Sino-National Intellectual Property Office (SIPO)
March 25, 2014, BEIJING, CHINA

Evaluation of Patent as a strategic resource – Chinese perspective

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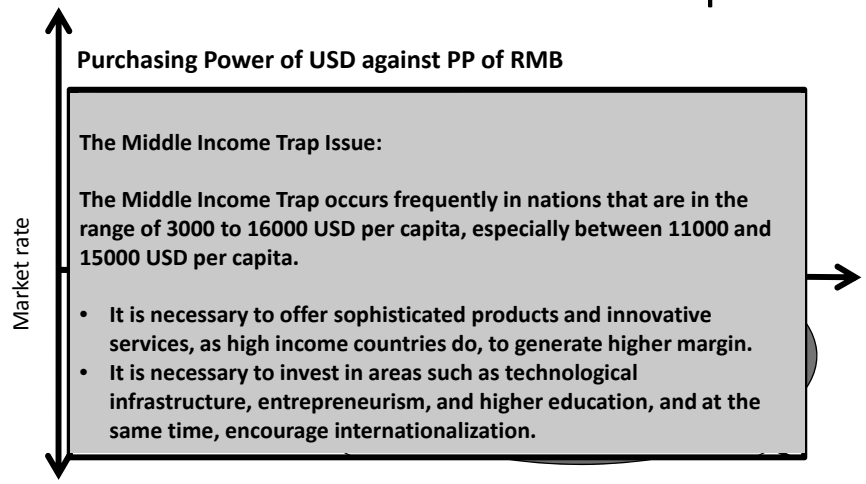
Where is Chinese producer / consumer's position?



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Focus of this report

- Patent data as a more objective source
  - Efficiency of innovation policy (various input)
  - Efficiency of patent system
  - Efficiency of innovative market
  - Efficiency in defining emerging technologies / sectors;
- Patent data as subjective source:
  - To find "innovation" behavior
  - To find productive vs. non-productive patenting behavior
  - To find major operators of different behaviors and related actions with positive vs. negative effect of the system.

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Which kind of FDI in China:

- Local production base focus:
  - To lower down the cost
    Global / regional integration
  - Production (facilities / management / local resources)
  - Technology (process & technical hardware facilities)
  - Overseas market competition (MNEs and regional companies)
- Local market focus:
  - To catch extra profit
    Global / regional differentiation
  - Products (Designs)
  - Technology (engineering / process / integration)
  - Local market competition (MNEs and local companies)

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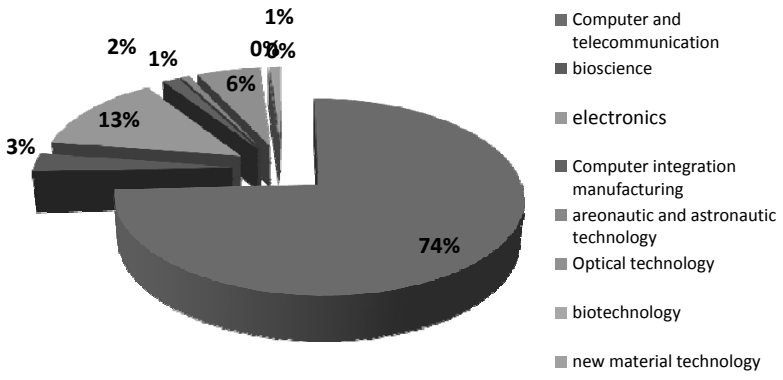
High tech export from China



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Driving forces for national / regional economies

- **Foreign direct investment (FDI)**
  - Advanced manufacturing technologies
- **Local regional production**
  - Dynamic market / technology varies
- **State owned companies / industries**
  - Advanced manufacturing technologies

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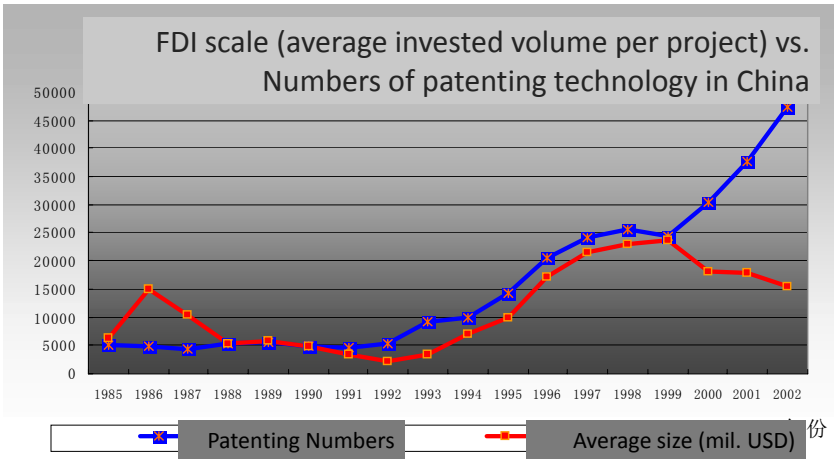
Overseas companies' patenting technology in China



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Topic I: Evaluation of Competitiveness of Overseas Companies in China

- National and Sector level:
- Ownershi
  - Owners
    differen
- Competit
  - Converg
  - Diverge
- Evaluation of relevant patent value

Evaluation of patented technologies in different owner group, particularly overseas and local!

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Case I – Technical Field Complementary in telecommunication sectors in China

- Word Frequency detection: key words, representing the most important technical areas, are:
  - Multiple access technology,
  - Channel encoding,
  - Digital modulation,
  - Power control,
  - Diversity technique,
  - Multi-user detection,
  - Multi-carrier,
  - Smart antenna,
  - Software radio technologies.

3 Chinese companies, 3 Japanese and Korean companies, and 6 European and the US companies in telecommunication industries are chosen to compare their competitive advantage on technologies in those 9 technical areas.

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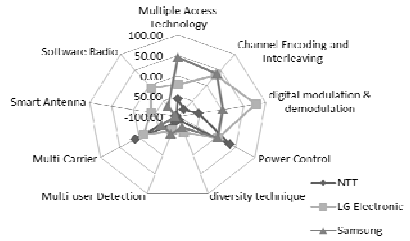
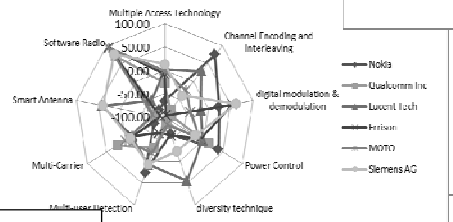
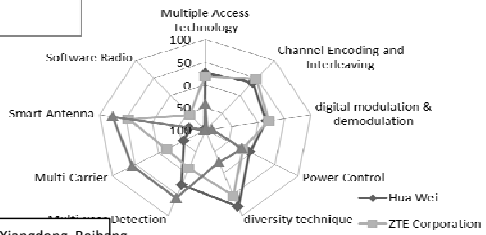
Telecommunication Technologies





US & European companies



Chinese companies

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Patent pool as an effective blocking entity

- Positive nature:
  - Solution for patent thicket
  - Limited form of open-innovation
- Negative nature:
  - Technological innovation becomes less efficient in larger social scales
- Effective control?

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Case II – WCDMA patent pool in telecommunication sectors in China

Patent Pools / Non-Pools	Member Firms	
WCDMA Pool	French Telecom (FT) Nippon Telegraph & Telephone (NTT) Fujitsū Kabushiki-gaisha NTT DoCoMo (NTTD) Royal KPN (KPN) SHARP	MITSUBISHI ELECTRIC Siemens AG NEC Corporation Panasonic (Matsushita) SK telecom (SK) TOSHIBA
Non-pooled Overseas Companies	LG, MOTO, Ericsson, Philips, Qualcomm Inc, Lucent, Nokia, Samsung, Sony	
Non-pooled typical leading companies from Mainland China	Datang, Hua Wei, ZTE Corporation	
Non-pooled institutions from China	Other Taiwan companies (TAIWAN)	Other Mainland China companies (MAINLAND)

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Empirical Measurement – Specialization vs. diversification in ICT sectors in China

- **Data: SIPO (1985.1-2011.10)**
- **4 major sectors: Patenting volume total: 776294**
  - Telecommunication (17 IPC fields, 213571 pieces)
  - Consumer electronics (8 IPC fields, 11785 pieces)
  - Computer and office devices (8 IPC fields, 209430 pieces)
  - Others (19 IPC fields, 241508 pieces).

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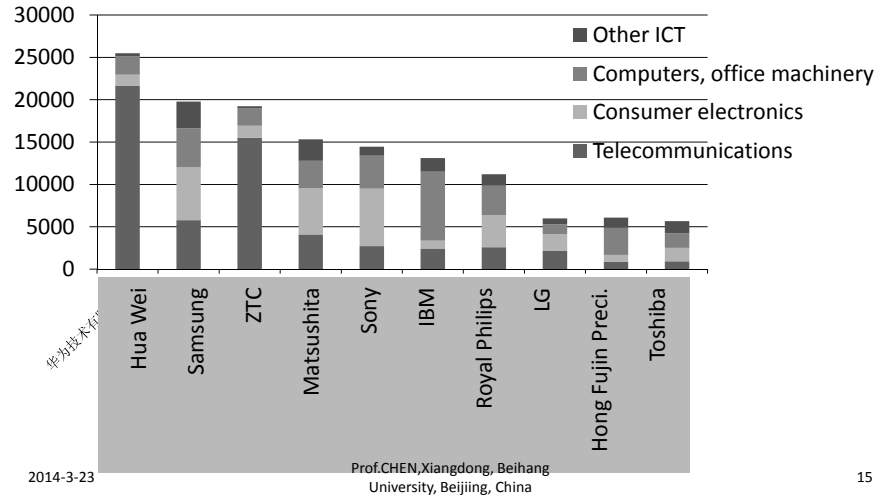
The Top 10 companies in 4 ICT sectors



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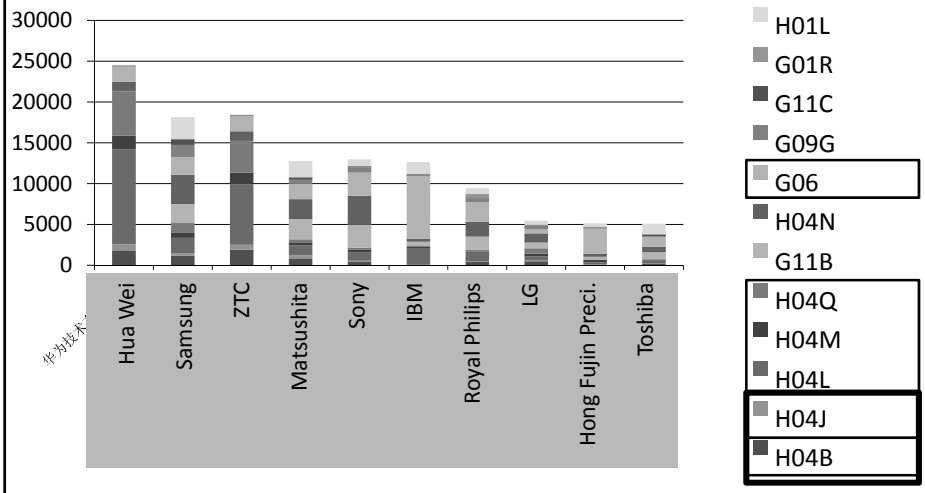
Top technical fields



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Ranking in diversification in technical fields

Top 10 companies in Shannon-Wiener		
Name of the company	Shannon-Wiener Index	**Ranking**
Hua Wei	0.769375	⑨
Samsung	**1.127690**	③
ZTC	0.835938	⑧
Matsushita	**1.201263**	①
Sony	1.020120	⑥
IBM Hong Fujin Precision Industry	0.659502	⑩
Royal Philips	**1.150038**	②
LG	1.110647	④
Hong Fujin Precision Industry	0.939918	⑦
Toshiba	1.058508	⑤

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Ranking in diversification in technical Breadth vs. Density

Name of the company	Technology Breadth	Ranking	Technology Density	Ranking
Hua Wei	0.189973	⑦	1.159027	⑦
Samsung	0.21789	④	1.224439	④
ZTC	0.212407	⑤	**1.248245**	②
Matsushita	**0.232083**	①	**1.285787**	①
Sony	**0.226771**	②	1.189568	⑤
IBM	0.140216	⑩	0.841512	⑨
Royal Philips	0.140925	⑨	0.780833	⑩
LG	0.208227	⑥	1.160892	⑥
Hong Fujin Precision Industry	0.169148	⑧	0.853607	⑧
Toshiba	**0.220013**	③	**1.236385**	③

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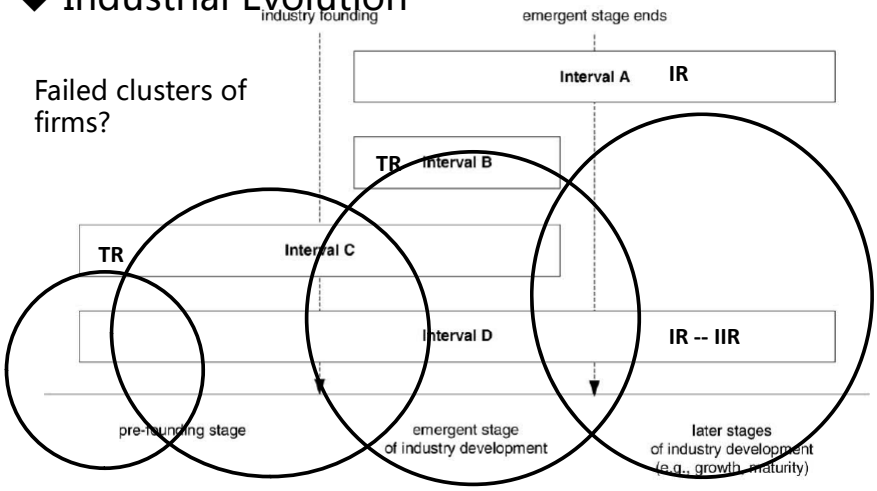
Topic II: Strategic Emerging Industries

◆ Industrial Evolution

Failed clusters of firms?



Source : Forbes, D.P., Kirsch, D.A., The study of emerging industries: Recognizing and responding to some central problems, Journal of Business Venturing (2010), doi:10.1016/j.jbusvent. 2010.01.004

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Topic III: Competition Strategies for Different types of technology innovation

- **Two kinds of innovation：**
  - **Incremental： highly specialized vs. highly diversified**
    - Less contributing to Catching Up Economies, however, beneficial to technology spillover and diffusion.
    - Developing Countries: incremental, imitative, and technical labor demand:
      - Technical skill based,
      - Knowledge application, …
  - **Radical (Original Innovation)： highly diversified**
    - Highly dynamic, discontinue, however, highly accidental.
    - Human resource demand:
      - Highly creative,
      - Highly heterogeneous,
    - Appropriate training system (Chandy and Tellis，1998)

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Industrial (sector based) Innovation System

- **Factors that differ across sector systems**
  - **Pharmaceuticals:**
    - Universities doing research
    - Institutional policy towards IPR
    - Policies supporting targeted R&D
  - **Auto**:
    - Suppliers (both MNCs and local companies)
  - **Software:**
    - Training organizations and a skilled labor force
    - Venture capital
  - **Telecommunication equipment**:
    - Targeted R&D support policies
    - Public research organizations
  - **Agro-food:**
    - Agricultural research organizations
    - Market institutions
  - **Semiconductors:**
    - Policies supporting targeted R&D

Source: Research findings by Franco Malerba and Richard Nelson (2011)

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"Catching Up" – research from Western scholars

- **Pharmaceuticals**
  - Successful catch up: India
  - Failure to catch up: Brazil
- **Automobiles**
  - Successful catch up: Korea
  - Catching up: China and Brazil
- **Software**
  - Catching up in waves:
  - First wave: India, Ireland, Israel
  - Second wave: China, Philippines
  - Third: Russia, Eastern Europe, Brazil, Argentina, Mexico
- **Telecommunication equipment fixed and wireless**
  - Successful catch up: China, Korea
  - Failure to catch up: India, Brazil
- **Agro- food:**
  - Catching up with exports: Costa Rica in Coffee, Brazil in Soybean
  - Transformation of the sector: China in vegetables, Nigeria in cassava
- **Semiconductors**
  - Successful catch up: Korea, China Taiwan
  - Catching up: China Mainland, Malaysia

Source: Research findings by Franco Malerba and Richard Nelson (2011)

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Strategic Emerging Technology / Industrial Sectors

◆ Technology Regime，TR

Evaluation of technologies in key / leading competitive sector / industry, especially emerging technology and sectors!

Table 1
Technology s

High appropriability	capabilities and license your innovation.	capabilities (R&D) and generic knowledge and/or network.	capabilities but try to find new opportunities through active search and imitation.	specific protected bits of knowledge, if possible.
Low appropriability	5. Invest aggressively in existing capabilities. Try to network or even sell your firm-specific bits of knowledge in order to profit from innovation or try to strengthen your appropriability.	6. Invest in exploring new capabilities (R&D) and generic knowledge and/or network in order to protect high opportunity resources.	7. Invest in existing capabilities but try to find new opportunities through active search and imitation. Networking or strengthening appropriability is a must.	8. No future.

Michael Peneder（2010）Technological regimes and the variety of innovation behavior: Creating integrated taxonomies of firms and sectors《Research Policy》，2010（6）323-339
Kylaheiko, K.,etal.,Valueofknowledge—Technology strategies in different knowledge regimes. International Journal of Production Economics (2010) 2010.07.009

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“Next generation of IT”

- New generation of mobile communication, next generation of internet and integration of three networking, subject-related networking, cloudy computing, larger scale integrated circuits, new displays, and high end software and service facilities and new types of service industries.

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Key technologies in New Generation of Telecommunication System

- Three layers:
  - Cloudy computing application in communication network;
  - Short distance telecommunication technologies;
  - 4G Key technologies:
    - Wireless link enhancement technology, Radio resource management technology, Networking technologies, and The key common technology.

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LTE related competition

- LET (Long Term Evolution) is a group of technologies between 3G and 4G (or 3.9G), whether or not future standard, not yet decided.
- Candidate solutions (patent pool initiation):
  - TD-LTE-Advanced, suggested by Chinese companies
  - 3GPP by Japanese, Korean, and European industrial standard organizations;
  - IEEE, by North American standard organization
  - 6 in total, primarily LTE and 802.16m (Wimax)

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Comparison of the key technology areas and market in China

Classification of technologies	CNPAT	%	WPI	%
T1 Wireless link enhancement technology,	10096	39.45%	29953	40.48%
T2 Radio resource management technology,	8759	34.22%	24061	32.52%
T3 Networking technologies	4331	16.92%	12688	17.15%
T4. The key common technology.	2408	9.41%	7291	9.85%
Total	25594	100%	73993	100%

Source: edited from New generation of telecommunication technologies in patents, by Yang and Zhang, <Science & Technology Management Research> (in Chinese), No. 20, 2013, Pp 174 – 190.

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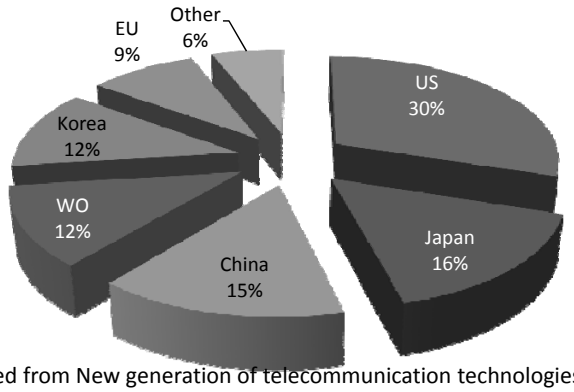

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Empirical investigation – Patent value in telecommunication sectors in China

- Patent value / quality measures:
  - **Citation (backward citation / forward citation)**
  - **Patent numbers, knowledge contents (citation), and R&D Input, are some typical influencing factors on investment by investors over those listed firms (Hirschey and Richardson, 2004)***
- However, this is knowledge / technology diffusion based quality measure:
  - **Social value: technology spillover / technology diffusion through licensing, adoptions, and protected productions.**
  - **Private value: may or may not be relevant to its social value**

* Hirschey and Richardson (2004), Are scientific indicators of patent quality useful to investors? Journal of Empirical Finance, No. 11, Pp91-104.

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Function change in patent system?

- Where is the largest part of patent value?
  - Production as private and social value
  - Knowledge diffusion as mostly social value
  - Purely private value via legal actions, patent bubble?
  - Strategic patenting / patent portfolio for better control / blocking premium, patent bubble?
  - Policy driven for non-market performance premium, patent bubble?

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Patent usage in European countries

	Internal use	License	Cross license	License and adoption	Blocking others	Sleeping (non-use)
	Distributions on the following are industries based , investigation number =7,711）					
Electrical engineering	49.2	3.9	6.1	3.6	**18.3**	**18.9**
Instruments	47.5	9.1	4.9	4.3	**14.4**	**19.8**
Chemical & Pharmaceutical	37.9	6.5	2.6	2.5	**28.2**	**22.3**
Technique	54.6	7.4	2.0	4.9	**15.4**	**15.7**
Mechanical	56.5	5.8	1.8	4.2	**17.4**	**14.3**
Total	50.5	6.4	3.0	4.0	**18.7**	**17.4**
	Distributions on the following are size and nature based, investigation number = 7,556					
Larger sized companies	50.0	3.0	3.0	3.2	**21.7**	**19.1**
Medium sized companies	65.6	5.4	1.2	3.6	**13.9**	**10.3**
Smaller companies	55.8	15.0	3.9	6.9	**9.6**	**8.8**
Private institutions	16.7	35.4	0.0	6.2	**18.8**	**22.9**
Public research institutions	21.7	23.2	4.3	5.8	**10.9**	**34.1**
Universities	26.2	22.5	5.0	5.0	**13.8**	**27.5**
Other government institutions	41.7	16.7	0.0	8.3	**8.3**	**25.0**
Others	34.0	17.0	4.3	8.5	**12.8**	**23.4**
Total	50.5	6.2	3.1	3.9	**18.8**	**17.5**

Source: Giuri, P., M. Mariani, S. Brusoni等. Inventors and invention processes in Europe: Results from the PatVal-EU survey[J]. Research Policy. 2007, 36(8): 1107-1127

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Patent trolls / Patent Sharks

- NPE (Non Practice Entities):
  - AT&T was sued 54 times in a year
  - Google, 43 suits
  - Verizon, 42
  - Apple, 41
  - Samsung and Amazon, 39 each
  - Dell, and Sony, 34 each,
  - Huawei, 32,
  - Blackberry, 31
- NPEs sued more than 4800 times

With 2600 companies, 6 times higher than in 2008.

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Survival Rate / Life Cycle – Private Value based

- Legal effect:
- Renewal based information – private value
  - Lanjouw and Schankerman (1999, 2001), Lanjouwd and Lerner (2001), Kingston (1995, 2001), Bessen (2008, 2009), …

Evaluation of patenting behavior / "Innovation" behavior through patent data!

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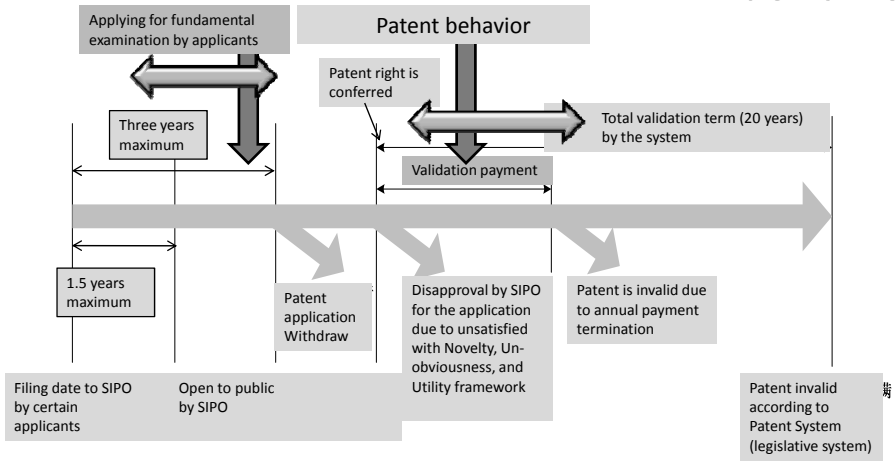
Patent / Patenting behavior



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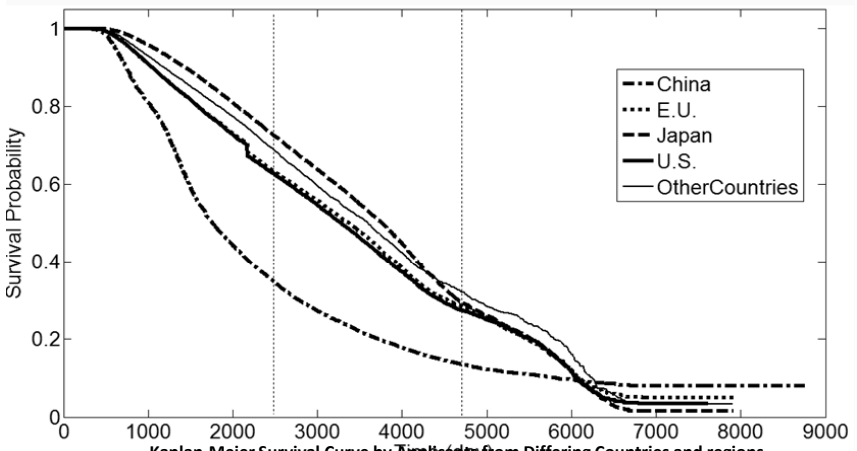
Patent Invalidation Rate Distribution based on China (SIPO) Data

Electrical machinery and apparatus, electrical energy



Kaplan-Meier Survival Curve by Applicants from Differing Countries and regions

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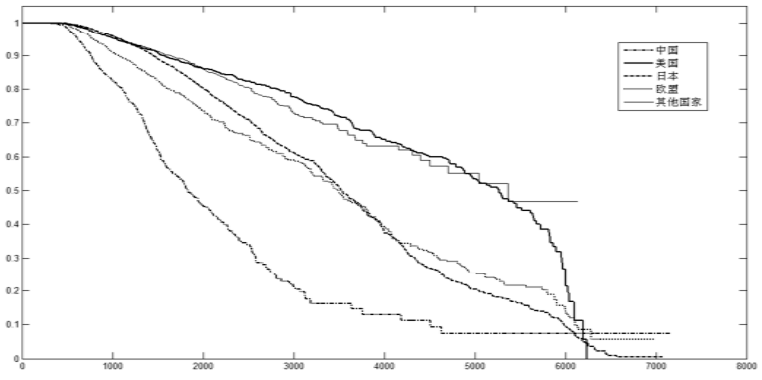
Audio-visual technology



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Payment level in China's Patent System

Duration	1-3 Yr	4-6 Yr	7-9 Yr	10-12 Yr	13-15 Yr	16-20 Yr
Annual Payment (RMB Yuan)	900	1,200	2,000	4,000	6,000	8,000

- Note: payment due is nominate number, without any consideration of deduction policy.

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Patent Value Comparison with Different Owners (Source Countries)

(against level by Chinese owners)

Expired: different time zone	U.S.	Japan	E.U.	Other Countries
25%	0.9	1.7	0.9	0.9
50%	1.6	2.3	1.5	1.7
75%	4.8	4.4	2.3	2.7
90%	4.5	5.6	4.0	2.4
95%	7.2	6.2	6.4	5.1
99%	4.0	3.1	3.2	3.0
Mean	2.4	2.2	2.2	1.9

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Relative value to average (patent value in different sectors)

Expired & survival: different time zone	**Telecommunica. & IT sectors**	Biotechnologies	Environmental technologies	Material technologies	Mechanical technologies
25	100.75%	103.30%	103.74%	94.70%	96.35%
50	101.01%	56.15%	56.30%	49.60%	93.54%
75	50.91%	54.39%	107.90%	44.16%	90.19%
90	48.99%	54.73%	54.65%	39.05%	85.27%
95	94.13%	78.86%	78.30%	74.35%	123.14%
99	132.63%	54.50%	86.83%	47.52%	93.77%

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Schumpeterian I vs. Schumpeterian II		
Notion	**Schumpeterian I**	**Schumpeterian II**
Source	Theory of Economic Development (1912)	Capitalism, Socialism and Democracy (1942)
Definition	Nelson and Winter (1982)	In Keith Pavitt's words
Character	"Creative Destruction", original, less concentration, smaller economic scale, un-stable competitive position, easy market entry ***– highly diversified knowledge***	Accumulative technology development, highly concentrated, larger company dominated, stable competitive position, difficult market entry. ***-- highly converging & path dependent.***
Evolution	**Schumpeterian Innovation Model varies along with different time period in economic development**	
Typical Sectors	Mechanical industries Pharmaceutical sectors	Semiconductors (1990's) and micro-processor, DRUM, (1950-1990's)

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Knowledge and technology innovation

- Function of Modern Universities
  - University-Industry consortium
  - University dominated industrial innovation
  - National Educational System
- Evaluation of knowledge innovation productivity of universities / university-industrial consortium.
- Evaluation of innovation function of university

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Timely based obstacles in international technology transfer

- Entrepreneurial: company perceptions
- Government: Policy environment
- Market: acceptance by major customers
- Political economic: between countries / business groups – patent pool.
- Technical with political: standardization and patent pool.

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Function of University / Higher Education: Major Argument

- Knowledge generation vs. knowledge transfer
- Question of focus:
  - **Universal interests vs. market interests**
  - **Academic background based research interests**
  - **Engineering and technology frontier (National Innovation System)**
  - **Emerging strategic technologies (National Innovation System)**
  - **Local / regional solutions (regional innovation system)**
  - **Sector based technical competition in company level.**

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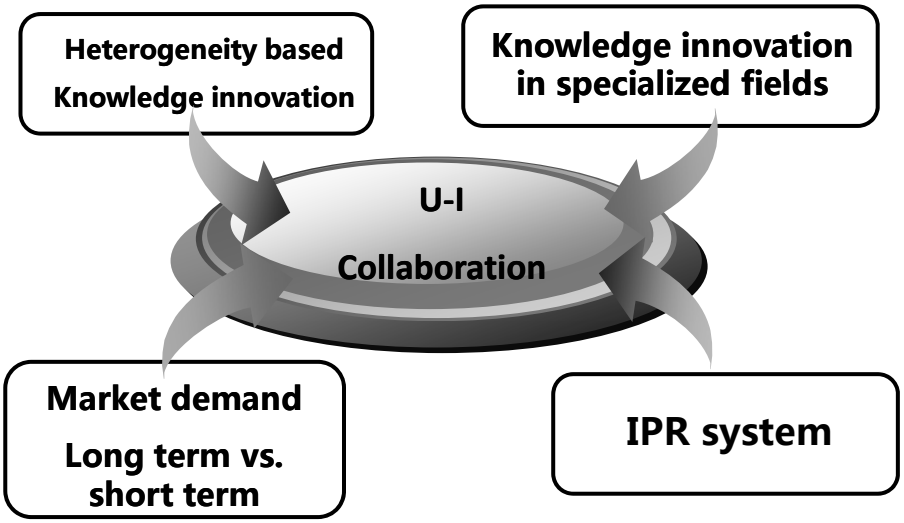
University-Industry Collaboration



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Important signs of Chinese universities

- Institutions / Input / Output
  - R&D institutions within universities
    - Licensing out
    - Start Up's & URE (URSMEs / UR high tech SME's)
  - R&D collaborations between U and I
  - Industry ordered / out sourcing:
  - Industry based Internationalization of R&D

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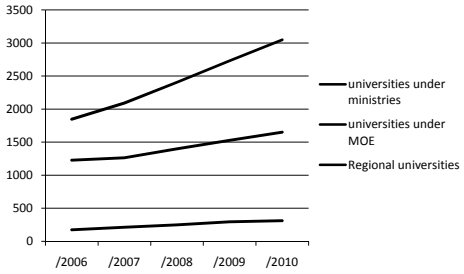
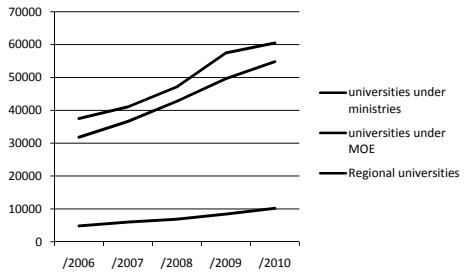
University R&D facilities & Output

University run R&D institutions



Numbers of Institutions



R&D projects within universities

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Industry contracted fund for university R&D

Table 1. Research Fund from Industries (2006-2010) 0.1 billion RMB

	2006		2007		2008		2009		2010	
	Total	Industr.	Total	Industr	Total	Industr	Total	Industr	Total	Industr.
Total	45.73	41.44%	54.54	38.43%	65.45	37.31%	72.77	37.86%	94.03	33.91%
"211" Universities &	32.36	42.03%	38.84	38.08%	46.46	36.10%	50.86	37.46%	67.93	32.59%
Other Universities	13.17	40.32%	15.46	39.46%	18.66	40.51%	21.4	39.11%	25.52	37.64%
Collegess	0.21	19.05%	0.24	29.17%	0.33	30.30%	0.51	25.49%	0.57	24.79%
MOE universities	24.16	43.05%	29.15	40.41%	34.76	37.89%	38.34	38.89%	52.19	32.09%
Regional univ.	16.09	39.34%	18.66	38.96%	22.99	39.02%	26.17	38.14%	31.27	36.55%
Sythetic Univ.	14.6	37.40%	17.71	33.37%	21.29	31.89%	23.2	33.58%	32.17	28.05%
Engineering Univ.	24.38	51.35%	29.15	47.99%	34.37	47.72%	37.92	48.34%	46.7	45.17%

Source: <Statistical Yearbook on Higher Education University S&T>, 2007 – 2011.

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What drives company / university patent records up?

- **Market competition**
  - Tangible market competition
  - Financial market
    - Capital market
    - Ventral capital market
- **Policy encouragement**
  - Direct: patent records as innovation output measures;
  - Indirect: patent records as company image …
  - University role under NIS

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Patent value differences:
Company vs. higher education inst.

Value against average by different organizations (%)

Organization / Patent value	Larger firms	SMEs	Universities (985) and CAS	Universities (Non – 985, but 211)	Universities (Non-211)
Value in average	208.5%	74.0%	75.6%	72.8%	69.1%

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Prof.CHEN, Xiangdong, Beihang University, Beijing, 100191, P. R. China

Table 3. University-Industrial Collaborative Patenting: Active Technology Fields.

2000		2001		2002		2003		2004		2005		2006		2007	
C07K	82	C07K	46	G01N	27	G01N	21	G01N	37	A61K	33	G01N	47	G06F	44
C12N	30	A61K	28	A61K	19	A61K	17	A61K	24	G01N	26	H04L	44	G01N	43
G01N	11	C12N	23	B01D	13	C07C	13	H01J	20	H04L	22	G06F	43	A61K	38
		G01N	16	C12N	11	C09D	13	B01D	19	C01B	21	A61K	36	B01D	36
		B01D	12	H04M	10	B01D	12	C07C	16	H01L	19	H01J	36	H04L	36
				H04N	10	C02F	12	G02B	15	H01J	18	C07C	32	C07C	29
						C04B	12	C04B	14	C07C	16	H04N	23	C02F	23
						H04N	12	C02F	12	C12N	15	C02F	20	H01L	18
						C12N	11	C07D	11	C07D	14	C07D	20	C01B	17
						C12Q	11	H05B	10	C02F	13	B01J	19	C07D	17
						H01J	11			C09K	13	C01B	19	H04N	17
						C08L	10			B01J	12	C12N	17	A01K	16
						H04L	10			H04N	12	F24F	15	G05B	16
										B01D	11	H01L	13	H01M	16
										C01G	11	C04B	12	B01J	15
										C04B	10	C08L	12	H01F	15
										G02F	10	C08F	11	D04H	14
										G06F	10	C08G	10	H05B	12
										H01Q	10	G05B	10	C04B	11
														C09D	11
														C09K	11
														C22B	11
														H01J	11
														A23L	10
														B23K	10

The most popular technical fields for University-Industrial Collaboration in China – Patent Record based.

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Major topics

- Evaluation of patent value for more objective oriented issues
- Evaluation of patent value for more subjective (behavior) oriented issues.
  - Individual companies, technology speculators
  - Group of companies, technology blockers
  - Upper stream (knowledge innovation) entities (e.g. universities?
  - Policy effectiveness vs. policy speculators (input – output?)

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Further collaboration

- Thank you for your kind attention!
- Looking forward to future possible collaboration!
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