



A Tale of Two Cities: A Comparison of Patent-based Innovative Performance of Domestic and Multinational Companies in China

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Introduction

- High economic growth in China
 - The average growth rate of Chinese GDP during the 1980s and the 1990s were 10.1% and 11.2% (World Bank, 2003).
- The transition from centralized planning system to market system, as well as the comprehensive opening to foreign investment, were credited as keys to the success of China
- However, the economy miracle of China is often described as the result of intensive inputs such as labor, resources and capitals, not oriented on innovations

Is it true?



China: Sources of Output Growth

	1983-88	1988-93	1993-98	1998-03	2003	1993 to 2003 Relative to 1985 to 1993
Output growth	12.1	8.9	9.8	8.0	9.1	-1.5
Employment contribution	1.5	1.0	0.3	0.3	0.4	-0.9
Capital contribution	5.0	4.5	5.5	4.9	5.5	0.4
Residual factors	5.6	3.4	4.1	2.8	3.1	-1.0
<i>Sectoral change</i>	2.2	0.8	-0.3	0.5	0.7	-1.4
<i>Education</i>	1.0	0.9	0.9	1.1	0.8	0.0
<i>Multi factor productivity</i>	2.4	1.7	3.4	1.3	1.6	0.3

Source: OECD Economic Survey of China 2005, cited from OECD Reviews of Innovation Policy CHINA, 2008, pp33, Table 2



Questions

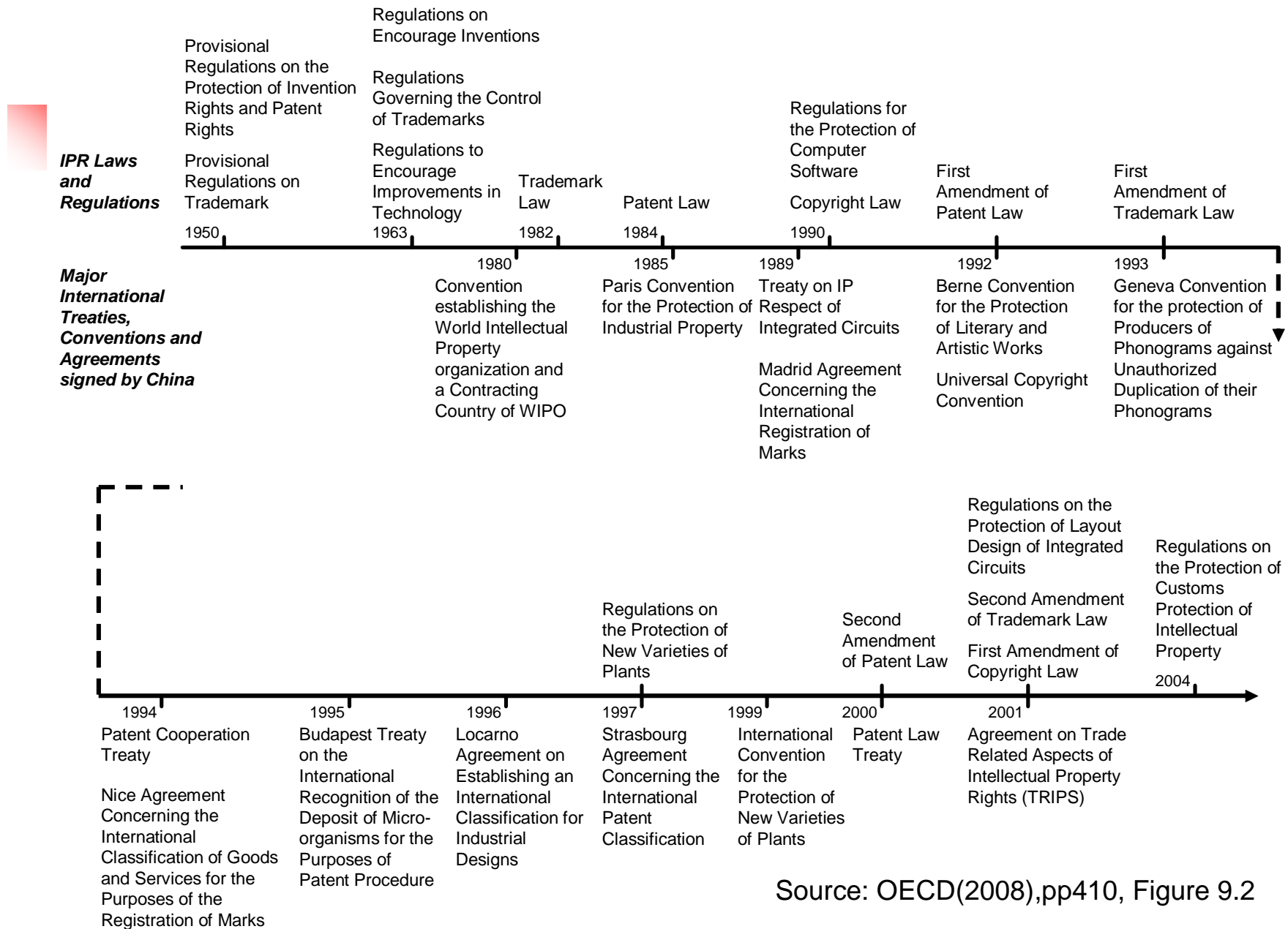
- How about the innovative performance of China's domestic enterprises, in comparison with their competitors from abroad, evaluated by patent data?
- What is the effects of China's patent system on patenting behaviors of these two groups?
- What is the role of innovation in China's economic growth?



Data and Samples

- National level
 - SIPO Statistical Annals(1985-2007)
 - Patent applications, grants, validity quantity/structure
- Firm Level
 - Domestic Firms: 500 China's biggest corporations(2006)
 - 652 related corporations, 16,109 invention applications(1985-2004) , 4.62% of the total domestic invention applications
 - Multinational Companies: Fortune Global 500 list (2006)
 - 775 related corporations, 108,747 invention applications(1985-2004) , 30.47% of the total foreign invention applications
 - Main info: application date, grant date, prior-right, patentee, inventors and their residences, IPC section number, and IPC class number

Timeline of major national and international IPR laws and regulations



Source: OECD(2008),pp410, Figure 9.2



The Evolution of China's Patent System

■ **Founding Stage (1985 ~ 1992)**

- Three kinds of patents, shorter duration period, “first-to-file” principle, public disclosure after 18 months
- Without the permission of administrative authorities, SOEs couldn't deal with their patents autonomously, for example, licensing out
- Excluded chemical, pharmaceutical, and alimentary or process inventions from patent coverage

■ **Developing Stage (1993 ~ 2000)**

- The duration of inventions was extended from 15 to 20 years; the duration of utility model and design patents was extended from 5 to 10 years
- Food, beverages, flavoring, pharmaceutical products, and substances obtained by means of chemical processes were also covered by patent protection
- Individuals were allowed to own patents for invention-creations during working time if an agreement was made between individuals and employers

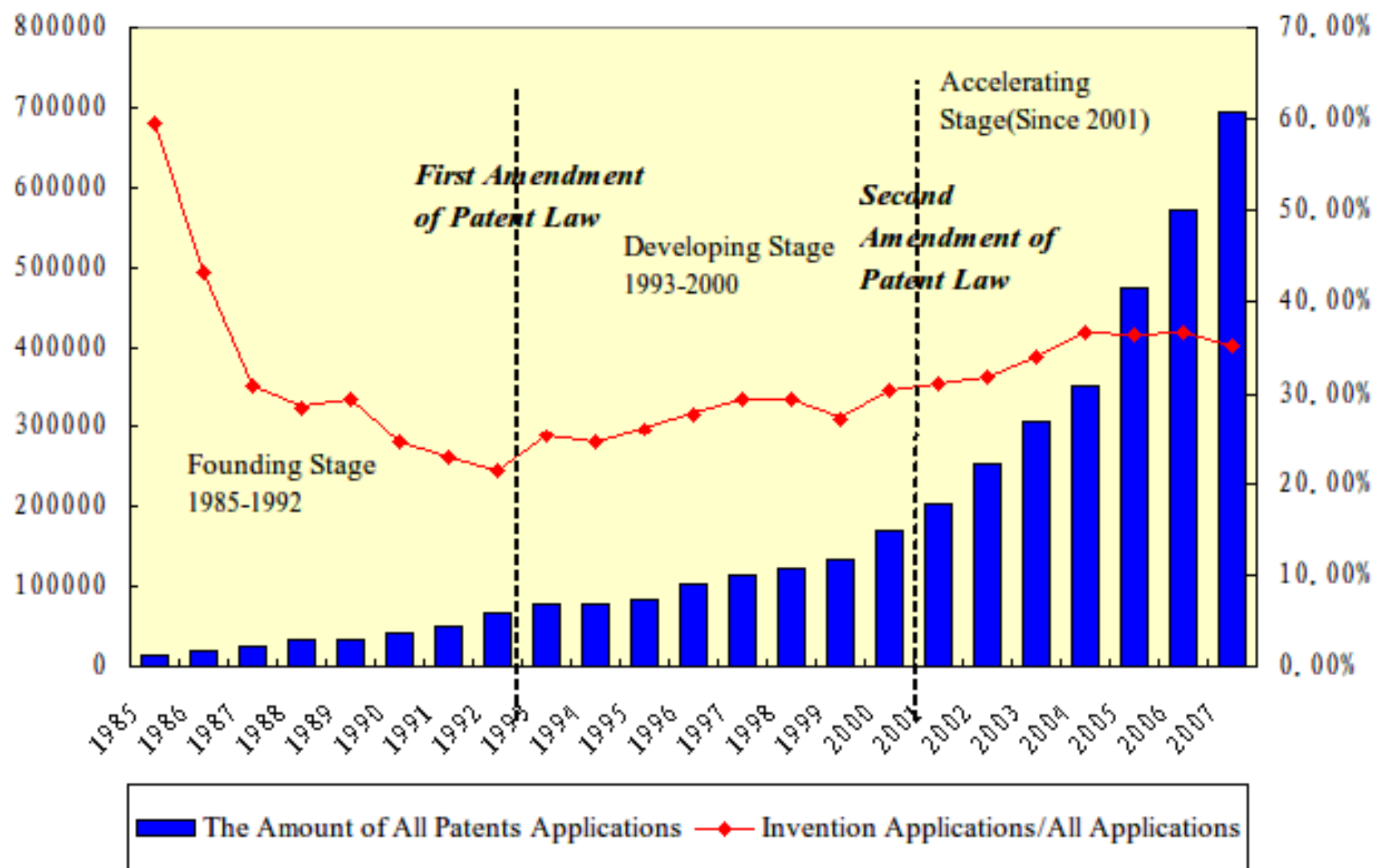
■ **Accelerating Stage (2001 ~ 2007)**

- State-owned and privately owned enterprises were treated as equals for obtaining patent rights
- Other amendments made to fit the requests of WTO, especially TRIPs, the simplification of examination process, e.g.
- Efforts on IPR protection enforcement, increasing infringement compensations, e.g.

■ **The Third Amendment of Patent Law (Since 2005)**

- formally approved by the National People's Congress in 2008 and will be put in force this October

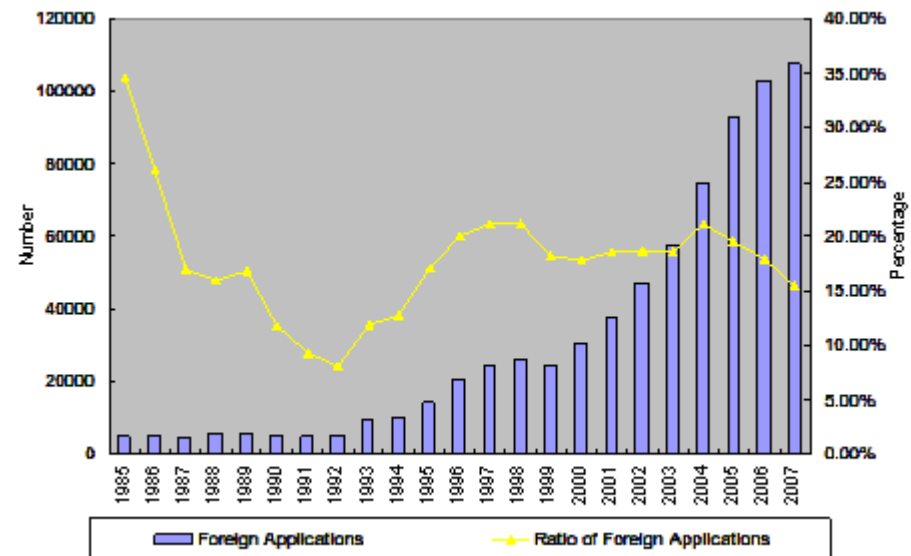
Figure. 2 The Three Stages of China's Patent System Development

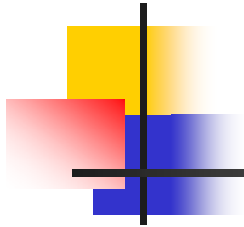


National level: Source of Patents

- After a lukewarm start for the first 5-6 years of China's patent system, foreign patent applications began to pick up after the first revision of patent law in 1992.
- Fast increase of domestic and foreign applications resulted in the stability of foreign application ratios since 2000 till 2003 and even the modest decreases in recent years after 2004.

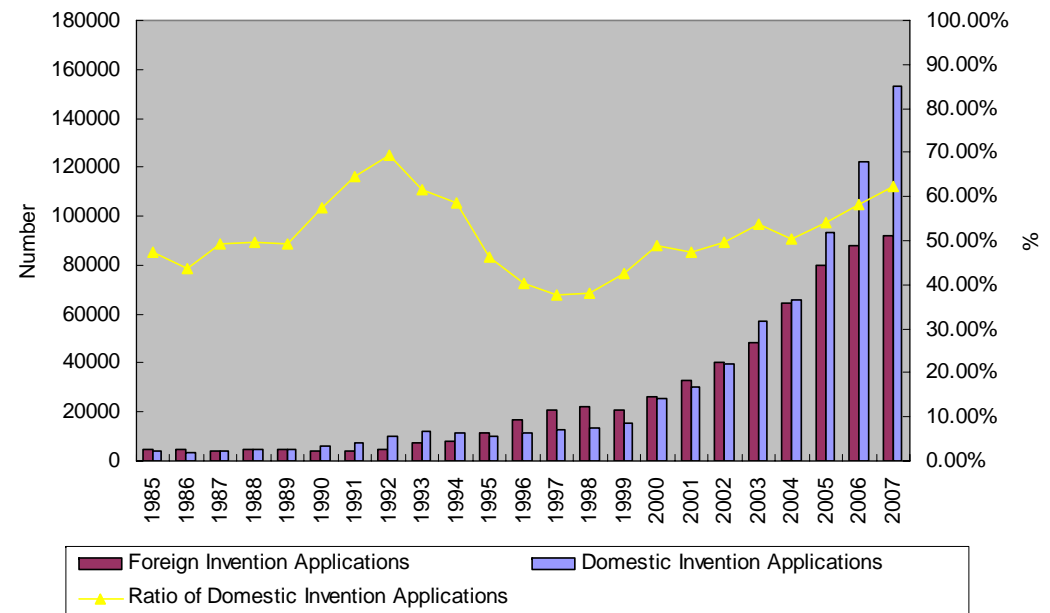
Figure 3 Applications for Three Kinds of Patents Received from Abroad and its Ratio in Total Applications (1985-2007)

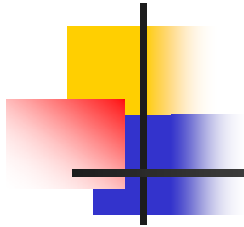




- There were really a surge of foreign invention applications and its ratio in total invention applications reached the peak in 1997(62.24%).
- After 1997, the domestic applications grew faster and surpassed foreign applications in 2003 despite the fact that foreign applications were still increasing.

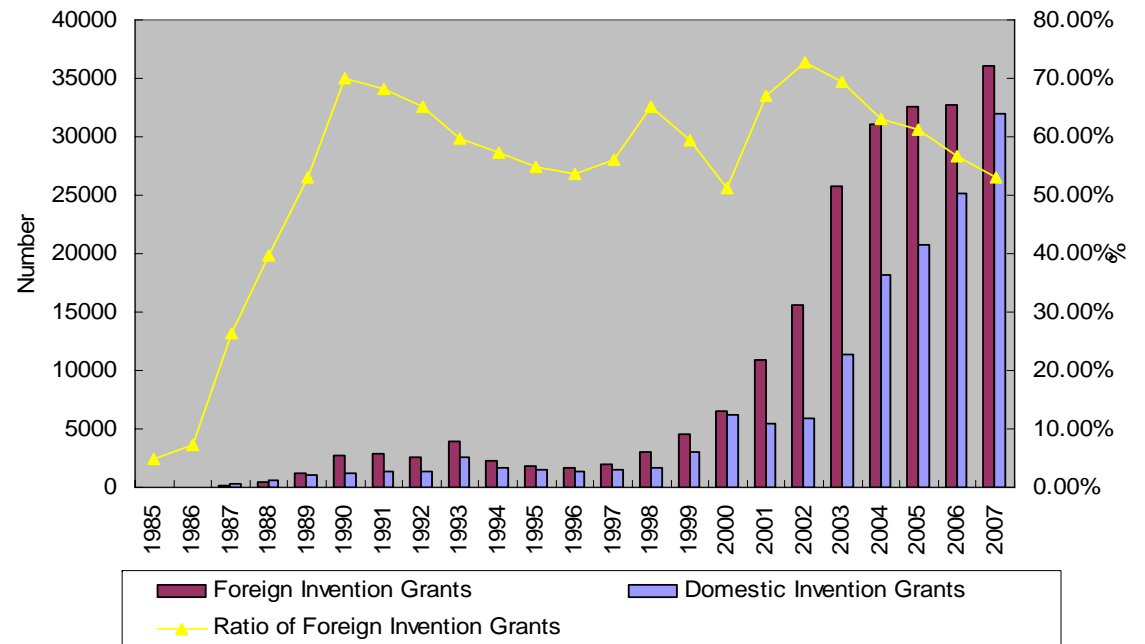
Figure 4 Distribution of Annual Applications for Inventions Received from Home and Abroad (1985-2007)

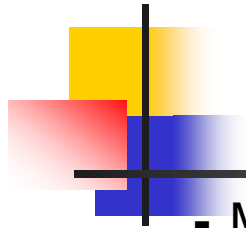




- Even till now, the invention patents granted to foreigners are still higher than native, although the gap has narrowed quickly in past five years.

Figure 5 Distribution of Annual Grants for Inventions Received from Home and Abroad (1985-2007)





- More than 99% applications for utility models, and more than 93% applications for designs are issued by domestic applicants.
- The ‘petit patents’ are mainly utilized by domestic players, which actually gave incentives to incremental innovations and the diffusion of knowledge

Table 1 The Total Applications for Three Kinds of Patents Received from Home and Abroad (1985.4-2008.9)

		Total		Invention		Utility Model		Design	
		Number	Ratio	Number	Ratio	Number	Ratio	Number	Ratio
	Sum	4576636	100.00%	1534934	100.00%	1623279	100.00%	1418423	100.00%
Total	In-service	2310455	50.50%	1184568	77.20%	516158	31.80%	609729	43.00%
	Non-service	2266181	49.50%	350366	22.80%	1107121	68.20%	808694	57.00%
	Sum	3780652	100/82.6	848390	100/55.3	1611467	100/99.3	1320795	100/93.1
Domestic	In-service	1545971	40.90%	522632	61.60%	507198	31.50%	516141	39.10%
	Non-service	2234681	59.10%	325758	38.40%	1104269	68.50%	804654	60.90%
	Sum	795984	100/17.4	686544	100/44.7	11812	100/0.7	97628	100/6.9
Foreign	In-service	764484	96.00%	661936	96.40%	8960	75.90%	93588	95.90%
	Non-service	31500	4.00%	24608	3.60%	2852	24.10%	4040	4.10%

Source: SIPO, <http://www.sipo.gov.cn/sipo2008/ghfzs/zltj/zljb>

National Level: Structure of Patents

- Different behaviors of foreign and domestic patent applicants.

Figure 6 Distributions of Annual Applications for Three Kinds of Patents Received from Abroad

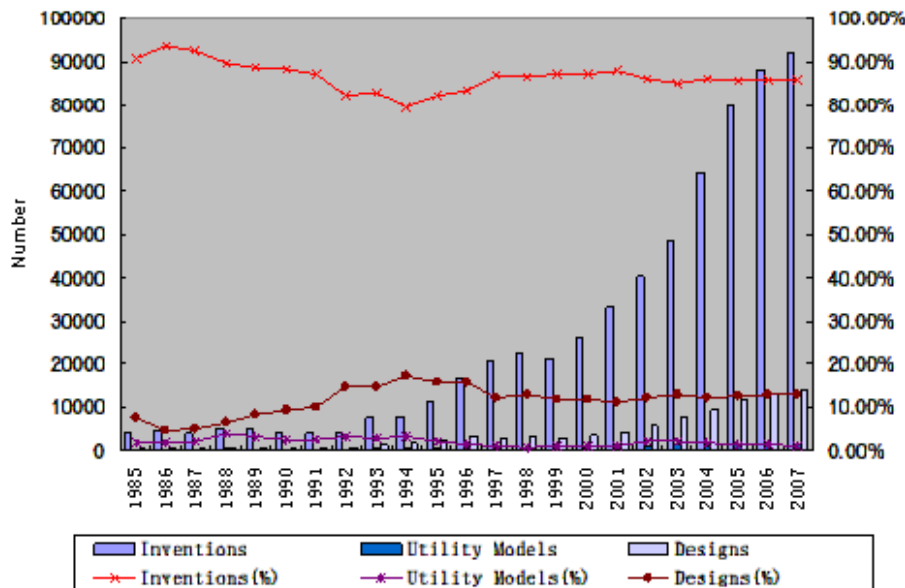
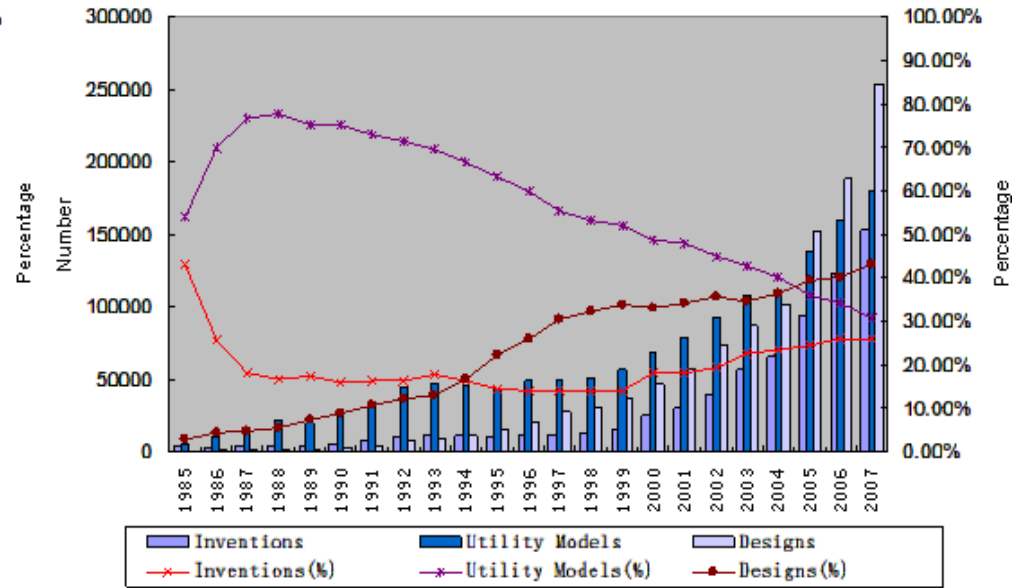


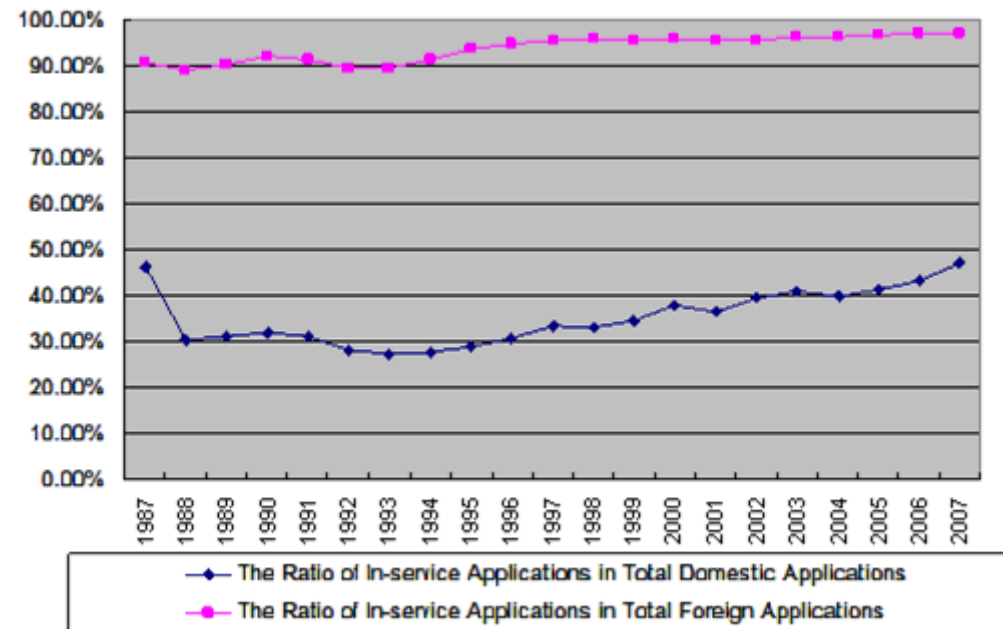
Figure 7 Distributions of Annual Applications for Three Kinds of Patents Received from Home



National Level: Character of Applicants

- In-service (corporate) applications occupied absolute dominant situations in total applications received from abroad, but even not exceeded 50% in total applications issued by residents until 2007.
- Most of the 'Petit Patents' in China is developed by domestic individuals, not the firms and other organizations

Figure 8 Comparisons of the Ratios of Domestic and Foreign In-service (corporate) Patent Applications





National Level: Patent Granting and Validity

- Although the domestic applications and granting of 'Petit Patents' grew very fast in China and attributed to the total increase of patents, their qualities were still poor. Quite a lot 'Petit Patents' were given up by the patentees themselves after a short term of maintaining.

Table2 Ratio of grant and in force for three kinds of patents received from home and abroad (1985.4–2007.12)

		<i>Total</i>	<i>Invention</i>	<i>Utility model</i>	<i>Design</i>
Total	Grant/application	51.87%	27.31%	67.17%	60.26%
	In force/grant	40.69%	74.61%	30.28%	37.86%
Domestic	Grant/application	54.02%	20.10%	67.10%	58.64%
	In force/grant	34.76%	66.26%	30.05%	34.88%
Foreign	Grant/application	41.87%	35.70%	77.44%	81.32%
	In force/grant	76.16%	80.09%	58.03%	66.02%



Comparison of Patenting Behaviors of Residents and Foreigners

	Foreigners	Residents
Patent Type of Applications	Invention dominant	Utility Model and Design dominant
Character of Applicants	Invention: In-service dominant Utility Model: In-service dominant Design: In-service dominant	Invention: In-service just exceed Non-service recently Utility Model: Non-service dominant Design: Non-service dominant
Granting Ratio	High	Low, especially for invention
Valid Ratio	Invention: High Utility Model: High Design: High	Invention: low, no big gap Utility Model: low, big gap Design: low, big gap

Innovative Performance of Domestic Firms: Evaluation by Patent Data

- Before 1999, there were rarely any invention applications. .
- After 2000, with the second amendment of patent law, domestic firms' innovation motivation increased obviously. Especially in the year 2002, there were totally 3625 invention applications, increasing by 92% than the previous year.
- Domestic invention applications are highly concentrated and the main players are just several large corporations

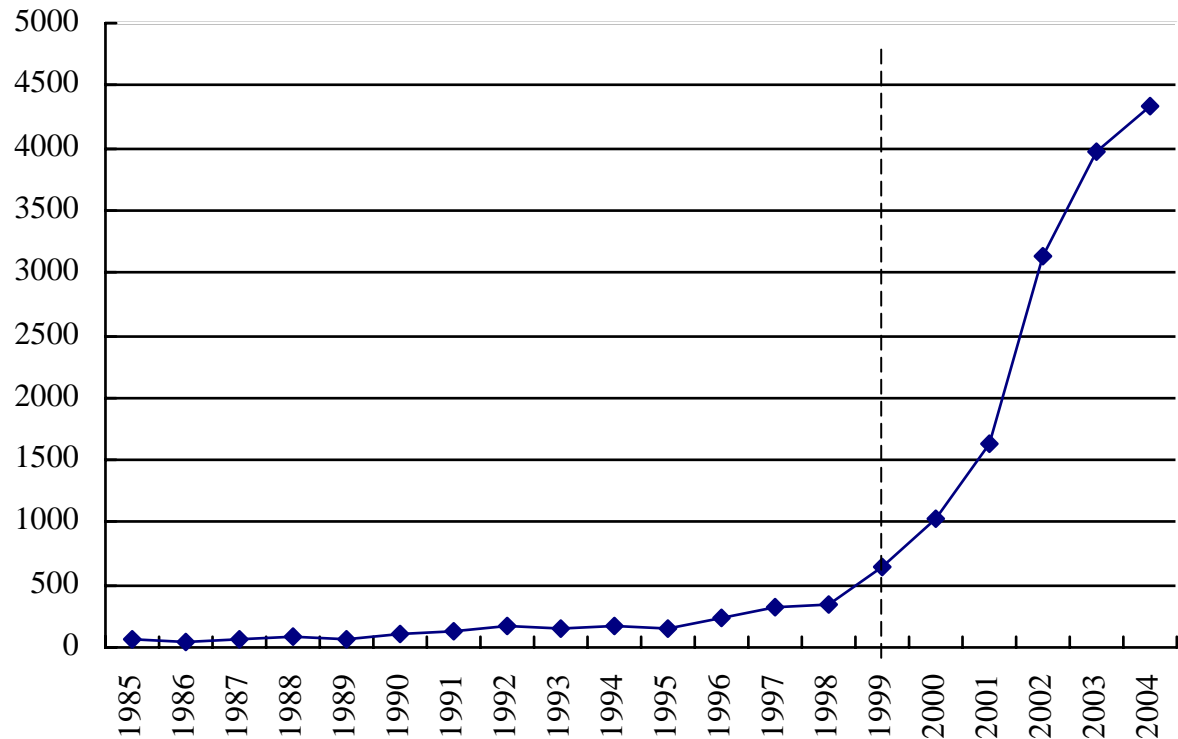


Figure 9 Invention Applications of Domestic Sample Firms (1985-2004)

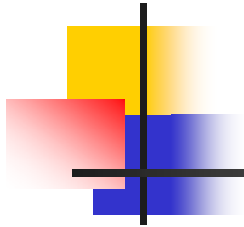
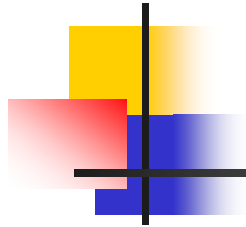


Table 4 Domestic Sample Firms with over 200 Invention Applications

Patentee	Industry	Invention application	Percentage	Accumulative percentage
Huawei Technology Ltd.	IT	5365	33.30	33.30
China Petroleum and Chemical Ltd.	Chemicals	2093	12.99	46.30
China Petroleum and Chemical Group	Chemicals	782	4.85	51.15
Lenovo Ltd.	IT	745	4.62	55.78
ZTE Corporation	IT	739	4.59	60.36
China Petroleum and Chemical Corporation	Chemicals	458	2.84	63.21
PetroChina Company Limited	Chemicals	346	2.15	65.35
Baosteel Ltd.	Steel	325	2.02	67.37
Haier Ltd.	Household Durables	256	1.59	68.96



- Before 1998, these firms had rarely any patent applications.
- During 1999 to 2002, the share of invention applications by top five firms kept rising, taking up to 80% of overall annual applications.
- After 2002 however, these top five firms slowed down their application paces and was outstripped by other firms, which may mean the growth of other domestic firms.

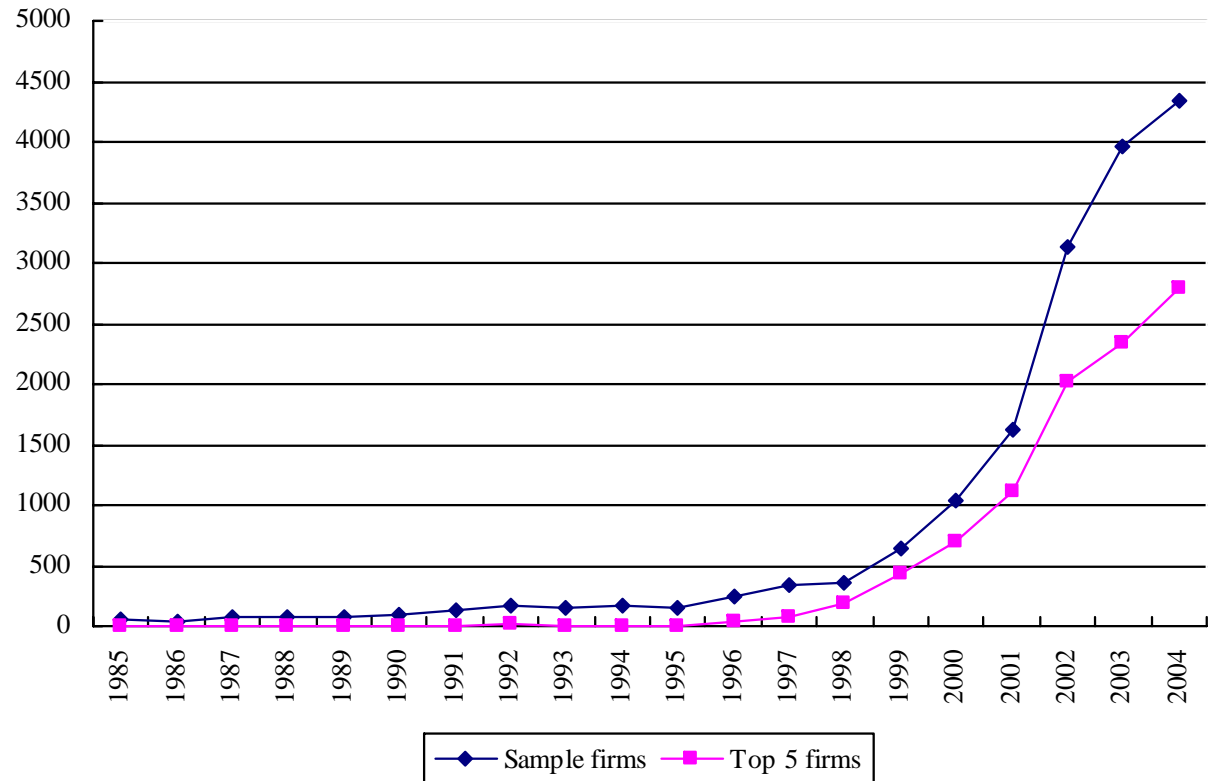


Figure 10 Invention Applications of Domestic Top 5 Firms (1985-2004)

Table 5
 IPC Subclass Distribution of Domestic Sample Firms' Invention Application
 (Above 200)

IPC Subclass Number	IPC subclass	Invention Application	Percentage	Accumulative percentage
H04L	Transmission of digital information, e.g. Telegraphic communication	2675	16.61	16.61
H04Q	Selecting	1595	9.90	26.51
G06F	Electric digital data processing	1120	6.95	33.46
C10G	Cracking hydrocarbon oils; production of liquid hydrocarbon mixtures, e.g. By destructive hydrogenation, oligomerisation, polymerisation	1067	6.62	40.08
B01J	Chemical or physical processes, e.g. Catalysis, colloid chemistry; their relevant apparatus	826	5.13	45.21
H04J	Multiplex communication	726	4.51	49.72
H04B	Transmission	598	3.71	53.43
C07C	Acyclic or carbocyclic compounds	570	3.54	56.97
H04M	Telephonic communication	539	3.35	60.31
C08F	Macromolecular compounds obtained by reactions only involving carbon-to-carbon unsaturated bonds	396	2.46	62.77
H04N	Pictorial communication, e.g. Television	368	2.28	65.06
C01B	Non-metallic elements; compounds thereof	274	1.70	66.76
G01N	Investigating or analyzing materials by determining their chemical or physical properties	251	1.56	68.32
C22C	Alloys	226	1.40	69.72

Highly concentrated in several fields including high-tech and traditional industries.

Table 6 IPC Subclasses Distribution of Domestic Sample Firms (Top Five)

IPC Subclass Number	IPC subclass	Invention Application	Percentage	Accumulative percentage
Huawei				
H04L	Transmission of digital information, e.g. Telegraphic communication	2107	39.27	39.27
H04Q	Selecting	1134	21.14	60.41
H04J	Multiplex communication	496	9.25	69.66
G06F	Electric digital data processing	390	7.27	76.92
H04B	Transmission	385	7.18	84.10
SINOPEC				
C10G	Cracking hydrocarbon oils; production of liquid hydrocarbon mixtures, e.g. By destructive hydrogenation, oligomerisation, polymerization	921	27.63	27.63
B01J	Chemical or physical processes, e.g. Catalysis, colloid chemistry; their relevant apparatus	669	20.07	47.70
C07C	Acyclic or carbocyclic compounds	421	12.63	60.34
C08F	Macromolecular compounds obtained by reactions only involving carbon-to-carbon unsaturated bonds	279	8.37	68.71
C01B	Non-metallic elements; compounds thereof	184	5.52	74.23
Lenovo				
G06F	Electric digital data processing	454	60.94	60.94
H04L	Transmission of digital information, e.g. Telegraphic communication	129	17.32	78.26
H04M	Telephonic communication	30	4.03	82.28
H04Q	Selecting	26	3.49	85.77
H04N	Pictorial communication, e.g. Television	19	2.55	88.32

Table 6 IPC Subclasses Distribution of Domestic Sample Firms (Top Five, continued)

ZTE				
H04L	Transmission of digital information, e.g. Telegraphic communication	179	24.22	24.22
H04Q	Selecting	152	20.57	44.79
H04J	Multiplex communication	128	17.32	62.11
G06F	Electric digital data processing	63	8.53	70.64
H04B	Transmission	63	8.53	79.16
PetroChina				
C10G	Cracking hydrocarbon oils; production of liquid hydrocarbon mixtures, e.g. By destructive hydrogenation, oligomerisation, polymerization	41	11.85	11.85
C08F	Macromolecular compounds obtained by reactions only involving carbon-to-carbon unsaturated bonds	35	10.12	21.97
C10M	Lubricating compositions; use of chemical substances either alone or as lubricating ingredients in a lubricating composition	31	8.96	30.92
C07C	Acyclic or carbocyclic compounds	29	8.38	39.31
B01J	Chemical or physical processes, e.g. Catalysis, colloid chemistry; their relevant apparatus	24	6.94	46.24

- Each top corporation's inventions are highly concentrated in limited fields.
- Domestic invention applications are highly concentrated in several firms.
- For example, Huawei has applied for 2107 inventions in the H04L subclass, which accounts for 78.8% of the overall invention applications in that subclass issued by all sample firms.

Innovative Performance of Multinational Companies: Evaluation by Patent Data

- Before 2000, there was huge gap between the two groups. Applications of domestic firms are less than 1/15 of that of foreign firms, which reflects the huge technology gap.
- After 2000, however, domestic firms' applications increased dramatically and reached 1/5 of foreign firms', which also indicates the domestic innovative capabilities increased very fast.

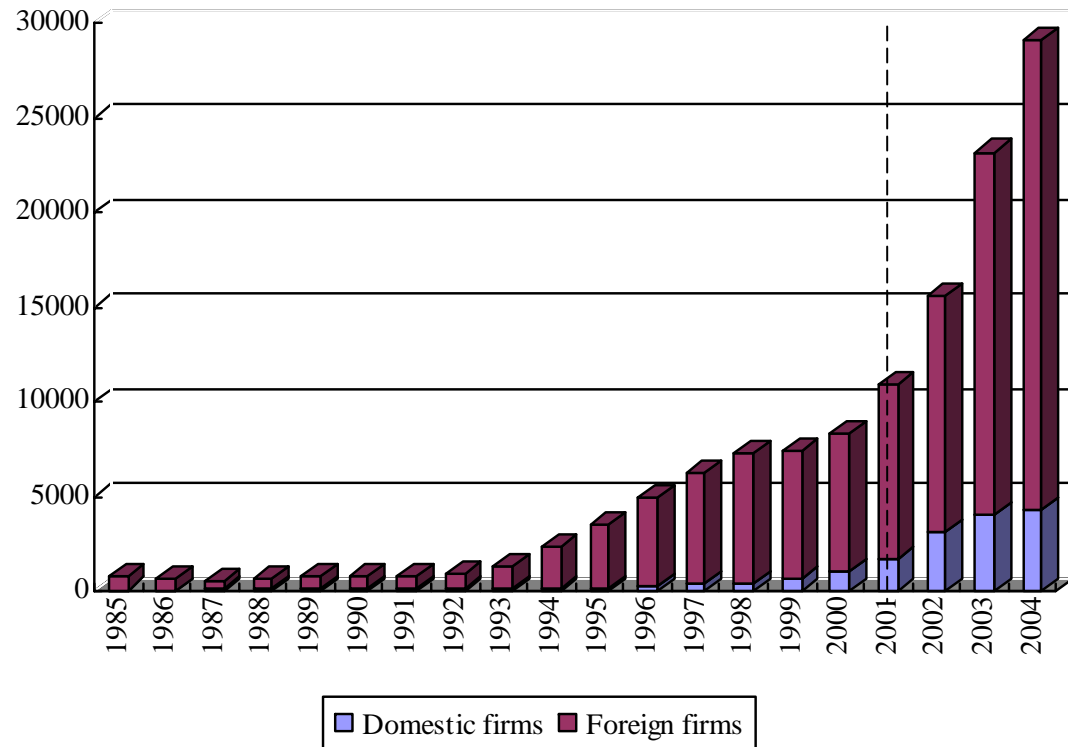
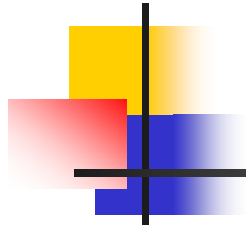


Figure 9 Comparison of Invention Applications of Domestic and Foreign Sample Firms (1985-2004)



- Top five countries account for over 95% of the total foreign applications
- Before 1993, there were rarely any invention applications.
- Korean firms applied for their first invention in 1989. After 1993, Japanese firms applied for more and more inventions every year in accelerating speed. Comparatively, U.S. firms' applications accelerated rather moderately.

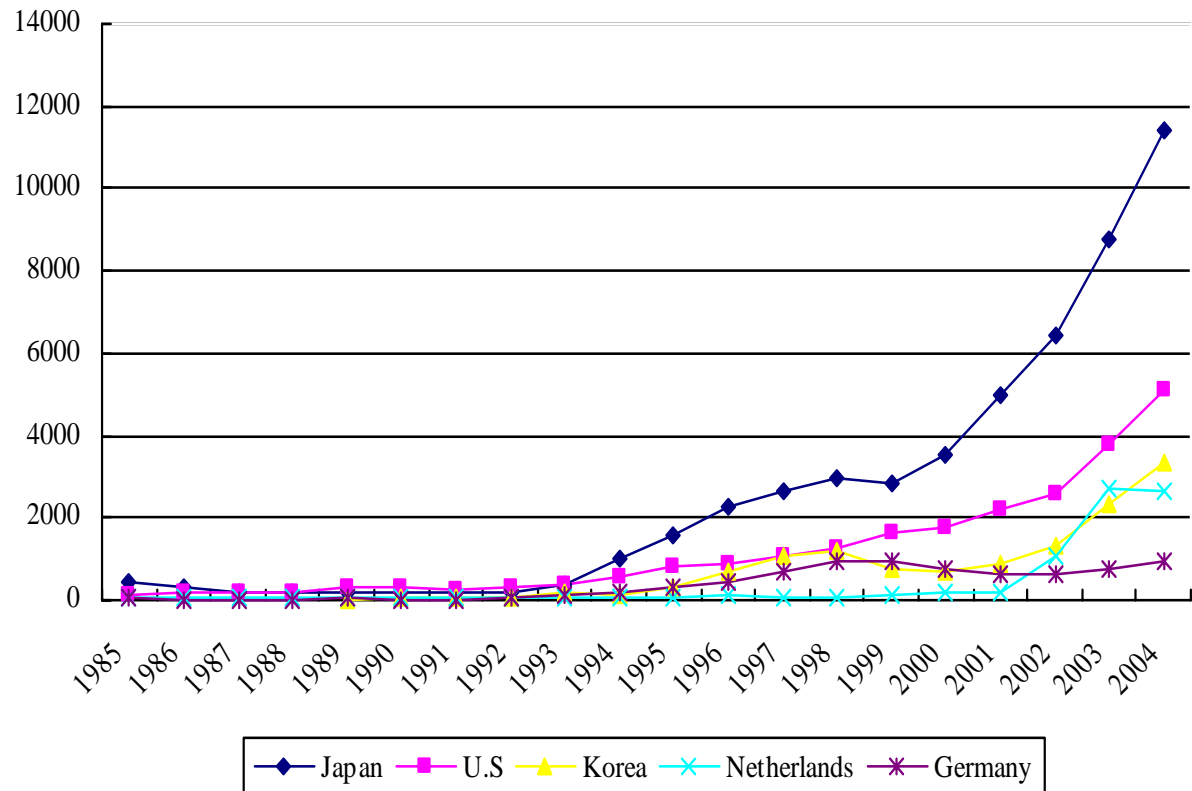


Figure 13 Annual Invention Applications of the Sample Companies from Top Five Countries (1985-2004)

Table 7 Foreign Firms with over 1000 Invention Applications

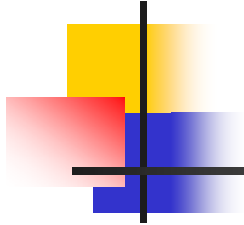
Patentee	Parent Country	Invention Application	Percentage	Accumulative Percentage
Panasonic	Japan	12644	11.63	11.63
Samsung	Korea	9998	9.19	20.82
Philips	Holland	5586	5.14	25.96
Simense	Germany	4713	4.33	30.29
Mitsubishi	Japan	4454	4.10	34.39
IBM	U.S	4119	3.79	38.17
Canon	Japan	4117	3.79	41.96
Sony Electronics	Japan	3832	3.52	45.48
Sanyo Electronics	Japan	3122	2.87	48.36
Motorola	U.S	2769	2.55	50.90
Sony	Japan	2762	2.54	53.44
Honda	Japan	2559	2.35	55.79
Intel	U.S	2199	2.02	57.82
Dupont	U.S	2183	2.01	59.82
GE	U.S	2135	1.96	61.79
Fujitsu	Japan	2060	1.89	63.68
P&G	U.S	1817	1.67	65.35
3M	U.S	1557	1.43	66.78
Shell	Holland	1458	1.34	68.13
Sharp	Japan	1424	1.31	69.43
Microsoft	U.S	1011	0.93	70.36
Sumitomo Chemical	Japan	1009	0.93	71.29

- Domestic firms are more concentrated than foreign firms.

- For example, only Huawei Technology one company takes up 1/3 of domestic applications while top five foreign firms take up the same percentage of foreign applications .

Table 8 IPC Subclasses Distribution of Foreign Sample Firms (above 2000)

IPC Subclass Number	IPC subclass	Invention Application	Percentage	Accumulative percentage
G06F	Electric digital data processing	8320	7.65	7.65
G11B	Information storage based on relative movement between record carrier and transducer	7064	6.50	14.15
H04N	Pictorial communication, e.g. Television	5971	5.49	19.64
H01L	Semiconductor devices; electric solid state devices not otherwise provided for	5450	5.01	24.65
H04L	Transmission of digital information, e.g. Telegraphic communication	4856	4.47	29.11
H04Q	Selecting	3801	3.50	32.61
H04B	Transmission	3204	2.95	35.56
H01M	Processes or means, e.g. Batteries, for the direct conversion of chemical energy into electrical energy	2182	2.01	37.56
H01J	Electric discharge tubes or discharge lamps	2137	1.97	39.53
G03G	Electrography; electrophotography; magnetography	2055	1.89	41.42



- Multinational companies' patent applications in China concentrated in high-tech fields, especially ICT areas
- The IPC distribution of foreign sample firms is quite similar to that of domestic firms except fewer differences in chemical category, which means that there are really competitions between multinationals and China's leading domestic companies, especially in certain areas such as telecommunication.
- During past 20 years, 104,091 inventions out of the 108,747 inventions have priorities, taking up nearly 96% of overall applications. which means most of foreign companies' invention applications in China have been applied in abroad before, most likely in their home countries.
- As a result, when MNCs bring forward invention applications to SIPO, they do not need to wait for the technology to be perfect but rather the market being ready (Hu, 2006). Another research performed by our team also proved this (Zhu&Liang 2006).



Conclusion I

- As the patent data reflect, multinational companies' innovative performance exceeds China's domestic firms a lot, either in quantity or in quality.
- But multinationals' patent applications in China are mainly regarded as competition tools oriented on market thinking instead of representative of their actual and whole innovative capabilities.
- At the same time, their patent applications in China not only inspire the "patent competition" in corresponding areas, but also give the chance for domestic firms to imitate and "invent around".



Conclusion II

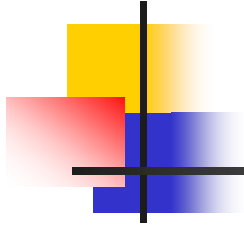
- Local firms also adapted to China's patent system through gradual innovation, taking advantage of the two kinds of minor innovations.
- But most of Chinese firms have not been able to become true innovators in corresponding industries, as evidenced by the lower invention granting ratio, with a few exceptions such as Huawei.
- Although there emerged domestic patent surge recent years, their understanding of patent and patent strategies is still at very early stage.
- The low-level orientations on innovations and pervasively following and imitating behaviors among domestic firms may also harm the cultivation of their long-term and core competences .



Conclusion III

- However, accompanied with the naturally growth of local innovative capabilities, the development trajectories of foreign and domestic firms may also converge.

Case: Huawei
- Cisco's litigation directly stimulated the formulation of Huawei's IPR Strategy.
 - The accumulative patent applications of Huawei reached 32822 by September 2008
 - It also became the first largest patent applicant under the WIPO PCT, with 1,737 applications published in 2008
- During this process, Huawei developed new collaborative relationships with multinationals, whose roles also changed in views of Huawei: first as teachers, then as competitors and finally as collaborators, which had become the typical road of China's domestic leading companies such as Lenovo, Chery etc



Thank You!

Comments are welcome

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