spent around 21.61% of their revenue on R&D investments per year. This R&D share of revenue varies from year to year, however, depending on company objectives for growth or unseen factors, such as reinforcing ongoing development projects or failed projects. When looking at non-private firms, the 12.54% of their revenues are spent on R&D. The differences in private versus non-private expenditure on R&D may be attributed to: (1) non-private firms receive government aid and direction for investments, (2) sometimes, government spreads these R&D projects across multiple SOE firms, their subsidiaries, and such to instill a discipline for R&D, and (3) private firms are competitively influenced to match R&D levels with domestic, foreign, and/or international firms.

CASE II: Dawning Information Industry Co., Ltd. (北京曙光天演信息技术有限公司)

Founded in 1995, Dawning Information Industry Co., Ltd. was promoted by the Ministry of Science and Technology, the Ministry of Information Industry, and the CAS in light of the national "863" program. Today, Dawning can boast its being the top domestic brand for computer servers and super computers. Because Dawning specializes in supercomputers, its clients would be government, institutions, or enterprises that need high power and capabilities. Thus, Dawning remains strategic to the nation because the supply of super computers can affect its large-scale customers. Dawning's projects have contributed to such large-scale projects as the "Two Missiles

and One Satellite" manned space flight and the Beijing 2008 Olympics. [24] Its super computers are also deployed in systems of government, education, finance, telecommunications, biology, meteorology, petroleum, and other industries.

In general, following China's Reform and Opening, the computer manufacturing industry in grew with the process of market liberalization. According to a paper by Kraemer and Dedrick: "In 1990, China had only 500,000 PC's in a country of more than 1.2 billion people. By 2000, mainland Chinese purchased more than 7 million PC's in a single year. During the same time, China's production of computer hardware grew from less than $1 billion to $23 billion." [25] Mostly, this accelerated market development has been led by the growth and international expansion Lenovo, although other companies such as Great Wall Technology and Founder have reflected and contributed to industry growth. There has also been a general influx of new market entrants and competitors, as is the natural result of market liberalization. Kraemer and Derick highlight the development of computer hardware industry in China as a process similar to the Japanese computer takeoff in the 1960's and 1970's, followed by the rest of the East Asian Tiger economies – Singapore, Korea, and Taiwan – in the 1980's. China's computer industry development has followed the Tigers' strategy to promote exports and invest heavily in information infrastructure. Until 1998, the Ministry for Electronics Industry was created to oversee computer and other electronics manufacturing.[26] Since 1998, the Ministry of Information Industry has assumed this role.

[24] Dawning Information Industry Co., Ltd. (2007, pp. 3, 6 – 8)
[25] Kraemer, Kenneth L. and Jason Dedrick. (2002, pp. 2)
[26] Federation of American Scientists. (2000, pp. 2 – 7)

National Strategy

Each administration or Chairman of the Communist Party of China (CCP) has brought with him a political slogan that translated into the direction of the nation. Mao Zedong declared "实事求是" to say that a new version of Marxist socialism constructed by Chinese revolutionaries would be for the establishment, recovery, and development of China. Under this direction, the nation was to transform to scientific thinking and to oppose the subjectivity and old ideologies. Next, Deng Xiaoping uttered that, "不管黑猫白猫, 抓住老鼠就是好猫" ("Regardless if it's a black cat or a white cat, one that catches mice is a good cat") [27] , thus legitimizing economic profit-seeking within socialist politics. Then, Jiang Zemin's "Three Represents" ("三个代表") asserted the CCP as a party that represents the majority population in directions for productive economy, societal progress, and political consensus.[28] Now, the credo of the Hu Jintao / Wen Jiabao administration – "Scientific Development Concept" ("科学发展观") – calls for technological innovation and scientific progress. In this essence, central government is inciting firms to innovate and to employ protections.

Hu's saying was officially added to theory of Socialism with Chinese Characteristics in the national constitution on October 2007. This Scientific Development concept is interpreted as a socialist move to reconcile the dissent arising from chronic unemployment, income disparity, gender ratio imbalance, and record natural disasters and pollution. Effectively, Hu is pushing technology as the force to create jobs and to help the country move beyond its constraints. In order to implement this, Premier Wen had promised to spend 10.9 billion yuan (about 1.3 billion USD) to reemploy workers and 3 billion yuan (about 0.44 billion USD) to improve industrial safety.

[27] 小人物未敢忘忧国. (2008, pp. 2 – 6)
[28] International Department Central Committee of CPC. (2003, pp. 1 – 4)

In 2006, China's 11th Five-Year Plan enumerated specific goals for the development of radio-frequency identification (RFID) technologies and implementing these technologies among Chinese companies. This latest Five Year Plan also budgets 128 million RMB (about $16.8 million) to reinvigorate the March 1986 Plan (called "863 Plan" after its date). Originally, the 863 plan was launched after four prominent Chinese scientists – Wang Dahen, Wang Ganchang, Yang Jiachi, and Chen Fangyun – wrote to the central government to promote research and development in high technology.[29] The recent allocation of funds to the 863 Plan is targeted for spending in high-technology and R&D.[30] According to the China Daily, after the launch of the 863 Plan, there has been an accumulation of 5.7 billion RMB (about $688 million) invested in research on technology for over 5,200 programs under 230 civil-use categories. Additionally, more than 2,000 technological innovations or improvements have been patented.

IP development is another prong of the Scientific Development Concept lever. Despite the fact that it is often unclear whether these protections on domestic innovations directly correlate with profits, it is in national interest to instill the habit of employing IP. As such, government's inducement of discipline offers external rewards for firms' compliant behavior. The national patent bureau gives monetary reward for each patent application – directly to the applying firm. Moreover, local governments also offer subsidies for the costs of filing a patent.

[29] China Online. (2002, pp. 1)
[30] RFID Info. (2006, pp. 2)

III. ***Methodology***

Generally, utilization of patent protection is measured as a fraction of patents filed over the innovations made by the firm. Unfortunately, this is very difficult to pinpoint as innovations may be proliferate or few, discrete (as innovative end-products) or contributory (as research tools for applied knowledge or end-products). The patentability of innovations would depend on the expected profitability of the product itself, the competitiveness of the industry, and so on. For this study on Chinese firms' propensity to patent, I will define propensity to patent as a ratio of costs of filing a patent over the costs of R&D, as an approximate measure of patents filed over the innovations made by each firm. This is based upon the studies by Griliches (1990), Jaffe and Trajtenberg (2002) Green and Scotchmer (1995), Scotchmer (1991), and others, who focus on patent causality from private R&D expenses. Although R&D costs are frequently loose indicators of patentability, this is the closest measure of productive and profitable innovation.

Hausman, Hall, and Griliches (1984) had tested various models of patent application dependent on R&D expense – from Poisson distribution to negative binomial model, with firm specific effects to random effects – in order to pinpoint coefficients for conditional and marginal firm effects.[31] While their analysis was most thorough, I borrow only their conclusion that there is correlation between individual firm effects and R&D expenditures, without borrowing the technical models. My study uses a simple, linear econometric model in order to make feasible comparison of two firms of interest against seven or eight competitors in respective industries. My study is not intended to find the exact coefficient for firms in Beijing. Rather, my study aims to test the significance of Beijing firms' propensity to patent as indicated by private funding R&D. That is, I expected a difference in private companies' application for patents versus that of SOE's – wherein,

[31] Hausman, Jerry and Bronwyn H. Hall, Zvi Griliches. (1984, pp. 909 – 937)

private companies represent independent rationale, and SOE's receive more government direction and have less clear corporate strategy.

In order to assess whether Chinese businesses are privately inclined to file for patent protection and / or to bring this legal protection to court, I will be looking at primary data on patent applications in the context of their investments in technology in general. From these data, I will summarize and interpret trends that in Beijing's patent filings from 2000 to 2008, and over eight or nine firms per industries.

A Linear Econometric Model

Assuming that a firm's propensity to patent depends on its revenues as a private source of funding for innovation; on competitive share of the market, which is often cited as reason for companies need to protect their technology; on R&D costs as expenditures on innovation; and on ownership structure as an indicator of the firm's private funding and constraints.

Let P_{it} = propensity to file for a patent
= (costs of filing patent * number of patent applications) ÷ (R&D expenditures)

S_{it} = sales revenue for products
= (product revenue) ÷ (firm revenue)

C_{it} = competitive share of market
= (firm revenue) ÷ (industry revenue)

R_{it} = research and development expenditures
= (R&D costs) ÷ (firm revenue)

V_{it} = indicator variable for privately owned firm

$$\begin{cases} 1 & \text{if privatized or listed on any stock exchange} \\ 0 & \text{otherwise} \end{cases}$$

ε_{it} = error term, accounting for unobserved factors

These variables were chosen based on prior empirical work on the subject of patents, but more importantly because these were factors – product sales, market competition, R&D costs, and private or public funding of R&D investment – were noted to be important in the patent decision process. Thus, the structural form of my model includes all of these factors in the decision process for filing a patent application:

$$P_{it} = \beta_0 + \beta_1 S_{it} + \beta_2 C_{it} + \beta_3 R_{it} + \beta_4 R_{it} V_{it} + \varepsilon_{it}$$

In the scope of my study of corporate strategies and national incentives (the result of government objectives), I am most interested in the influence of the ownership structure of a firm – that is, the privatization indicator – across a sample of telecommunications and computer manufacturing firms. Meanwhile, although the S_{it} and C_{it} components are also important, I felt that those would be convoluted factors to my study:

- The product sales variable will actually be a lagged variable, pending the grant of the patent (usually at least a twelve month process[32]), so propensity to patent based on product sales of patented goods is speculative at time *t*.

- Although according to a 2000 study of patent propensity among French firms[33] the measure of competitors is the most important consideration to IT firms, among Chinese employees and management, competition is less tenable. Typically,

[32] Long, Wen and Lirong Zhang, Jianghua Cheng, Pingping Ji. (2007, pp. 57)
[33] Duguet, Emmanuel and Kabla, Isabelle. (2000, pp. 267 – 305.)

competitors increase the likelihood of close substitutes or infringing products, so firms would be more inclined to protect their inventions under the threat of counterparts. Using patents to secure temporary monopolies and, hence, pricing, licensing, and market power, is a common strategy amongst firms. However, this variable was also less ideal to test, since product turnover is so high within the IT sector.

Thus, my reduced model that I will be testing is:

$$P_{it} = \beta_0 + \beta_3 R_{it} + \beta_4 R_{it} V_i + \varepsilon_{it}$$

As an estimation of patent demand, this model reflects the microeconomic rationale for firms to utilize patent protection. This analysis serves to approximate propensity to patent (utilization of patent protectionism) as a part of corporate strategy in China. The private sector's propensity to patent is only one side of the story in China, where government plays a proactive role in national development and industrial development. However, since information on government's exact role and expense in nurturing these industries is difficult to aggregate, I will address government role in innovation and patenting later in my qualitative analysis. It will further be assumed that a firm is privatized if it appears on any public listing of firms on stock exchange, even if this is partial privatization. This is a simplification, but still attends to the fact that R&D is privately and publicly supplied or subsidized. Since data on public funding and subsidies is inaccessible, here I aim to measure propensity to patent as purely corporate strategy.

Data Collection

Data was collected from SIPO on firms' patent applications (their propensity to patent), from interviews with firm employees, and from press releases on policies and enforcement of patent law. The data provided by SIPO, corporations, and press give indication of the diffusion and inclination to use patent protection in China. Through this study, I am interested in answering the question: "Is intellectual property and rule of law commensurate with the business incentives in China's development?" Is IP law merely a Western imported law to which the Chinese must conform through TRIPS? Is the patent propensity merely a government-induced action? Or is it in the firm's profit incentive to pursue patents?

To contextualize my findings on Potevio and Dawning, I have gathered data on 7 other competitors in each of the mobile telecommunications and computer manufacturing industries. Their propensity to patent will shed some light on the efficacy of patent protection on firms' rational strategy, or may reveal that patent protection is mainly a national government strategy.

For the dependent variable, propensity to patent was measured by the number of patent applications filed by each firm at the State Intellectual Property Office (SIPO) in Beijing from 2000 to 2008. The cost of patent applications was calculated by multiplying the average cost for each type of patent applications – invention, utility, design, PCT – with the number of each type of application. These costs include only minimum, official rates[34] due to SIPO and do not include arbitrary costs such as legal fees, translation costs, and so on.

For corporations' product sales, revenue, and R&D expenses, I consulted their annual reports, which were available for publicly listed firms. The selection of the seven or eight competitors per industry usually pended on available information. However, many companies choose not to disclose their R&D expenditures or not to recognize it in their income statements

[34] All-China Patent Agents Association. (2009, pp. 2 – 3)

because it is a high cost that will deduct and make the companies' top line of cash look less favorable to shareholders, and because R&D expense is a flow variable that corporations may delay the recognition of R&D in their accounting.[35] As a result, I sometimes could only estimate firms' R&D expense from telling categories or cash flows, such as "Unusual expense (income)," "Other operating expenses," "Other investing cash flow items," or "Cash from investing" on firms' financial statements.

Calculations

Where data was incomplete, I have taken the liberty and the pains to annualize data from interim reports or press releases, to interpolate and to extrapolate figures when certain firms lacked consistent annual filings. Specifically, R&D costs tend not to be recognized by firms in their accounting immediately, since these costs may be continuous and firms want to show higher short-term growth on their annual reports. As such, R&D costs are sometimes calculated as 10% of firm revenue or operating income, based upon press releases stating such.

Also, competitive share of the market is based on the ratio of company revenues to industry revenues. Again, where data was incomplete, I have annualized company revenues and estimated industry revenues through the following priority of methods: (1) market share reported on companies' annual reports (certified by public accountants), (2) market share disclosed via news articles, or (3) interpolation or extrapolation by ratio of relevant metrics, such as the change in number of users in the market, relative to those years.

[35] Libby, Robert and Patricia A. Short, Daniel G. Libby. (2005, pp. 155 – 209)

IV. ***Results***

Despite the partial privatization and soft budget constraints of Chinese SOE's, patent propensity is approximated as a ratio of a corporation's patent expenses to its private R&D expenditures. There was no significance found for private versus non-private firms and SOE's. That is, the R&D and ownership structure cannot be identified as significantly affecting the propensity to patent amongst the sample of firms in Beijing. The results of my study may be affected by a number of reasons and susceptibilities, including:

- **Misreporting**

  Especially for non-private firms – which are not publicly listed and have less public transparency and accountability – corporate information is suspect because there is no certification by external auditors. Specifically for SOE's such as Potevio and Dawning, figures for R&D were reported verbally in interview or correspondence without backing. When figures were given verbally or in writing, there was tendency for interview subjects to round off figures to the nearest ten thousand Chinese yuan. As such, information is prone to human bias or error.

- **Identification Problem**

  Because government hopes to promote technology diffusion and engagement in R&D among many firms, government often creates alliances – vertically integrating along the production chain – for example, to reduce waste in transaction costs or overlapping costs. In interview, I have learned that Potevio is engaged in R&D

alliances with other government owned telecommunications, mobile phone, or transportation infrastructure companies.

Meanwhile, firms are also horizontally integrated through mergers and acquisitions. For example, China Unicom and China Netcom merged in 2008, at the end point of the period of this study. Moreover, firms tend to change names throughout their history, sometimes under change of ownership or change of structure such as through merger, acquisition, or creation of subsidiaries. Lastly, firms may be extended through the creation of subsidiaries (typically with provincial branches). Frequently, firms' will file patents under many different company names or branches. The reason for this is unclear, but for this particular study, it was difficult to exact the number of patent applications.

- **Missing Data**

For some companies, annual reports were unavailable or incomplete. Other times, the subjects' report of figures were incomplete because subjects did not have final numbers or full reports at hand. This problem was corrected for by annualizing monthly statements, interpolating between years, or referring to the next best source – typically, some news release – that stated the revenue or cost of interest.

- **Sample Size**

Due to my limited time and resources, I was only able to interview two or three subjects at each firm and nine other relevant personnel. In scope, my interviews were well-diversified, but still not a "large number" for statistical measures.

> Industry data is limited since market studies that have been carried on are either non-academic or are offered for commercial sale at exorbitant prices. As such, I could only conduct my own market research for seven telecom firms and eight computer manufacturers to serve as context for my case firms Potevio and Dawning. All in all, my sample size of eight or nine total firms is too small to be presumably normal – and, in fact, seems not normal – in distribution. So the statistical regression can neither accept nor reject any hypothesis.

For closer discussion of my quantitative data, graphical analyses, and econometric output, please refer to the appendices – in particular, Appendices A and B – which pair data analysis alongside the original graphs and tables. Following this list of my quantitative data weaknesses, I will proceed to analyze the qualitative data from my on-site interviews.

Corporate Strategy

CASE I: *China Potevio, Ltd.* (普天)

By arrangement of the SASAC, Potevio and other telecom firms cooperate in a vertical alliance. Within this alliance, the firms would share their patented technologies for lower license fees and longer license terms. This set up is beneficial, according to one of Potevio's in-house lawyers, because these companies can share and trade IP according to the fast pace of the telecom industry at familiar and pre-negotiated terms. Effectively, this alliance integrates the business process to reduce transaction costs and impediments. Meanwhile, from the lawyer's viewpoint, as a part of this alliance, Potevio relies more on licensing production rights from others' patents than on submitting

new patents.[36] It is unclear whether being a part of an alliance does have an effect on Potevio's development of technology. On the other hand, from speaking with Potevio's R&D executive, I was informed that R&D frequently translates to patented projects. For example, at Potevio, they are currently developing a TD-SCDMA standard. The rationale of creating and adopting a new standard is to undermine the monopolization of the CDMA standards already in place that benefit American firms (e.g. Qualcomm) and European firms.[37] Furthermore, by leveraging this new standard within an alliance of Chinese firms will ensure this standard in the Chinese market for mobile telecommunications.

Meanwhile, government has sought to gradually privatize firms of the telecom sector. Reform of the telecommunications market is motivated by three factors:[38] (1) market efficiency, (2) enterprise performance, and (3) consumer welfare. Primarily driving the reform is government initiative and foreign forces. Generally, the direction of telecom reform has followed: reform outside the industry (involving legal and economic policies, stock adjustment, combining with operators in the capital market, reform of state-ownership, and in-depth adjustment of telecom regulations.

Potevio's competitors have gone through similar government management and cultivation, gradually easing into partial privatization and issuing IPO, gradually easing from government allocations and soft financial constraints to major league competition on the international market. As observed from Huawei's transition, government nurturing has successfully created a state enterprise that grew into a viable telecommunications power:

> Huawei has benefited from China's central government policy to construct large, indigenous globally competitive firms. Government support such as soft loans has helped local and overseas customers fund the purchase of Huawei's products. … These policies and actions have provided both a spur and the potential for Huawei to

[36] Interview. 12/29/2008.
[37] Interview. 01/03/2009.
[38] China Academy of Telecommunications Research. (2009, slides 3 – 11)

> construct successful local and global R&D and technical joint ventures, as well as marketing and distribution alliances. However, major technical, economic, and political challenges confront Huawei in a transitional global telecommunications market.
>
> One of these is continued central government involvement in constructing large indigenous enterprises that can challenge the world, although some critics have argued that Huawei has achieved success despite being largely independent of the central government. The second and somewhat paradoxical factor is China's bureaucracy, which has a tendency to limit the expansion of ambitious, and increasingly entrepreneurial indigenous firms. Third is the perennial question of whether the nation's, and by inference, Huawei's aspiration to become a technological super power can be achieved without access to foreign technical and marketing help, and access to the global equity market.[39]

The greatest concern about Huawei's competitiveness on the international telecommunications market hinges on Huawei's ability to innovate and its ability to pursue innovation through R&D. Huawei's R&D expenditures have been ostensibly lower than its global counterparts (e.g. Motorola and Nokia), however, at $480 million (next to $5 billion, and $3.1 billion, respectively) in 2004. Even in relative terms, Huawei's R&D expenditures – if indicative of its innovative output and patentability – reveal a critical factor of corporate strategy in the telecommunications sector.

Similarly, Potevio's government and corporate strategies for growth will hinge on its ability to innovate and to support innovation through expenditures. Given the nature of high expense and rapid turnover, especially with mature telecommunications companies, upfront costs and economies of scale are certainly barriers to entry. Thus, vertical integration and alliances for technology sharing may be seen as substituting for economies of scale in order to establish some innovative base, from which these firms will work to climb "the rungs of the R&D ladder."

[39] Low, Brian. (2007, pp. 23)

CASE II: DAWNING (曙光)

For instance, Dawning's latest model – the 5000A supercomputer – has reached 200kHz of speed after taking 4 years of development. Even though the American supercomputers compare at 1000kHz of speed, Dawning's President Li Jun is optimistic in the progress that has been made in 4 year's time. Li believes that with the twenty-fold improvement in speed since the 4000A model four years ago, the next step invention to bring Dawning products closer to American supercomputers will be within grasp.[40] Li says that the difference between American and Chinese supercomputers right now is in the utilization of each and that the critical factor will be technology diffusion ("差距在应用，关键在普及"). In short, it is a contest of standards that will proliferate technology.

China's computer-industry strategy includes similar elements, as it has promoted exports and invested heavily in building an information infrastructure. On the other hand, China's strategy also embodies the government's desire to catch up technologically while maintaining central control over key aspects of the economy, reducing its dependence on foreign technologies. Corroborating with this philosophy, China has opened its computer sector to foreign firms – including US, Taiwanese, and a few Korean and Japanese PC companies – to attract investment and technology.[41] It has also promoted exports by joining the global production networks of multinational corporations. Because it is unwilling to give foreign firms control of its computer market, the government directly limits the role of foreigners in telecommunications services, data communications, and Internet services.

While this is a story about corporate strategies and economic incentives, there is an implicit third character of the government. By the design and structure of economic incentives, government

[40] Dawning Information Industry Co., Ltd. (2007, pp. 3, 6)
[41] Kraemer, Kenneth L. and Jason Dedrick. (2002, pp. 7)

is extending the plan for national strategy. When previously criticized for widespread counterfeiting and disregard for IPR, central government had argued that these were foundling companies with neither understanding of nor capacity to pay license fees and to contract. The Chinese have argued that advanced economies such as the U.S. and EU use IP as a new arm of imperialism to smite any one that can actually produce goods at lower prices and at higher efficiency. Previously, central government had let the counterfeiters continue to operate insofar as these were small firms extracting their rational profit. However, with intense international dissent and with the rules of WTO, China's central government has taken a new position with regard to domestic infringers.

Now it is central government's objective to crack down on any counterfeiting business or black market because it seeks to instill national discipline and domestic utilization of IP itself. Feeling that the best defense now is offense, central government hopes no longer to see its companies as the vulnerable accused. Instead, by arming its own firms with IP, government hopes that technology and production will no longer be a national crutch.

Government and Corporate Strategies

Virtually all companies in China have some sort of tie with government founding, sponsorship, and national interests. Only in recent years has government taken minority shares in many companies. Rising from a history of collectivization and public ownership, all enterprises were required to register with the government, as well as all enterprises needed national support because there was not the available domestic capital or the sense of private investment. While Westerners immediately take any government connection as indication of blurred interests, the Chinese find this to be natural and necessary.[42] Even with nationalist origins or government shares, companies usually

[42] Interview. 01/05/2009.

insist that they are independent in their decision-making. That is not to say that government objectives do not play a part in private or enterprise decisions. In certain key industries where the players are few and the market is national, companies must pay attention to the central government's goals delineated in its five-year plan, one CTO explains. Given the direction that central government hopes wire signals to be compatible across provinces, for example, telecommunications companies will adopt this into their own R&D objectives, and many teams or many companies will submit their proposals and initial product to government to apply for funding to pursue this product on a grand scale.

Thus, the stated objectives from central government largely influence the research objectives of companies. Unless a private enterprise has the financial capability to not require public funding, then its product development will depend on how satisfactorily it can meet the government's technological objectives. While government grants meant to work as a reward system for technological progress, the implications of this system are that innovations are (at best) highly influenced or (at worst) limited to the stated national objectives and each five-year plan.

Furthermore, most firms have some extent of state ownership, which Westerners take with a grain of salt. When speaking with lower level employees to chief executives at various firms, however, these companies believe themselves to be no different in operation from private companies of capitalist nations. They believe that they strive for the same aspects of revenue, market growth, and technological innovation. Meanwhile, the central government argues that China's economy has only recently and gradually moved to a free market model, and that enterprises need guidance and gradual discipline."

Patent Regulation in China

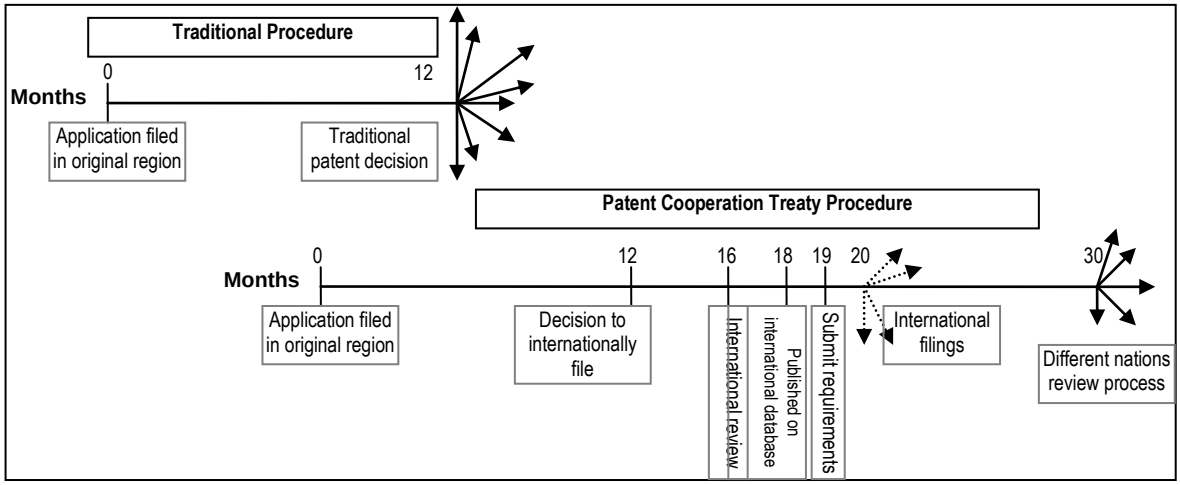
SIPO holds the sole power of examining and granting of patents in the PRC. Yet, disputably, this is a very weak power, reflects one patent examiner. The magnitude of the SIPO's power to grant or to reject is minor next to other government arms, such as the Ministry of Commerce of the PRC, for example. The incentives that the Ministry of Commerce can offer and the influences that the Ministry has on corporate strategies far outweigh anything that the SIPO can offer. That is, the SIPO has both limited resources to push its policies and limited power to compel others to follow its policies, whereas other government ministries have more prestige, more command, and a higher budget. "The worst thing that we can do is to reject a patent," one examiner said, "but that doesn't matter because the firm can always apply again." [43] This may seem like the case with any other country, but this examiner clarifies the difference that, in China, other ministries (such as the Ministry of Commerce) wield much higher incentives and power in economics and policy. The Ministry of Commerce, can also accord firms with high rankings, market permits, and other tangible and intangible benefits that may or may not be aligned with SIPO's policies for promoting quality innovation and IP enforcement.

Furthermore, for two of the three kinds of patents – for utility model and design patents – examination is merely a formality against the stipulations of the *Patent Law and the Implementing Regulations of the Patent Law* handbook. For the third kind of patent – invention patents – the application is examined with consideration of "next inventive step" and "practicality." The SIPO charges 950 RMB for basic filing of a patent[44], but also offers monetary reward for each application in order to positively reinforce patenting among civil society. Yet, because different regions or entities might offer different subsidies or bonuses to firms applying for patents, there is a layering

[43] Interview. 12/30/2008.
[44] All-China Patent Agents Association. (2009, pp. 2 – 3)

effect of incentives. This has resulted in excess reward for patenting in some cases to cause arbitrage.

For the same price of applying for a patent in the PRC, one also has the option of filing for a patent under the Patent Cooperation Treaty (PCT), an international patent law treaty. Established in 1970, the PCT serves to unify patent processes by moving to an international standard for filing on an international database, thus, to simplify criteria and transaction costs. In order to compare the traditional patent review procedure and the PCT procedure, the following diagram is translated and adapted from the *China IP Protection Handbook*[45] :



Under the PCT system, an applicant has the advantage of submitting for international patents under a single set of criteria, single language, single instance of revealing invention, and 18 extra months to decide where else to apply. In spite of these apparent advantages, some patent examiners believe that PCT is not a viable system because it most significantly benefits the U.S.

Since the U.S. leads in IPR and holds 80% of the patents in the world, other nations might see PCT as a "stick" by which the U.S. will more easily extend its IP prowess. After all, it is noted that the U.S. holds 80% of the world's patents already and the U.S. is the most proliferate patent

[45] Long, Wen, and Zhang, Lirong, and Chen, Jianghua, and Ji Pingping. (2007, pp. 57)

power. The PCT standardization and efficiencies will most benefit the U.S., and the PCT is seen as another way that the U.S. can exercise pressures on IP standards and regulations or that the U.S. can exercise rights to exact monetary compensation after pressuring others to get on board. For *developing* nations, one source says, IPR is stick that beats their industries for trying to produce and that impedes their industrial development, while for *developed* nations, IPR is a stick that leverages their industrial and commercial power.

Magnitude of the IP Issue

In Appendix E are graphs that I generated from data obtained from a source at the SIPO. I'm only including generic breakdown of foreign vs. domestic filing of patents for this paper in order to disprove the notoriety that domestic firms are completely IP rogues and infringers of foreign IP rights. As shown in the graphs, there are 3 types of patents in China, which are granted based on the nature of the product itself, whether it categorizes as a mechanical "invention," as a "utility model," or a process "design." Domestically, the utility model is most consistently popular. Among foreign applicants, the invention patent is, by far, the most popular. However, it is important to note that the foreign filing of patents is measured at half the scale that domestic filing is shown at. So while we think that foreigners are more likely to use IP law, it seems that the Chinese are actually utilizing patents very robustly.

A note about these graphs, I showed the *average* number of patents filed across the years 1985 – 2002, so the actual cumulative patents of 1985 – 2002 would have made the three bars on the very left end of each graph is much higher. But for viewing the trends in growth in patent filing, this "annualized" filing is more useful to see.

The Chinese have a continental legal system – for purposes of stability – that makes it closer to the European model than it is to the American system.[46] Different from both the Europeans and the Americans, however, is the fact that, Chinese system is very much influx. People consider the legal environment to be constantly evolving, and that government is constantly modifying the national agenda to complement economic growth. As such, the nation operates by "rule by law" instead of "rule of law." [47] As a SIPO examiner said to me, "上有政策, 下有对策" (meaning, "governmental policies are given from the top, however, on the playing field, there are counter-policies.") Likewise, a visiting law professor from Peking University emphasizes that, law and policy are discrete forms in China. Law states a theoretical, social value or rule, but policy will interpret and implement the law. For example, "Customs protection of IP" was a policy utterance from 2005. Trade and politics also affect legal and policy implementation.

Growth of Litigation

Beyond firms' applications and attainment of patents, the ability of patents to protect innovation is put to the test when cases are contested in court. Typically, a patent dispute involves the patent holder (usually the plaintiff) and the infringer (the defendant), who usually argues about the terms of the property use. Court cases are actually quite significant since the whole industry will be watching to see what rights and limitations are established by rule of law. Essentially, court rulings serve as a touchstone for IP protection and enforcement when information on court proceedings is widely available.

With the institution of law in China, there has been pronounced growth in court litigation from 1978 to 1997. Included in Appendix F is a graph (Figure F-1) generated from World Bank

[46] Gewirtz, Paul. (2003, pp. 4)
[47] Kahn, Paul. (2002, pp. 151 – 153)

data, showing trends in civil and economic cases. Table F-1 presents interesting information about who files these lawsuits. Unfortunately, this is not a random sample, but it still sheds some perspective of who actually steps up to court and reveals whether or not the legal system is doing its job serving the people.

Historical Case: domestic dispute about unfair competition

As a specific case of domestic firms with formal IP protection (patent), Beijing Financial City Network challenged a fellow IT company (Chengdu Caizhi Software Co.) to court to settle their dispute about IP infringement and resulting unfair competition.[48] The facts of the case are that: Financial City Network (FCN) had cooperatively developed a website with China Construction Bank Beijing Branch. Featured on the website was a column that was solely developed and published by FCN: the "Foreign Exchange Trends" column (hereby called the Chart) featured data and charts that became widely popular. In June 2000, Chengdu Caizhi Software Co. (CSC) established a direct link to the Chart that bypassed the rest of the website. This act was protested by the plaintiff (FCN) as "unfair competition" to raise public confusion and to subvert FCN's ownership and product value. Moreover, FCN would lose economic value as website visitors would decrease if they can access this Chart elsewhere.

On the defense, CSC acknowledges that it had established a link to the Chart, however, CSC had ceased to link after learning that FCN did not approve of such an act. Furthermore, CSC claimed to have made no earnings from the link and have made no claims of ownership of the Chart.

In reviewing this case, three judges unanimously sided with FCN that the establishment of a link without permission of the owner and undercutting FCN's website traffic did "constitute unfair

[48] Lin, Zhou. (2002, pp. 576 – 597)

competition and is an infringement of the plaintiff's legal rights and interests. Judge Ma Xiurong argues that the Chart is not made common information on the Internet, but is intellectual property that was developed through the labor of FCN and has market value. Therefore, the developer of the property deserves sole rights to determine the use of the Chart. Judge Luo Dongchuan argues that the argument of "unfair competition" was proven through: (1) civil rights and interests that are protected by the law, and (2) such rights and interests were damaged through infringement. Judge Chen Jinchuan argues that different versions of a patented material still represent a property's legal rights and interests. As both FCN and CSC are financial information service companies using computer network information services, they are direct competitors, and such an act of unfair competition.

The example of this case reveals very important rising issues in defining property rights and limitations of use. It shows the coverage of patent protection and proves, in this case, that such a patent protection ensured economic incentives and product ownership for the innovator, FCN. A case such as this would not only reinforce innovators' understanding in the patent system, but their trust in the legal system. That is, the bringing act of infringement to court made FCN's patent a touchstone for IT firms and patents everywhere.

V. ***Conclusion***

Summary of findings

The decision to patent is made based on perceived effectiveness of the patent to offer protection of innovative property. Typical assessment by firms follows a cost-benefit analysis and an analysis of the product and the market conditions. Moetteli & Associés SàRL (a firm of European and US Patent attorneys that practices in the PRC) advise that a patent should be filed if certain product and industry conditions are met, and if the cost-benefit analysis is favorable. The innovative product should not be easily copied – e.g. website content or database, such as in the Beijing Financial City Network case – and product protection should at least be enforceable – e.g. if the websites can prevent download or rerouting of links to alternate sites. In terms of industry conditions, M&AS suggests that patents are not worth filing in industries of lower barrier to market entry – for example, if there are low fixed costs for the industry, competitor firms will quickly enter the market and the duration of patent will not be as effective or worthwhile.

Also, firms must consider the costs associated with patent application: including both translation fees and legal fees. Despite these monetary costs, the promise of profits and sole defensible rights to the invention for the duration of 20 years will draw innovators who believe that formal patents offer more than informal protectionism.

Discussion (explanation of findings)

Despite the fact that there was no significant result from my econometric analysis, I believe that effects of human bias, identification problems, missing data, and small sample size can be mitigated in a more robust data set. At the same time, the lack of significance between private and

non-privately funded R&D investments may in fact corroborate with the assertion by the Chinese that, "SOE's bear the same strategies for growth and innovation as any other corporation." [49] Basically, the decision to patent reveals an innovator / entrepreneur's evaluation of whether there is effective and enforceable IP protection. If an innovator / entrepreneur chooses not to patent, he may reveal perceptions of insufficient protection, lack of confidence in the legal mechanism, or that the costs of the patent are unsuitable to his product or industry. Thus far, I have no way of distinguishing which was the factor that dissuaded the innovator from patenting his invention. In order to pinpoint the exact reasons for patent failure, I would need qualitative insights from Chinese IT firms themselves. This will be addressed in the subsequent Recommendations section.

Also, I note that patents are not necessarily the best nor the only means of protecting IP, so a decision against patenting is not an utter rejection of the formal IP system. It very well may be the case that a paranoid innovator feels that he can best protect his invention as a trade secret (since patents require disclosure of knowledge in its delineation of protection claims). However, patents are the most robust of formal IP protection mechanisms and are the most prevalent form of IP protections over copyright, trademark, etc. As such, it is pertinent to use patents as an indicator of the extent of IP law throughout the PRC over a number of years. This "extent" of IP law's rights, incentives, and enforcement may be interpreted within certain limits and within specific cases.

Recommendations (based on findings)

IP law already exists but will be more effective if institutional corrections are made to improve the transparency, enforcement, and availability of information on both the law and court proceedings. While this paper focused on the development and utilization of patents across

[49] Interviews. 12/30/2008 – 1/12/2009.

provinces – and particularly patents and litigation in Beijing – it would be pertinent to extend research to provincial litigations.

Having conducted this study over a limited sample of firms, I would recommend that further research seek larger samples of data in order to make more robust analysis. My own study focused on two specific firms in two specific industries, however, no comparison could be made between the two – besides the fact that both were SOE's – since they otherwise had completely different markets and strategies. Thus, I tested for the significance of private versus non-private ownership in affecting the patent decision, however it may be interesting to apply comparative analysis of SOE's across more than two industries. That is, in order to attribute any effect of state ownership to the propensity to patent, one must consider a wider variety and sample of industries.

If this study were to be repeated in the future, it could also be interesting to contrast the qualitative views and strategies espoused by economic agents. This would require repeated interviews – preferably with the same interview questions and same personnel – among corporate management, inventors, lawyers, and scholars. At present, this study is limited by time and constraints, so it merely captures the "snapshot" views and strategies told of two case firms – Potevio and Dawning – against the context of seven or eight competitors, over eight years.

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APPENDIX A: Potevio and Telecom firms

The following are charts and output from original data collections and analysis on Potevio and 7 competitors in the telecommunications and mobile phones industry.

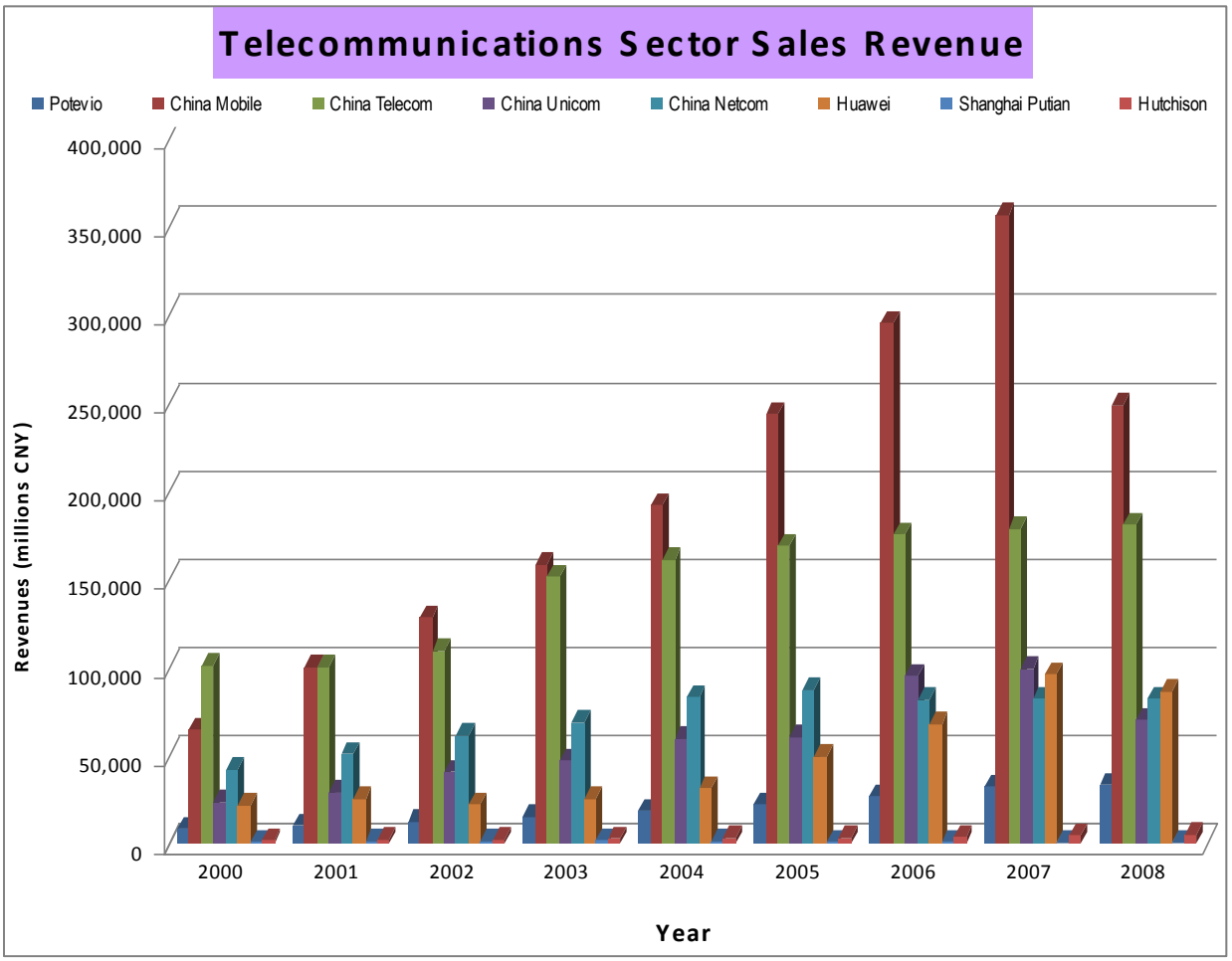


Figure A-1.1

The above graph (Figure A-1.1) shows the revenue of all 8 firms, as was reported in their annual reports, news releases, or verbally through interviews and correspondence. The revenues were all converted to common currency (Chinese yuan, denoted "CNY"),

Below, Figure A-1.2 then normalized the revenues with respect to Potevio's revenue figure in 2000. Normalizing the figures thus was meant to show year-on-year growth in revenue, relative to the firm of interest (Potevio), thus making more even comparison between firms, since China Mobile and China Telecom have much higher sales than other firms in the market. In the Figure A-1, Potevio shows steady growth, but is clearly outstripped by most other competitors. Each firm seemed to hit a peak in 2007 revenue, but subsequently declined. This has primarily been attributed to the worldwide recession that hit in 2008.

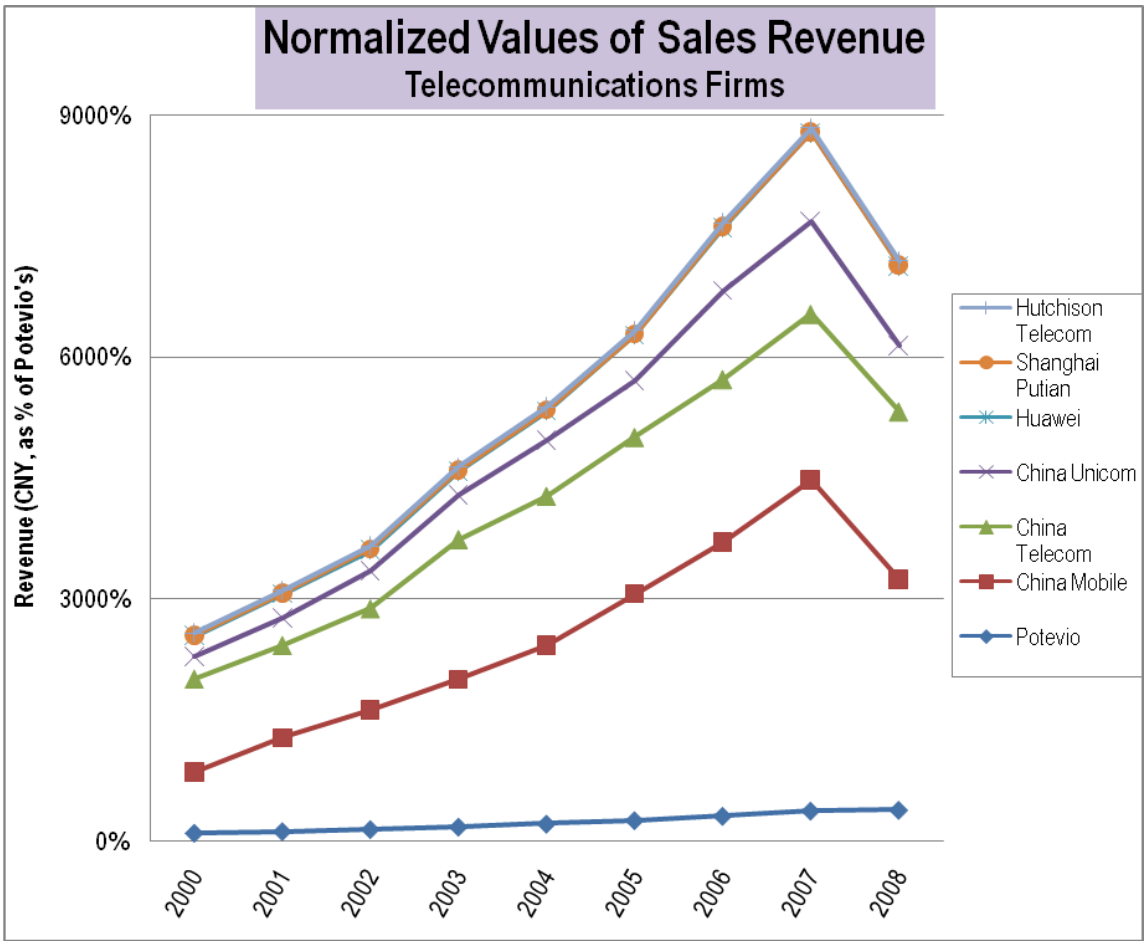


Figure A-1.2

	Potevio 普天	China Mobile 中国移动通信	China Telecom 中国电信	China Unicom 中国联通	China Netcom 中国网通	Huawei 华为技术	Shanghai Putian 上海普天	Hutchison Telecom
2000	100.00%	747.31%	1166.46%	272.43%	486.41%	253.19%	13.05%	23.94%
2001	120.80%	1153.79%	1155.70%	338.01%	587.59%	295.10%	15.77%	26.65%
2002	145.93%	1478.43%	1259.97%	466.62%	709.80%	256.98%	19.05%	29.66%
2003	176.28%	1823.92%	1742.84%	545.90%	794.84%	293.16%	23.01%	33.01%
2004	212.95%	2212.35%	1853.91%	685.00%	960.17%	364.26%	18.42%	36.74%
2005	257.24%	2804.46%	1947.04%	695.28%	1003.15%	569.36%	12.63%	40.89%
2006	310.74%	3396.57%	2019.56%	1096.48%	940.55%	784.15%	11.23%	45.51%
2007	375.38%	4104.97%	2054.52%	1144.68%	948.60%	1104.74%	5.63%	53.16%
2008	385.89%	2860.56%	2079.95%	808.21%	948.60%	996.63%	5.78%	62.12%

Table A-1.

Growth can be seen through the break down of marketshare between these 7 firms in Figures A-2 through A-4 below. Again, it is seen that Potevio's growth has been steady, since its market share has remained at 3%, while the rest of the industry has been expanding. Furthermore, China Unicom and China Netcom's merger in 2008 consolidated another market power.

In the following Figure A-2 and Table A-2, market share is calculated by dividing each firm's revenue over reported revenues for the telecommunications industry as a whole. These statistics came from company annual reports and press releases, or were annualized or interpolated from other available data. Industry revenue was subjective to reporting biases, since each company report deemed its own firm to be a market leader. However, using the most objective sources available –

such as third party journalists – a single industry revenue number was divided through company revenues to find the competitive market share.

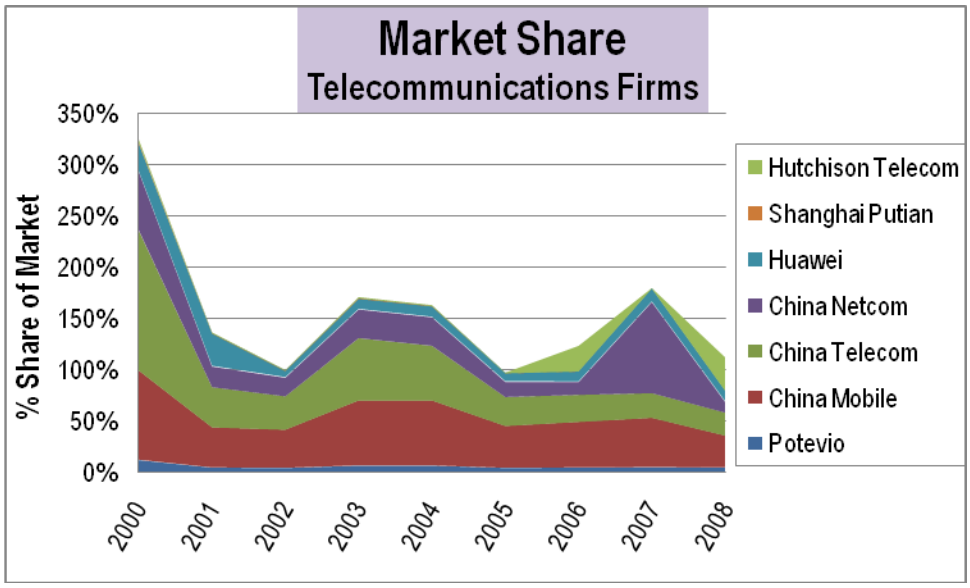


Figure A-2.

	Potevio 普天	China Mobile 中国移动通信	China Telecom 中国电信	China Unicom 中国联通	China Netcom 中国网通	Huawei 华为技术	Shanghai Putian 上海普天	Hutchison Telecom
2000	11.75%	87.78%	137.01%	32.00%	57.13%	27.00%	1.53%	2.81%
2001	4.15%	39.60%	39.66%	11.60%	20.16%	32.00%	0.54%	0.91%
2002	3.72%	37.70%	33.00%	10.60%	18.10%	6.55%	0.49%	0.76%
2003	6.19%	64.00%	61.15%	19.16%	27.89%	10.29%	0.81%	1.16%
2004	6.16%	64.00%	53.63%	30.59%	27.78%	10.54%	0.53%	1.06%
2005	3.79%	41.30%	28.67%	34.50%	14.77%	8.38%	0.19%	0.60%
2006	4.12%	45.00%	26.76%	14.53%	12.46%	10.39%	0.15%	25.00%
2007	4.45%	48.70%	24.37%	13.58%	88.90%	13.11%	0.07%	0.63%
2008	4.24%	31.42%	22.85%	8.88%	10.42%	10.95%	0.06%	**32.79%**

Table A-2.

With these results, it is seen that market share also takes on a cyclical component in the telecommunications industry. The market is clearly dominated by China Mobile and China Telecom in the beginning, from 2000 – 2006, then China Netcom experienced huge market gain. Furthermore, it should be noted that China Netcom merged with China Unicom in 2008, which is not shown as combined market share, but as separate in the table and diagram.

In the next set (Figure A-3, Table A-3), R&D expenditures over revenues indicate each firm's spending on and relative value of technological development and innovation. Again, values of R&D over revenues were normalized to the base value of Potevio's in 2000. The results a cyclical component to the amount of R&D spent relative to revenues. Aside from dominant market players – China Mobile and China Telecom – the other firms were more volatile in their spending, likely due to competitive pressures for growth. It should also be noted that the R&D expenditures generally tend to rise while revenues are rising, however for companies aiming for high growth, high R&D years precede years of high revenues, therefore showing as dramatically different ratios of R&D to revenue.

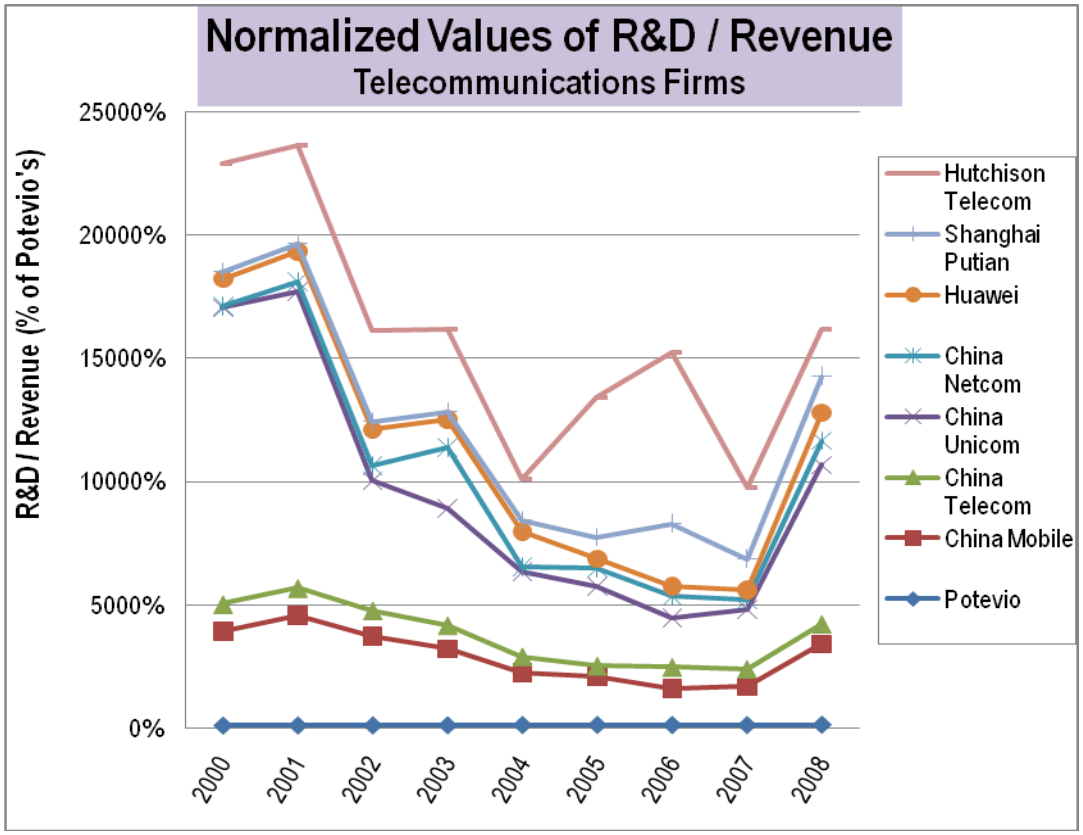


Figure A-3.

	Potevio 普天	China Mobile 中国移动通信	China Telecom 中国电信	China Unicom 中国联通	China Netcom 中国网通	Huawei 华为技术	Shanghai Putian 上海普天	Hutchison Telecom
2000	0.88%	33.80%	9.61%	106.29%	0.38%	10.00%	2.25%	39.01%
2001	0.91%	39.37%	9.86%	106.32%	3.38%	10.97%	2.50%	35.64%
2002	0.95%	31.89%	9.19%	46.68%	5.19%	13.00%	2.84%	32.55%
2003	0.98%	27.29%	8.46%	42.24%	21.46%	10.00%	2.78%	29.74%
2004	1.08%	18.70%	5.70%	30.81%	1.51%	12.54%	4.15%	14.45%
2005	1.12%	17.37%	3.65%	28.86%	6.33%	3.24%	7.78%	49.95%
2006	1.11%	12.94%	7.69%	17.81%	7.65%	3.45%	22.66%	61.38%
2007	1.07%	13.74%	6.16%	21.60%	3.34%	3.45%	11.24%	25.41%
2008	1.19%	28.83%	7.20%	57.12%	8.51%	10.00%	13.23%	16.93%
AVG.	1.03%	24.88%	7.50%	50.86%	6.41%	8.52%	7.72%	33.90%

Table A-3.

Typically, the larger, privatized, globally competitive firms show the highest levels of R&D expense in the scope of company revenues. These include Hutchison, China Unicom, and China Mobile. While most of these firms' expenditures were highly volatile, Potevio's expense was consistent and low, despite market trends. This may be due to the fact that Potevio's R&D funding is largely and constantly supplied by government grant or commission. However, it should also be noted that certain firms experienced decline of R&D investment rates because those firms later merged. Specifically, China Telecom and China Unicom have merged in 2008, and China Mobile and Tie Tong (not featured) merged in 2007.

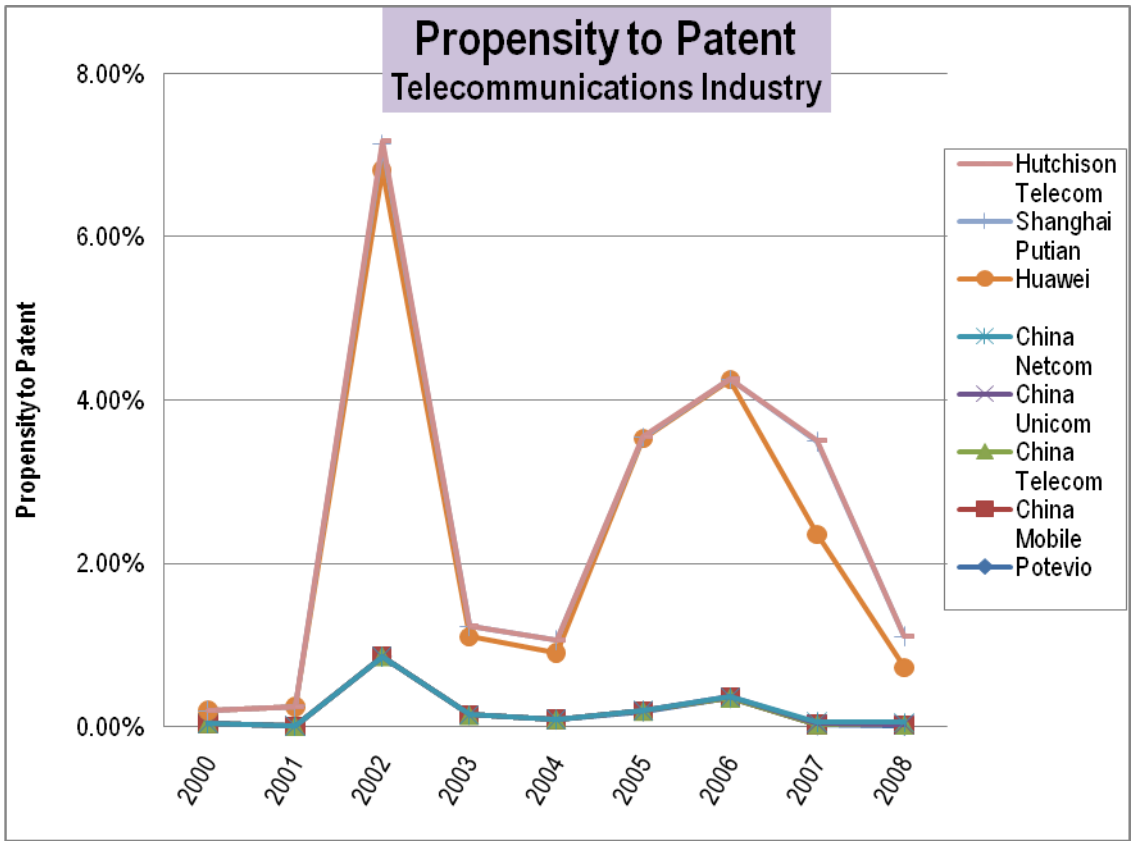


Figure A-4.

	Potevio 普天	China Mobile 中国移动通信	China Telecom 中国电信	China Unicom 中国联通	China Netcom 中国网通	Huawei 华为技术	Shanghai Putian 上海普天	Hutchison Telecom
2000	0.04%	0.00%	0.00%	0.00%	0.00%	0.16%	0.00%	0.00%
2001	0.00%	0.00%	0.00%	0.00%	0.00%	0.25%	0.00%	0.00%
2002	0.86%	0.00%	0.00%	0.00%	0.00%	5.95%	0.32%	0.04%
2003	0.14%	0.00%	0.00%	0.00%	0.00%	0.96%	0.13%	0.00%
2004	0.08%	0.00%	0.00%	0.00%	0.00%	0.82%	0.16%	0.00%
2005	0.18%	0.00%	0.00%	0.00%	0.00%	3.34%	0.02%	0.00%
2006	0.34%	0.01%	0.00%	0.01%	0.00%	3.89%	0.01%	0.00%
2007	0.01%	0.01%	0.00%	0.01%	0.02%	2.31%	1.14%	0.00%
2008	0.00%	0.01%	0.00%	0.00%	0.02%	0.68%	0.39%	0.00%

Table A-4.

Propensity to patent is measured as the ratio of patent expenditures (based on average costs of filing patents multiplied by the number of applications filed) to the firm's R&D expenditure (spending on technology or innovation as a whole). These figures are not normalized, but appear as "raw" propensity to patent in each year. Huawei and Hutchison clearly had the highest propensity to patent throughout this period 2000 – 2008, and had nearly concurrent cycles of patent expenditure over R&D investment. On the other hand, Potevio, China Movile, and China Telecom had very similar trends in propensity to patent. Generally, 2002 and 2006 were peak years for patenting across all eight firms.

	Coefficient			
	Intercept (β_0)	R&D / Revenue (β_3)	Private Funding (β_4)	Average Standard Error
2000	0.00019902	-0.00056238	0.00041209	0.00052128
2001	0.00032108	-0.00091518	0.00067622	0.00092382
2002	0.00786982	-0.02651093	0.02008542	0.02865585
2003	0.00021187	-0.00080660	0.00017060	0.00037175
2004	0.00130023	-0.08560628	0.08226631	0.09882308
2005	0.00563220	-0.08888299	0.07356717	0.08508097
2006	0.00652172	-0.08512100	0.06956924	0.08210708
2007	0.00770481	-0.22778183	0.19237620	0.10479145
2008	0.00163989	-0.01789532	0.01457737	0.01352538

Table A-5.

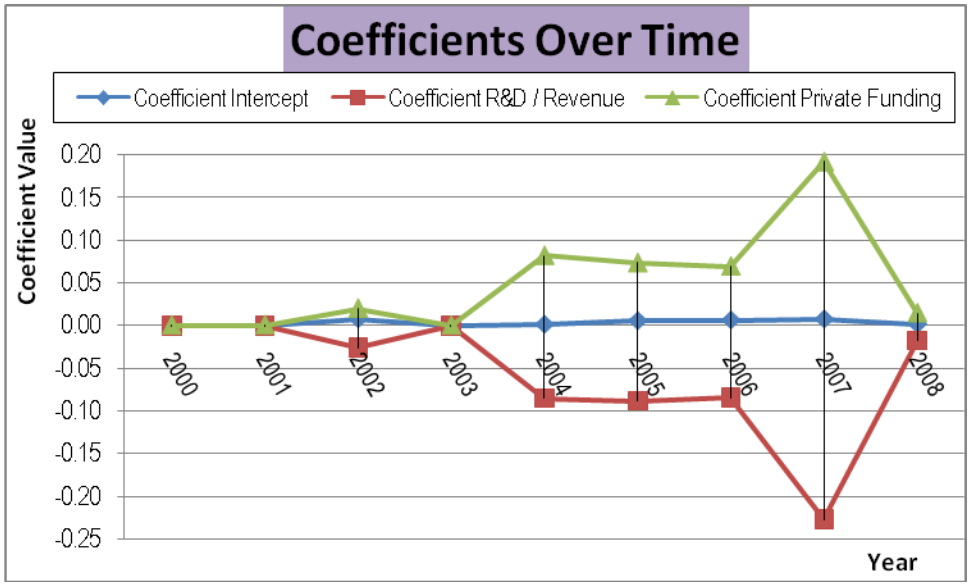


Figure A-5.

In the following Table A-5 and Figure A-5, a linear regression was performed for data across each year. That is, with time fixed effects, the data was tested for statistical significance of R&D expenses and, specifically, private R&D expenses in affecting the firms' propensity to patent. None of these years – except from the 2007 data point – show significant affect of the patent decision. In 2007, there may be indication that R&D relative to revenue was influential, however, more data and larger samples are needed before this can be accepted.

Summary Statistics for Telecommunications Firms

R&D / Revenue		*% of Industry*		*Private Funding*		*Propensity*	
R_{it}		C_{it}		$R_{it} * V$		P_{it}	
Mean	0.176018293	Mean	0.220470895	Mean	0.132043189	Mean	0.001468712
Standard Error	0.024804269	Standard Error	0.029460379	Standard Error	0.02503825	Standard Error	0.000560463
Median	0.1	Median	0.127836172	Median	0.066791891	Median	1.73423E-05
Mode	0.1	Mode	0.32	Mode	0	Mode	0
Standard Deviation	0.210471201	Standard Deviation	0.249979604	Standard Deviation	0.212456599	Standard Deviation	0.004755682
Sample Variance	0.044298126	Sample Variance	0.062489803	Sample Variance	0.045137806	Sample Variance	2.26165E-05
Kurtosis	7.364296027	Kurtosis	5.895459492	Kurtosis	9.232879843	Kurtosis	20.87340505
Skewness	2.424837267	Skewness	2.064050496	Skewness	2.824631099	Skewness	4.406594341
Range	1.059423326	Range	1.369502329	Range	1.063182431	Range	0.029669869
Minimum	0.003759106	Minimum	0.000635282	Minimum	0	Minimum	0
Maximum	1.063182431	Maximum	1.370137611	Maximum	1.063182431	Maximum	0.029669869
Sum	12.67331713	Sum	15.87390441	Sum	9.507109635	Sum	0.10574724
Count	72	Count	72	Count	72	Count	72
Largest(1)	1.063182431	Largest(1)	1.370137611	Largest(1)	1.063182431	Largest(1)	0.029669869
Smallest(1)	0.003759106	Smallest(1)	0.000635282	Smallest(1)	0	Smallest(1)	0
Confidence Level(95.0%)	0.049458307	Confidence Level(95.0%)	0.058742326	Confidence Level(95.0%)	0.049924852	Confidence Level(95.0%)	0.00111753

Table A-6.

Table A-6 gives descriptive statistics for the spread of data for each firm's annual R_{it}, C_{it}, and $R_{it} * V$. None of these independent variables were significant at the 10% level, and only the variable measuring firms' competitive market share (C_{it}) seemed significant to affect the propensity to patent at the 5% level.

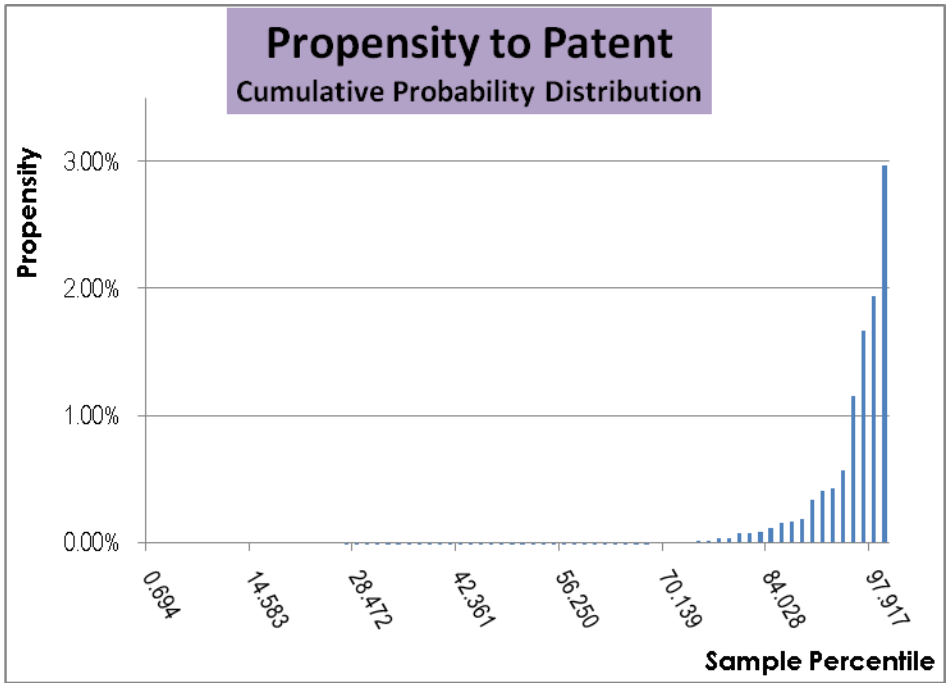
On the other side, propensity to patent remains statistically insignificant at both the 10% and 5% levels for the data spread.

Summary Statistics for Telecommunications Firms

The following is output from a linear regression analysis according to the reduced form of the equation:

$$P_{it} = \beta_0 + \beta_3 R_{it} + \beta_4 R_{it} V_i + \varepsilon_{it}$$

in which the coefficients are calculated across the panel of data (across eight firms in the industry and eight years). This contrasts with the previous regression since time was not fixed. In this regression, there is no significance in R_{it} or in $R_{it} * V$ to affect the propensity to patent (P_{it}) at both the 10% and 5% levels.



SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.179108738
R Square	0.03207994
Adjusted R Square	0.004024286
Standard Error	0.004746103
Observations	72

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	5.15131E-05	2.57565E-05	1.1434394	0.324685151
Residual	69	0.001554259	2.25255E-05		
Total	71	0.001605772			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.002180645	0.000743141	2.934361596	0.00453504	0.000698119	0.003663171	0.000698119	0.003663171
R&D / Revenue	-0.00732463	0.005585602	-1.311341235	0.19408954	-0.018467601	0.003818341	-0.0184676	0.003818341
Private Funding	0.004372326	0.005533405	0.790169135	0.43213629	-0.006666515	0.015411166	-0.00666651	0.015411166

Table A-7.

APPENDIX B: Dawning and Computer Manufacturing Firms

The following are charts and output from original data collections and analysis. Dawning and sample of 7 competing firms in the computer manufacturing sector:

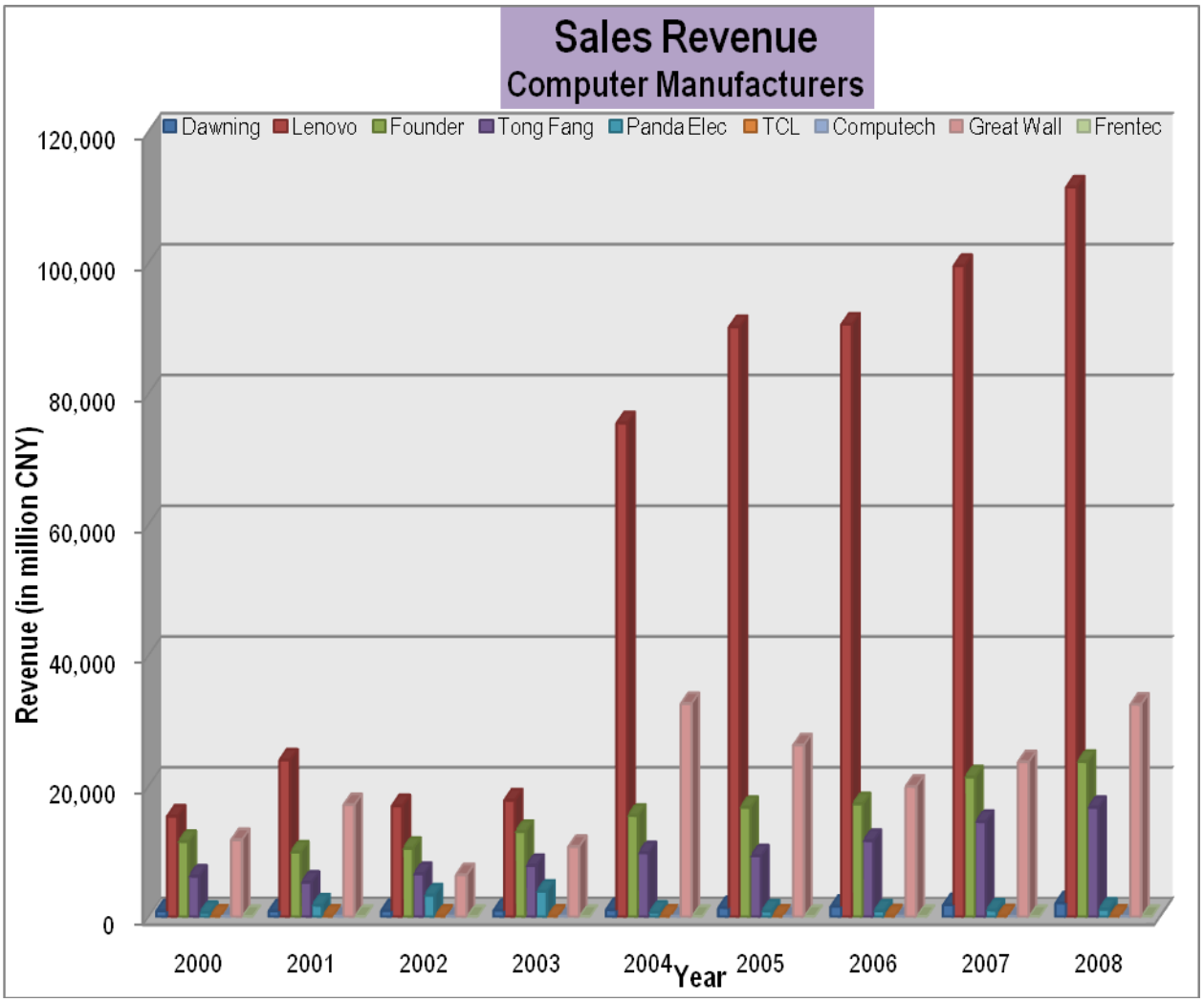


Figure B-1.1

In the above graph, Figure B-1.1 shows the raw value of R&D expense as a proportion of revenue per year for Dawning and eight select competitors.

Below, (Figure B-1.2) shows relative expense of R&D over revenue, roughly reflecting each firm's propensity to invest. By measuring innovation costs against the firm's profitability, the larger market players – Lenovo, Founder, Tong Fang, and Great Wall – all seemed to follow cyclical but upward trend of growth. It should also be noted that the R&D expenditures generally tend to rise while revenues are rising, however for companies aiming for high growth, high R&D years precede years of high revenues, therefore showing as dramatically different ratios of R&D to revenue.

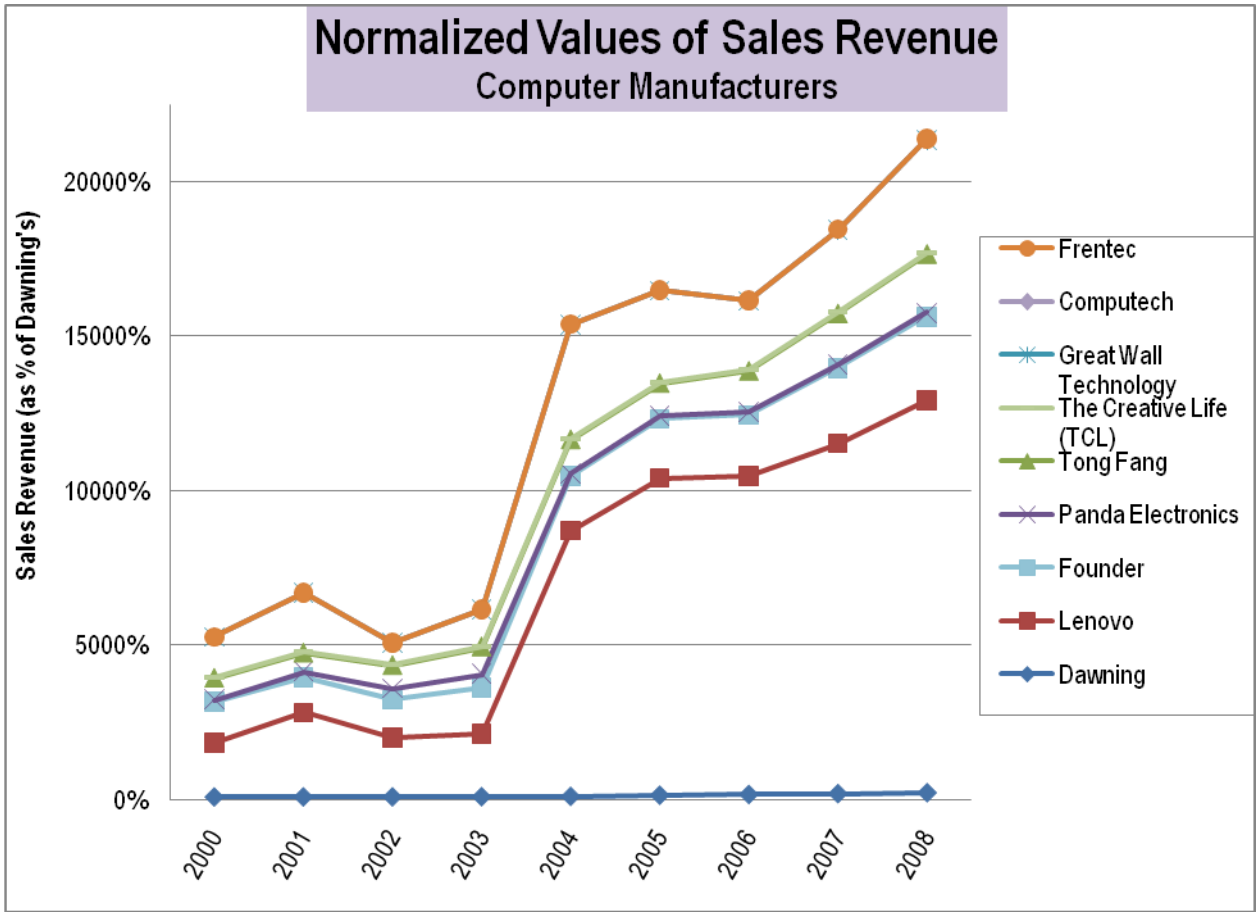


Figure B-1.2

	Dawning 曙光	Lenovo 联想集团	Founder 方正科技	Tong Fang 清华同方	Panda Electronics 熊猫集团	The Creative Life (TCL) TCL 集团	Computech	Great Wall Technology 中国长城计算机集团公司	Frentec 方瑞
2000	100.00%	1748.33%	1307.34%	705.13%	68.69%	9.02%	3.81%	1338.77%	0.04%
2001	100.50%	2727.17%	1123.14%	597.57%	198.52%	9.06%	4.25%	1949.25%	0.05%
2002	103.61%	1930.42%	1187.13%	746.96%	372.46%	9.17%	4.75%	728.29%	0.06%
2003	109.06%	2027.20%	1480.35%	889.24%	440.26%	8.34%	4.32%	1220.96%	0.08%
2004	118.55%	8596.20%	1761.62%	1111.55%	75.67%	8.00%	4.82%	3709.61%	0.07%
2005	155.98%	10270.26%	1902.55%	1058.62%	96.87%	8.61%	5.39%	2988.76%	0.06%
2006	179.29%	10314.61%	1961.53%	1323.28%	100.30%	10.55%	5.03%	2267.92%	0.06%
2007	206.08%	11335.88%	2432.29%	1654.10%	113.18%	11.97%	3.21%	2696.38%	0.07%
2008	236.88%	12704.32%	2699.85%	1902.21%	127.56%	7.95%	2.95%	3696.96%	0.08%

Table B-1.

Growth can be seen through the break down of marketshare between these 7 firms in Figures B-2 through B-4 below. Similar to Potevio, Dawning shows steady market share that has been expanding at or around the same rate of market expansion after 2004. From 2000 to 2001, as well as from 2003 to 2004, Dawning experienced declines in marekt share. This has been reflected in Founder, as Lenovo has taken the lead in growth and proliferation.

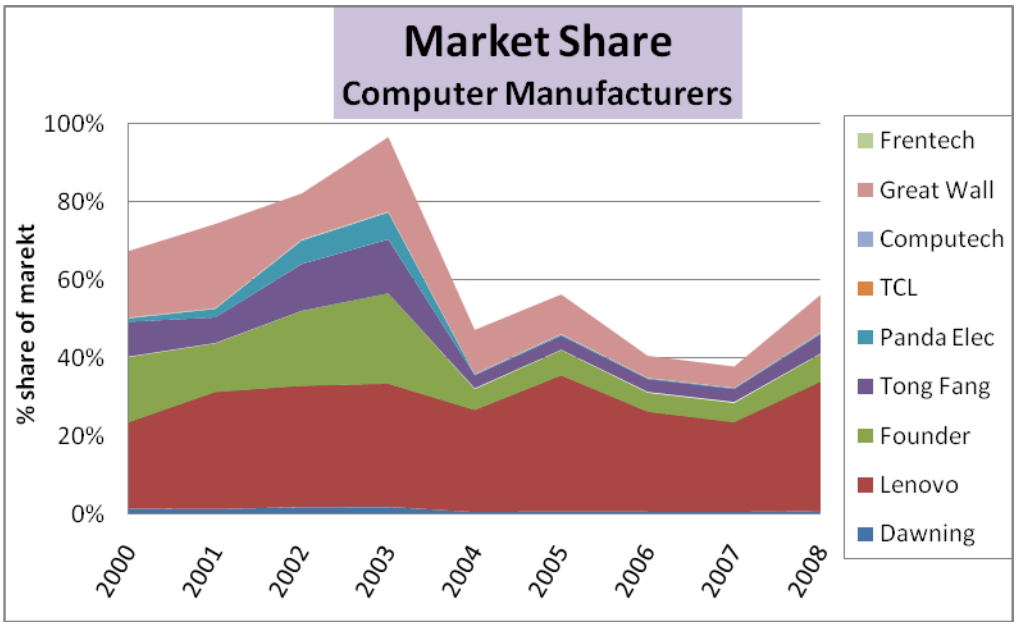


Figure B-2.

	Dawning 曙光	Lenovo 联想集团	Founder 方正科技	Tong Fang 清华同方	Panda Electronics 熊猫集团	The Creative Life TCL 集团	Computech	Great Wall Technology 中国长城计算机集团公司	Frentec 方瑞
2000	1.28%	22.30%	16.68%	8.99%	0.88%	0.12%	0.05%	17.08%	0.00057%
2001	1.11%	30.20%	12.44%	6.62%	2.20%	0.10%	0.05%	21.59%	0.00059%
2002	1.67%	31.20%	19.19%	12.07%	6.02%	0.15%	0.08%	11.77%	0.00103%
2003	1.71%	31.70%	23.15%	13.91%	6.88%	0.13%	0.07%	19.09%	0.00119%
2004	0.36%	26.30%	5.39%	3.40%	0.23%	0.02%	0.01%	11.35%	0.00021%
2005	0.53%	35.00%	6.48%	3.61%	0.33%	0.03%	0.02%	10.19%	0.00021%
2006	0.45%	25.79%	4.90%	3.31%	0.25%	0.03%	0.01%	5.67%	0.00014%
2007	0.42%	23.14%	4.96%	3.38%	0.23%	0.02%	0.01%	5.50%	0.00013%
2008	0.62%	33.33%	7.08%	4.99%	0.33%	0.02%	0.01%	9.70%	0.00020%

Table B-2.

Cyclical growth and recession can be seen through the break down of marketshare between these eight firms in Figures B-2 through B-2 above. From 2000 to 2003, all of the firms had been experiencing steady growth, but there was a marketwide decline in share of sales in 2003 and a smaller decline in 2006. Beyond that, companies have continued to pursue modest growth, not nearly as volatile as the growth in the telecom sector.

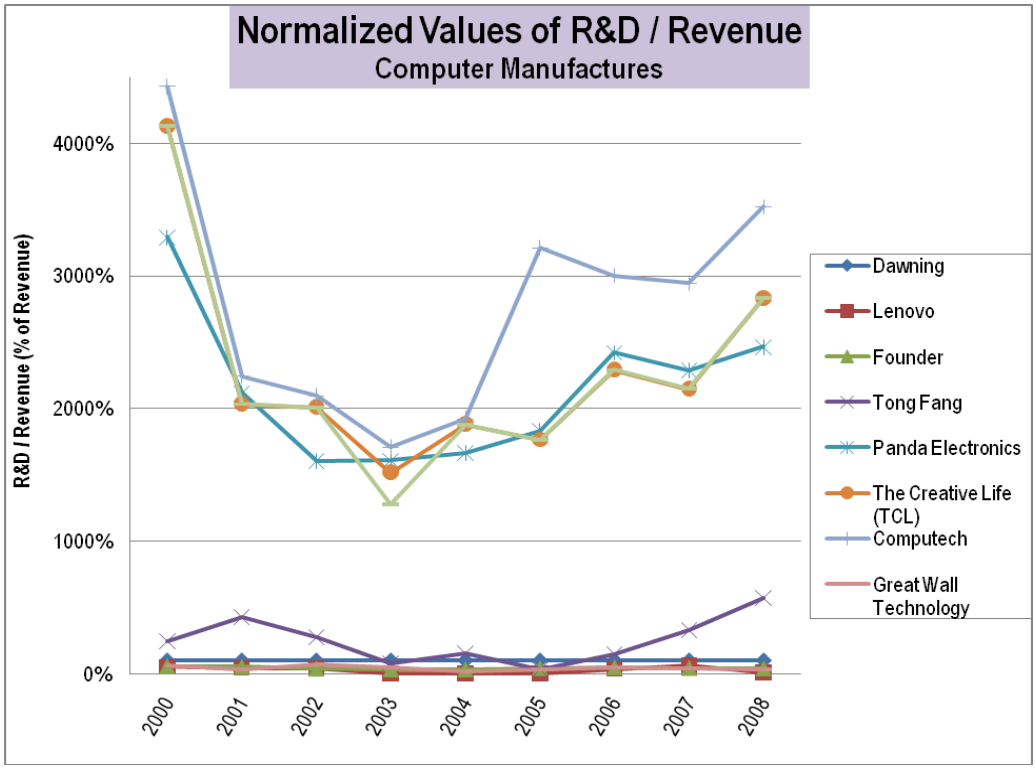


Figure B-3.

	Dawning 曙光	Lenovo 联想集团	Founder 方正科技	Tong Fang 清华同方	Panda Electronics 熊猫集团	The Creative Life (TCL) TCL 集团	Computech	Great Wall Technology 中国长城计算机集团公司	Frentec 方瑞
2000	1.37%	0.72%	0.79%	3.35%	45.00%	56.48%	60.52%	0.85%	56.48%
2001	2.13%	0.95%	1.16%	9.07%	45.00%	43.28%	47.75%	0.74%	43.28%
2002	2.81%	1.23%	1.16%	7.71%	45.00%	56.48%	58.91%	2.08%	56.48%
2003	2.80%	0.07%	0.99%	2.25%	45.00%	42.48%	47.90%	1.33%	35.82%
2004	2.70%	0.02%	0.93%	4.10%	45.00%	50.83%	51.94%	0.49%	50.83%
2005	2.21%	0.01%	0.97%	0.69%	40.40%	38.95%	70.86%	0.68%	38.95%
2006	2.05%	0.73%	1.02%	3.03%	49.71%	47.06%	61.68%	0.98%	47.06%
2007	1.95%	1.27%	0.90%	6.40%	44.53%	41.83%	57.36%	0.90%	41.83%
2008	1.83%	0.18%	0.79%	10.44%	45.18%	51.96%	64.58%	0.64%	51.96%
AVG.	**2.20%**	**0.57%**	**0.97%**	**5.23%**	**44.98%**	**47.70%**	**57.95%**	**0.97%**	**46.9%**

Table B-3.

This graph shows that R&D investments have been generally consistent over company revenue figures from 2000 to 2008. For Dawning, Lenovo, Founder, and Great Wall, the investment in R&D per unit of revenue is far smaller than the proportion that Panda Electronics, TCL, Computech, and Frentec spend. There is clearly two separate levels of R&D expenditure in the computer industry, where larger firms – Lenovo, Tong Fang, Great Wall – and state-owned ones – Dawning, Founder – show lower and less volatile R&D expenditures over their revenues. Whereas, smaller firms – such as Computech, TCL, Frentec, and Panda Electronics – show higher percentage of R&D investment relative to their revenues. For the larger and state-owned firms, the consistency of R&D expense may be a result of corporate maturation and established economies of scale, while the smaller firms are more volatile and in pursuit of growth.

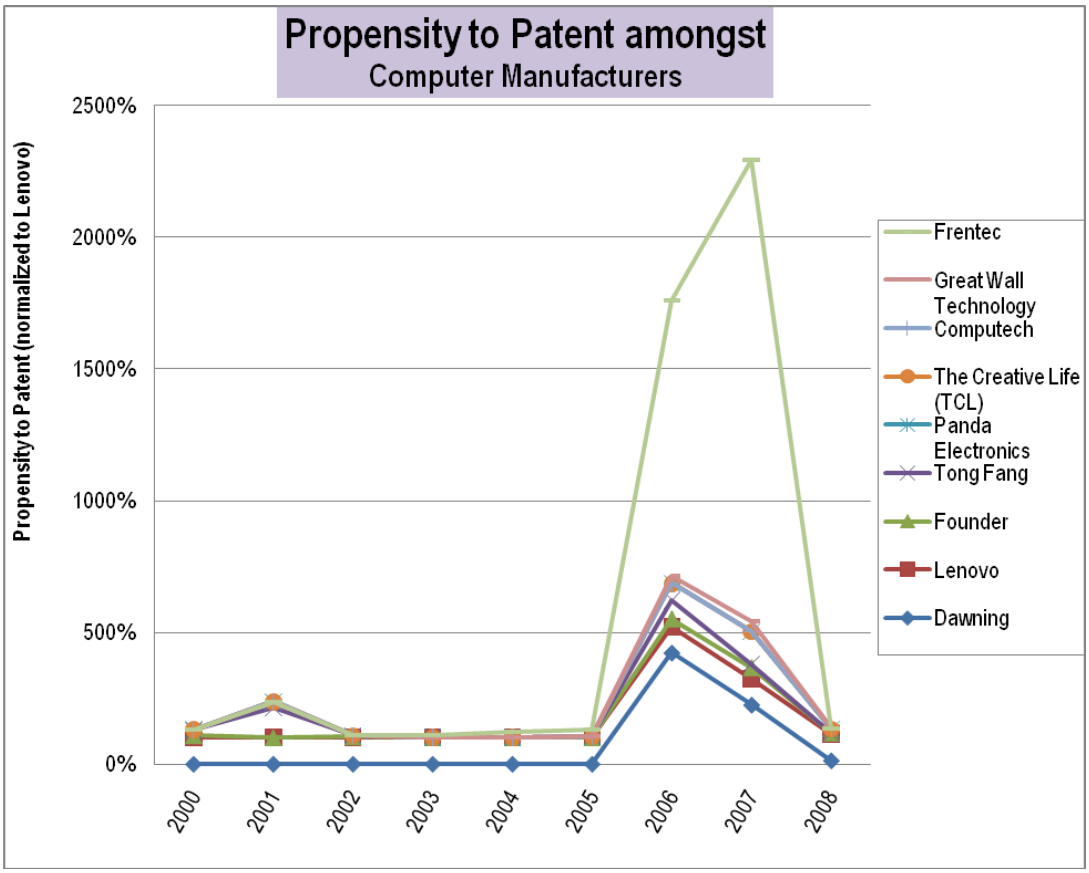


Figure B-4.

	Dawning 曙光	Lenovo 联想集团	Founder 方正科技	Tong Fang 清华同方	Panda Electronics 熊猫集团	The Creative Life (TCL) TCL 集团	Computech	Great Wall Technology 中国长城计算机集团公司	Frentec 方瑞
2000	0.00%	0.69%	0.06%	0.15%	0.01%	-	-	0.00%	0.00%
2001	0.00%	0.01%	0.00%	0.01%	0.00%	-	-	0.00%	0.00%
2002	0.00%	2.07%	0.07%	0.08%	0.01%	-	-	0.05%	0.00%
2003	0.00%	33.19%	0.00%	0.17%	0.02%	-	-	0.00%	3.33%
2004	0.00%	13.53%	0.04%	0.10%	0.14%	-	-	0.04%	2.58%
2005	0.00%	27.23%	0.09%	0.77%	0.22%	-	-	0.07%	7.40%
2006	1.28%	0.30%	0.09%	0.22%	0.19%	-	-	0.08%	3.18%
2007	0.43%	0.19%	0.08%	0.03%	0.23%	-	-	0.07%	3.33%
2008	0.22%	1.65%	0.08%	0.00%	0.23%	-	-	0.07%	0.00%

Table B-4.

Propensity to patent is measured as the ratio of patent expenditures (based on average costs of filing patents multiplied by the number of applications filed) to the firm's R&D expenditure (spending on technology or innovation as a whole). In the graph (Figure B-4), the numbers were normalized with respect to Lenovo's annual patent applications, since the firm of interest (Dawning) did not have applications for all of the years 2000 to 2008. In the table, (Table B-4), the data are not normalized, but appear as "raw" propensity to patent in each year.

As seen in Figure B-4, the general trend amongst the eight computer manufacturers has been fairly stagnant proportion of patent expense to R&D expense from 2002 to 2005. There was a unilateral rise in the propensity to patent in 2006, followed by general decline in propensity in 2007 and 2008. Dawning seemed to hold the lowest propensity to patent throughout 2000 – 2008.

	Coefficient			
	Intercept (β_0)	R&D / Revenue (β_3)	Private Funding (β_4)	Average Standard Error
2000	0.00182261	-0.00331762	0.00015746	0.00307409
2001	0.00004453	-0.00008037	0.00000983	0.00008273
2002	0.00491634	-0.00917670	-0.00012026	0.00934205
2003	0.07166889	-0.16792776	0.02678909	0.18810602
2004	0.02888586	-0.06007293	0.02958801	0.06840108
2005	0.05651924	-0.09807528	0.04881958	0.13791340
2006	0.00406723	-0.00718163	0.03264666	0.01290365
2007	0.00148711	-0.00090652	0.03750285	0.00895308
2008	0.00375954	-0.00212171	-0.00334594	0.00505952

Table B-5.

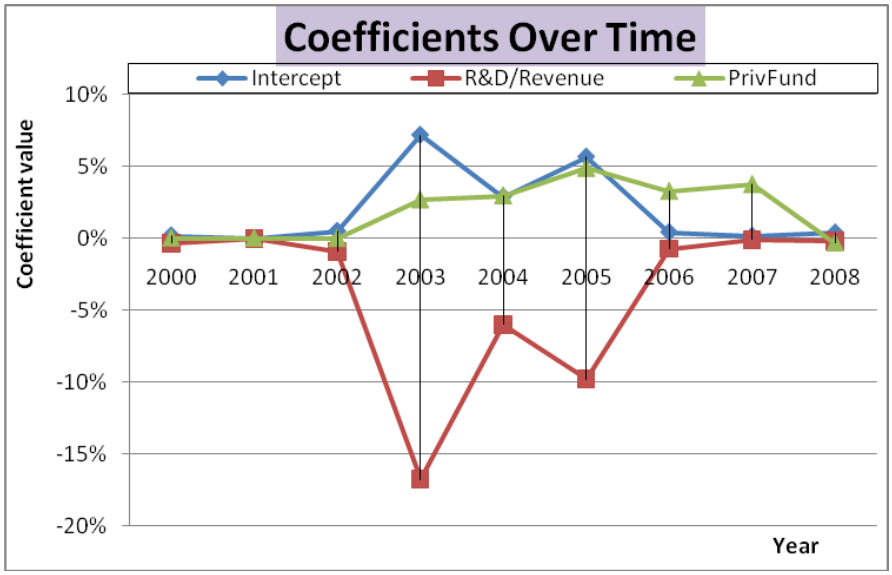


Figure B-5.

In the above Table B-5 and Figure B-5, a linear regression was performed for data across each year. That is, with time fixed effects, the data was tested for statistical significance of R&D expenses and, specifically, private R&D expenses in affecting the firms' propensity to patent. Besides the data from 2003 and 2005, the standard error for coefficients were less than the 10% significance level. Between 2003 and 2005, however, standard error was over 10% for β_3 for the whole period. There may be some indication that R&D relative to revenue was influential, however, more data and larger samples are needed before this can be accepted.

Summary Statistics for Computer Manufacturing Firms

R&D / Revenue		*% of Industry*		*Private Funding*		*Propensity*	
R_{it}		C_{it}		$R_{it} * V$		P_{it}	
Mean	0.072534681	Mean	0.246533699	Mean	0.096999294	Mean	0.011025109
Standard Error	0.011619274	Standard Error	0.036638986	Standard Error	0.022126169	Standard Error	0.006168471
Median	0.01690028	Median	0.037218422	Median	0	Median	0
Mode	0.317	Mode	0.45	Mode	0	Mode	0
Standard Deviation	0.098592808	Standard Deviation	0.310892105	Standard Deviation	0.187746773	Standard Deviation	0.05234121
Sample Variance	0.009720542	Sample Variance	0.096653901	Sample Variance	0.035248851	Sample Variance	0.002739602
Kurtosis	0.602951987	Kurtosis	10.27115736	Kurtosis	0.509933791	Kurtosis	28.51368025
Skewness	1.32419499	Skewness	2.31100838	Skewness	1.538259928	Skewness	5.324069543
Range	0.35	Range	1.921620453	Range	0.56475	Range	0.331884817
Minimum	0	Minimum	0.000106425	Minimum	0	Minimum	0
Maximum	0.35	Maximum	1.921726878	Maximum	0.56475	Maximum	0.331884817
Sum	5.222497031	Sum	17.75042634	Sum	6.983949172	Sum	0.793807813
Count	72	Count	72	Count	72	Count	72
Confidence Level(95.0%)	0.023168174	Confidence Level(95.0%)	0.073056062	Confidence Level(95.0%)	0.044118328	Confidence Level(95.0%)	0.012299581

Table B-6.

Table B-6 gives descriptive statistics for the spread of data for each firm's annual R_{it}, C_{it}, and $R_{it} * V$. None of these independent variables were significant at the 10% level, and only the variable measuring firms' competitive market share (C_{it}) seemed significant to affect the propensity to patent at the 5% level.

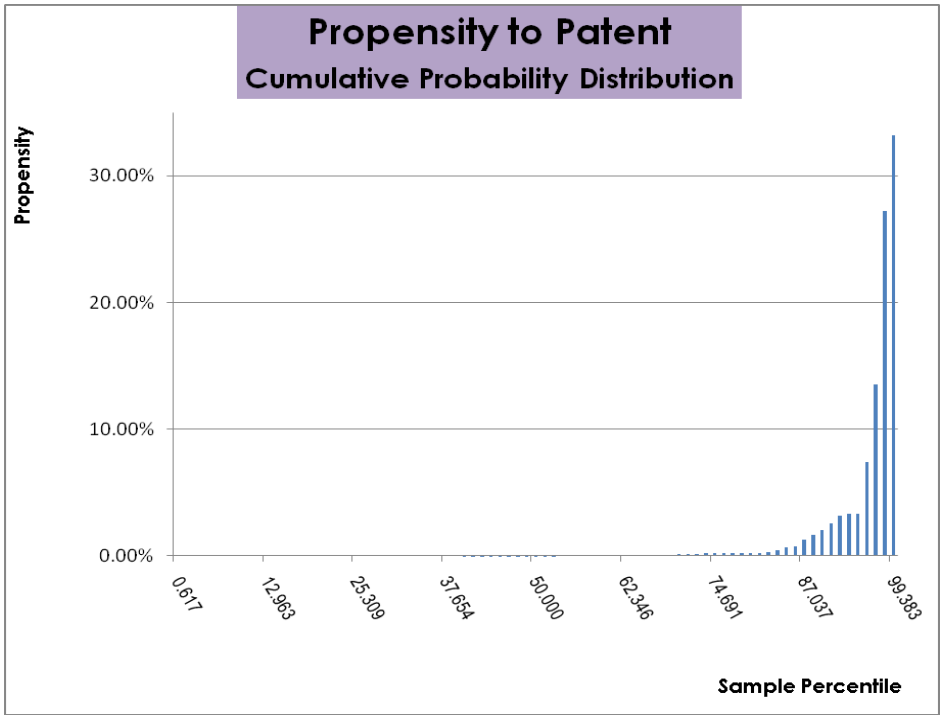
On the other side, propensity to patent remains statistically insignificant at both the 10% and 5% levels for the data spread.

Summary Statistics for Computer Industry

The following is output from a linear regression analysis according to the reduced form of the equation:

$$P_{it} = \beta_0 + \beta_3 R_{it} + \beta_4 R_{it} V_i + \varepsilon_{it}$$

in which the coefficients are calculated across the panel of data (across eight firms, eight years). According to this regression analysis without time fixed effects, there is statistical significance in $R_{it} * V$ at the 5% level, thus suggesting privately funded R&D as a possible influence on the propensity to patent (P_{it}). However, more data and larger samples are required before any conclusions can be made.



SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.127934576
R Square	0.016367256
Adjusted R Square	-0.008854097
Standard Error	0.050173533
Observations	81

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.003267284	0.001633642	0.648944408	0.525395233
Residual	78	0.196355907	0.002517383		
Total	80	0.19962319			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.01711861	0.007129412	2.401124942	0.018725758	0.00292504	0.031312179	0.00292504	0.031312179
R&D / Revenue	-0.01776089	0.015760844	-1.126899655	0.263239816	-0.04913832	0.01361654	-0.04913832	0.01361654
Private Funding	0.004561134	0.030790176	0.148136007	0.882617721	-0.056737396	0.065859664	-0.056737396	0.065859664

Table B-7.

APPENDIX C: Secondary data on telecommunications industry

The following graphs and tables are borrowed from secondary sources to illustrate the prevalence of different code standards for channel access – including CDMA 2000 (also known as CDMA), WCDMA, and other comparable standards. These standards are quintessential to Chinese telecom firms, which must comply and lease the technology in order to build commercial and national networks.

From the Figure C-1, it is notable that CDMA 2000 1X has clearly held the greater margin of users in commercial networks, however, other standards (especially WCDMA) have risen to contend with the old standard. While there is argument over the efficiency of either standard, these standards tend to be backed by the interests of continents and nations that hope to curtail any monopoly held by Qualcomm or other pioneers in the field.[50] Such standards would confine further technological developments and quality improvements to a narrow "ladder" of invention formed by Qualcomm's CDMA 2000, for example. As such, European firms have sought to determine their own innovation path via WCDMA, and now Chinese firms are attempting to do the same with TD-SCDMA.

Figure 6-1: Number of 3G Commercial Networks Worldwide, 2001- Aug.2007

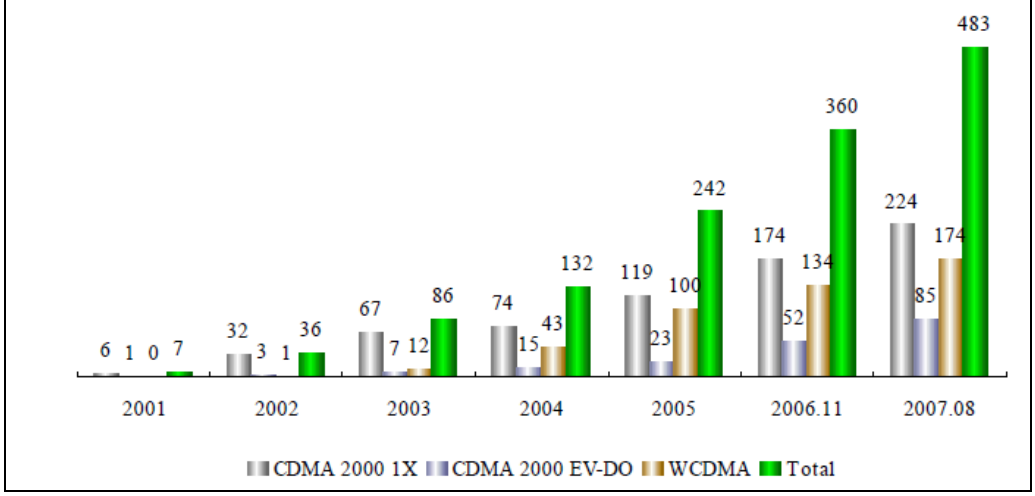


Figure C-1.

Table 6-1: User Bases of Various Communications Networks in the World, 2002-2007H1

Time	2002	2003	2004	2005	2006	CAGR	2007Q2	Growth Rate Dec06-June 07
GSM	809.3	1,012	1,296	1,709.2	2171.1	27.98%	2,377.8	9.52%
GSM (WCDMA)	0.2	2.8	16.3	50	98.2	370.73%	136.2	38.70%
CDMA	104.2	98.9	87.4	62.4	21.1	-32.92%	15.6	-26.07%
CDMA1X	36.1	80.1	131.9	213.1	282.7	67.28%	288.5	2.05%
CMDA1X EVDO	0.2	4.6	12.3	21.2	50	297.64%	65.6	31.20%

Source: China TMT Review[51]

Figure C-2.

[50] Scotchmer, Suzanne. (2006, pp. 237 – 289)
[51] China TMT Review. Jan 2008. URL:

APPENDIX D: Secondary data on computer manufacturing industry

The following are relevant secondary data gathered for the computer manufacturing industry, upon which I draw a few conclusions.

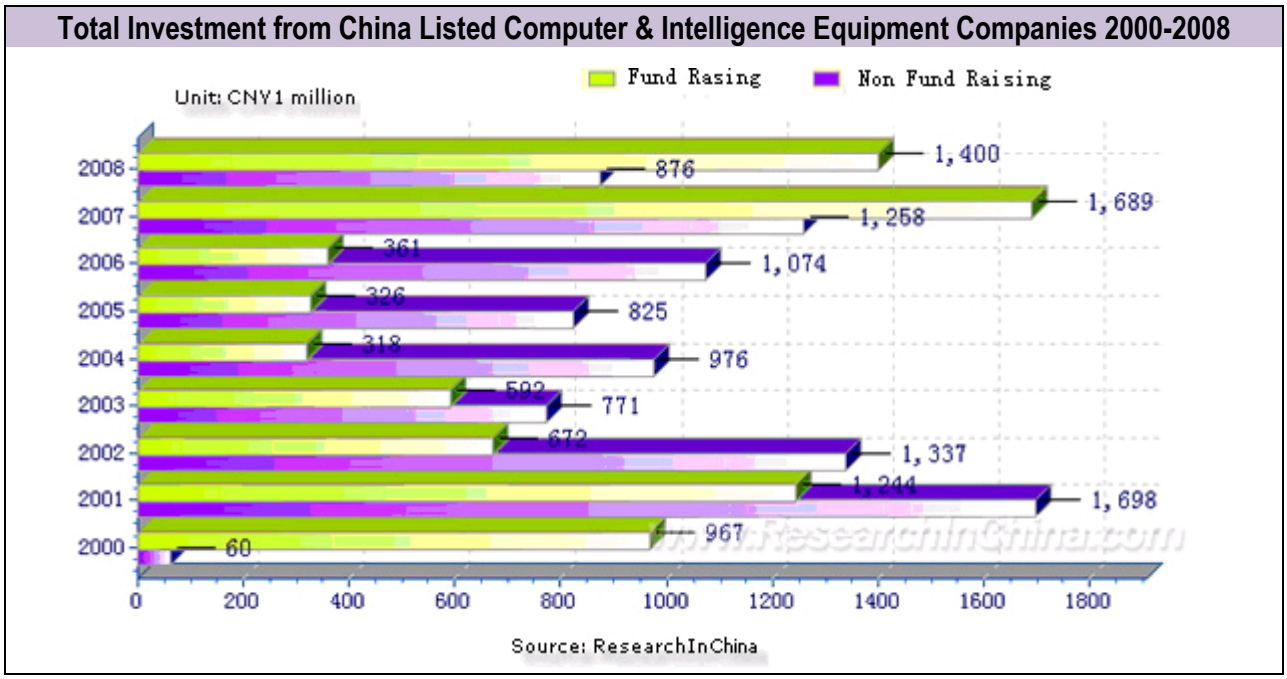


Figure D-1.

In the above graph, Figure D-1 shows the computer industry's aggregate investment expenses, broken down by private fundraising and non-fundraising (which I interpret as either directly granted to the firm by government or angel investors). According to the data provided by ResearchInChina, computer manufacturers depended much more in non-privately raised money to fund their investment from 2001 to 2006. Only in 2000, 2007, and 2008 did privately raised funds exceed non-private funds for investment.

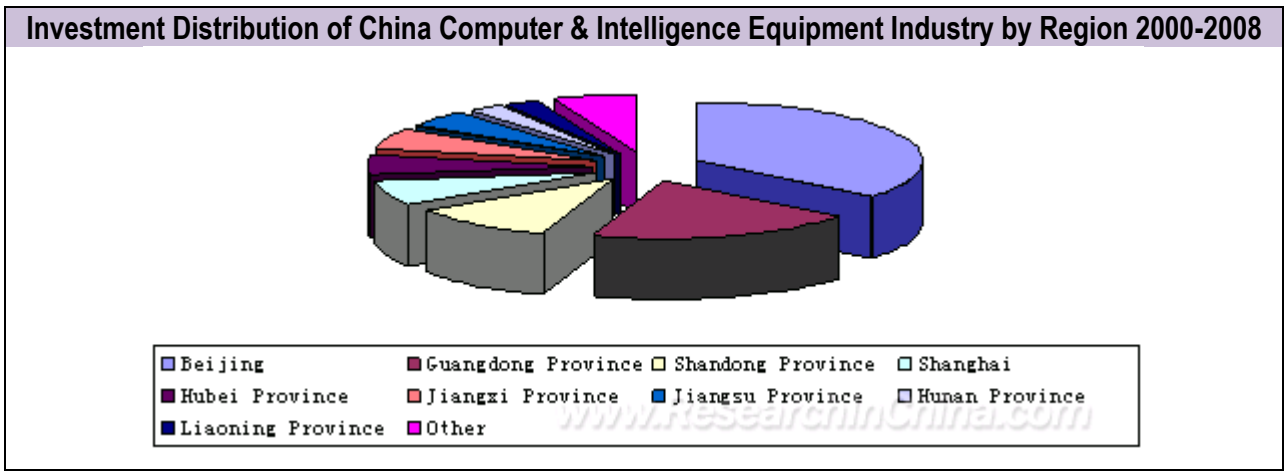


Figure D-2.

The above graph shows the average investment expenditure by computer and technology equipment manufacturing firms from 2000 to 2008. The data is broken down by province, in which Beijing holds the clear majority (about 30%) of investments in this period, followed by Guangdong, Shangdong, and Shanghai. Usually, the revenues and expenditures (such as investment spending) by corporations are reported according to the province in which the corporation is registered. Investment spending by local governments is also reported with regard to province. Unfortunately, the full report by ResearchInChina was unavailable for viewing, so I cannot relay why Beijing holds such a great lead in investment spending. However, this investment distribution serves to contextualize the case of Dawning and its select competitors in the industry for the period of 2000 to 2008.

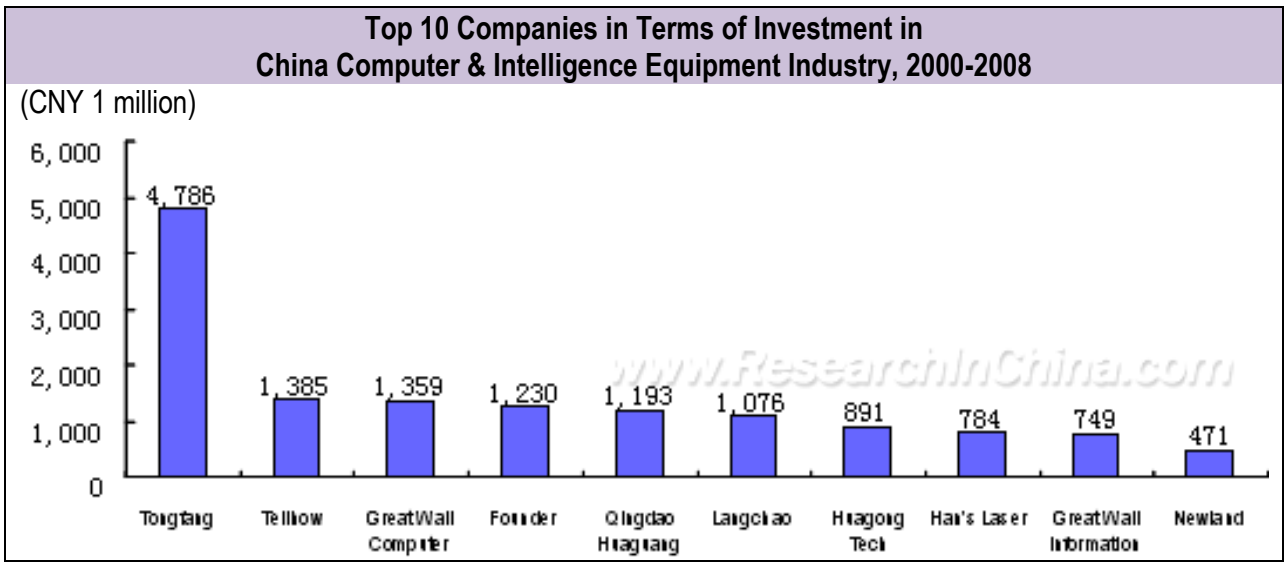
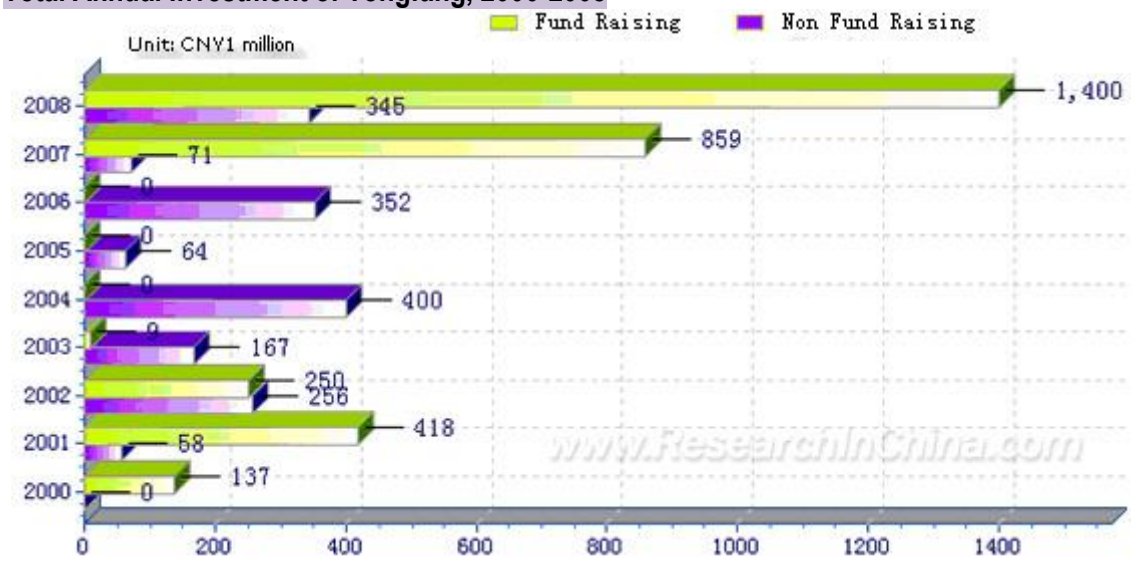


Figure D-3.

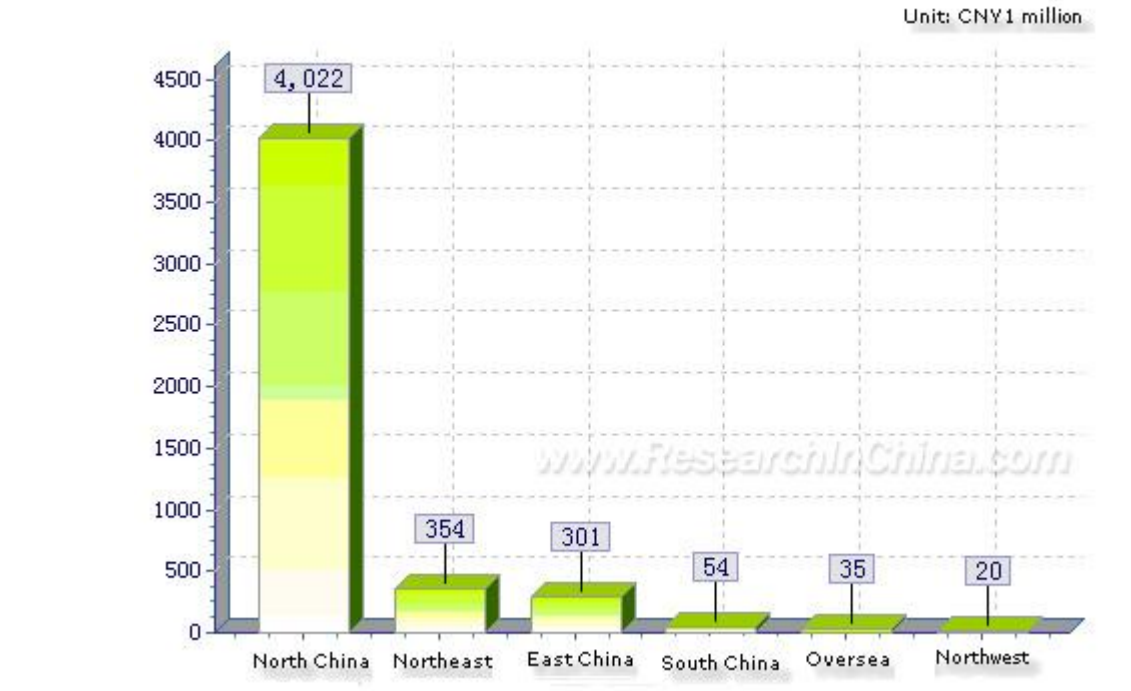
The above graph (Figure D-3) and the following ones (Figures D-4 and D-5) are from ResearchInChina's sample report that focuses on Tongfang's investment expenditure in the period of 2000 to 2008. Figure D-3 compares Tongfang's average investment expense in this period to nine other competitors. Figure D-4 shows Tongfang's year-on-year investment expenditure, revealing not only absolute growth in investments made, but also shifting sources of investment funding. At the beginning and end of the 2000 – 2008 period, Tongfang depended heavily on private fundraising for its investments. However, from 2003 to 2006, Tongfang's investment was predominately supplied by non-private fundraising. Figure D-5 confirms the provincial breakdown of investments made by computer and technological equipment manufacturers. As shown, there is highly unequal distribution of investment spending in northeastern China,[52] which includes the top investing provinces: Beijing, Shangdong, and Shanghai. Such data points to the perpetual inequalities across regions in China, in which resource inequalities affect investment capacity and industrial capacity in a vicious cycle of disparity.

[52] Naughton, Barry. (2006, pp. 362 – 413)



Source: Research in China, 2008.

Figure D-4.



Source: Research in China, 2008.

Figure D-5.

APPENDIX E: Litigation cases filed in China, by type of plaintiff

The following graphs are based on original data from SIPO, showing the number of each type of patent filed for by domestic or by foreign sources. It should be noted that the patents filed from 1985 – 2002 were averaged, since SIPO had aggregated these figures, but I wanted to show the year-on-year trend in patent applications. In absolute terms, the number of patent applications had increased for both domestic and foreign applicants, with the exception of foreign applications for utility model patents between 2005 and 2006.

It should be noted that foreign filing of patents is at half the scale that domestic filing is shown at. So while people tend to think that foreigners are more likely to use IP law, it seems that the Chinese are actually utilizing patents very robustly.

More interesting, however, is the breakdown of what kinds of patents are preferred by domestic and foreign parties. The vast majority of foreign patents filed are for invention patents, which are considered the more rigorous patent type because it undergoes substantive review, whereas the utility and design patent applications only undergo preliminary examination for review of formalities.[53] Among domestic applications for patents, there is still clear favoring of utility and design patents. So far, in spite of the threat of patent thickets with junk patents, there is still a general sense of effectiveness. After all, the greater objective was to instill the discipline of IP rights among the populace.

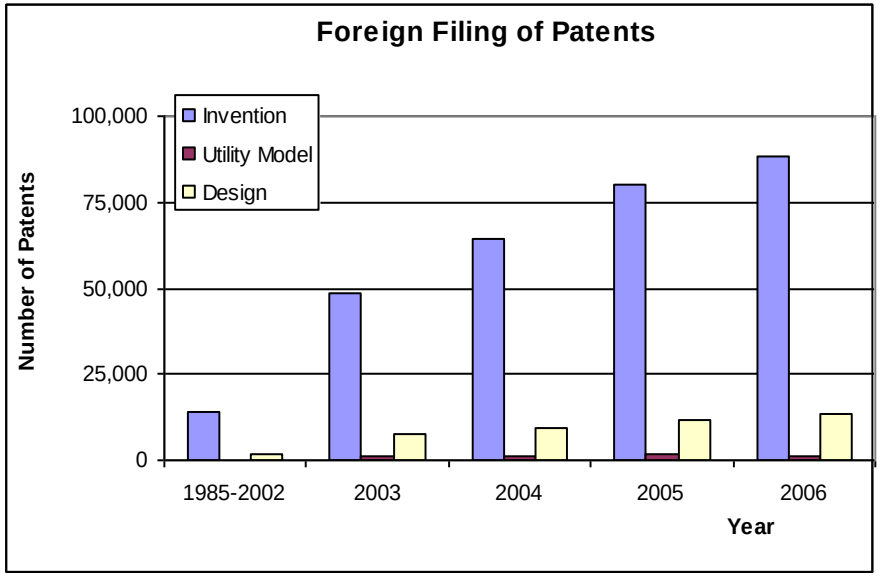


Figure E-1.

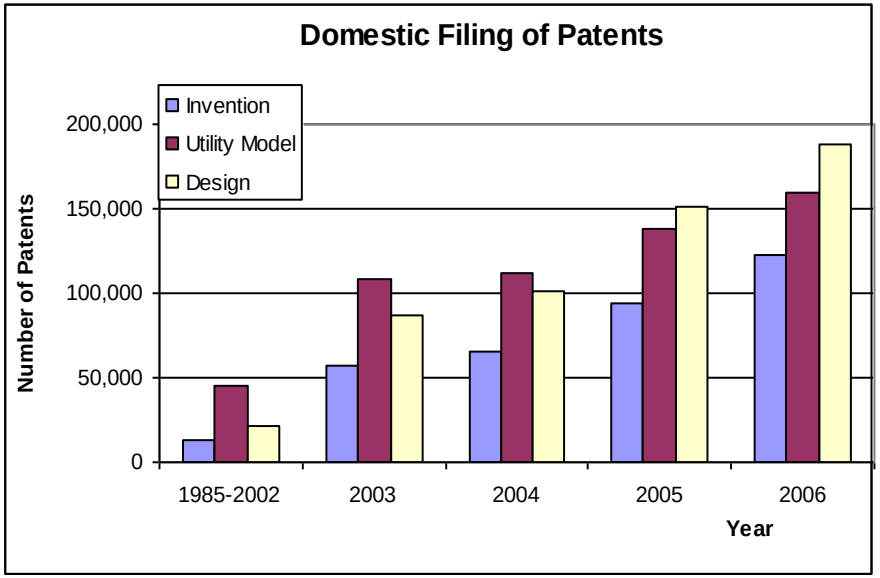


Figure E-2.

Data Source: SIPO, 2008.

[53] Interview. 1/9/2009.

APPENDIX F: General cases of litigation in China and Who Files Them

Who Sues? (types of plaintiffs)	% of Cases
SOE	20%
Private enterprise	20%
Peasants	17%
Workers	11%
Collective firms	9%
Unemployed	4%
Foreign firms	4%
Professionals	4%
Cadres	4%
Collective suits	3%
Other	4%

Table F-1.

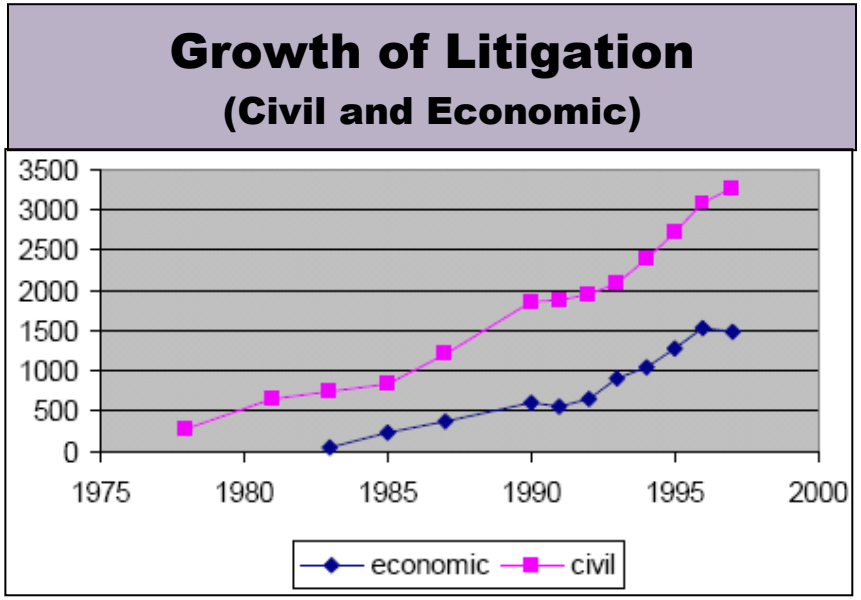


Figure F-1.

Source: David Roland-Holst. "Topic 13 – Legal System." Econ 162 Lecture, 4/15/2008.

The above graph shows civil and economic cases taken to litigation from 1978 to 1997. While these figures from the World Bank are a bit dated, the trend of growing litigation in China shows greater inclination toward and utilization of the court system. Yet, even beyond the growth of litigation cases, this data indicates the fact that, domestically, property rights have been revitalized and the Chinese are more willing and able to protect these property rights.

Table F-1 shows what types of people or groups filed for these litigations. In 1997, SOE's and private enterprises each filed 20% of the court cases. Peasants (or those employed in the agricultural sector) comprised 17% of the cases.

APPENDIX G: Secondary data on investment and revenues in telecommunications sector

The following is adapted from a graph by Alcatel in a presentation from 2003. This secondary data is borrowed to show the relationship of invested capital with the sector's revenue stream. According to data from 1990 to 2002, both investment and revenues have grown each year – except for a decline in investments from 2001 to 2002. Except for in 1994, revenues have held a marginal gain over investment expenditure, showing positive returns to the telecommunications sector. The growth in investment expenditures over time has been interpreted as the growing propensity to invest in technological innovation.

The industry trend is similar to the investment expenses of telecom firms observed from 2000 to 2008, during which investments and revenues also had relative growth.

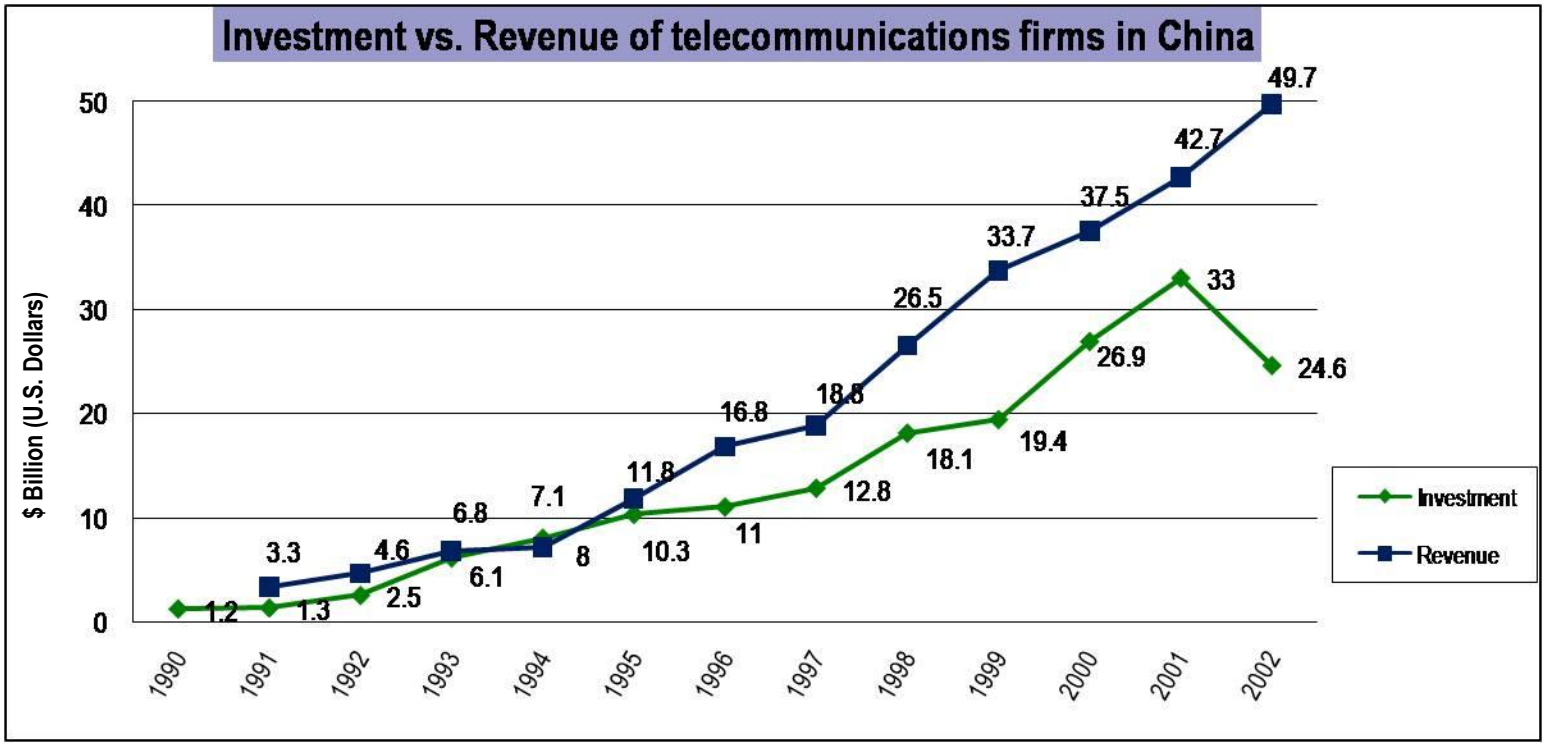
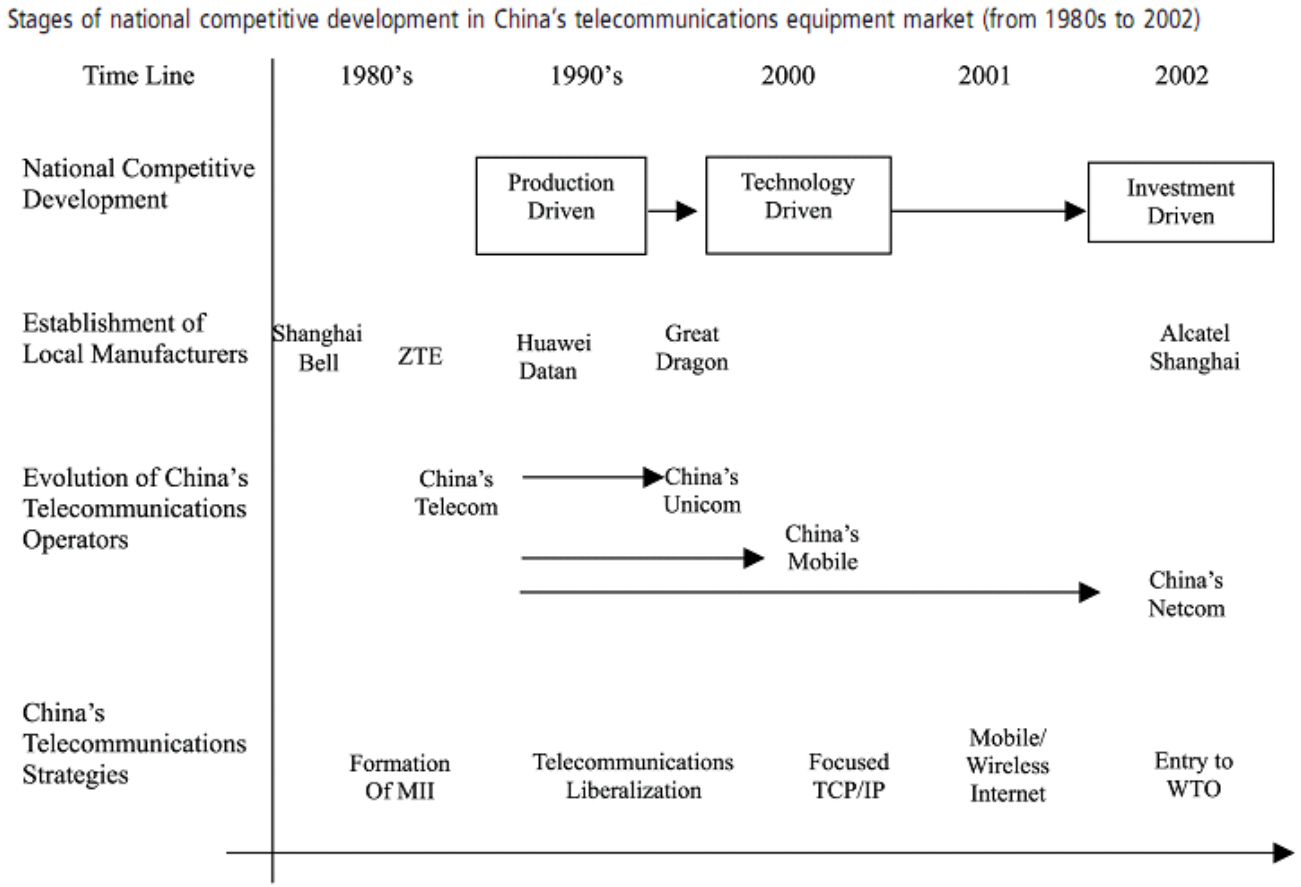


Figure G-1.

Source: Alcatel, 2003.

APPENDIX H: Secondary source diagram of telecom industry development



Source: Brian Low, 2007.

Figure H-1.

The above diagram chronicles the national plans for development of the telecommunications market, resulting in the establishment of national corporations and local manufacturers, and the establishment of governing bodies and other industry influences.