



Asian rise in ICT R&D

Assessing China's ICT policies

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Agenda

1. Preamble
2. Assessing China's ICT policies: some macro and micro perspectives
3. Conclusions



Tianhe (milky way)
Most powerful supercomputer ($2.5 \times 10^{15}/s$)
EUR 56 million (military support not included)
Hybrid technology: Intel, Feiteng, Nvidia

Key messages

- Tremendous efforts devoted to putting China in league of countries doing **significant** ICT R&D
- Still long march ahead but:
 - Strong **political signals** backed up by **financial means** (e.g. research programs + credit lines)
 - Some firms (“national champions”) have emerged as **serious contenders** in the market and increasingly in the labs
 - Shift from domestic to international patenting → globalization of Chinese firms



Not an “if” but a “**when**” → 1-2 decades provided...
China gets the **institutional setting** right

Preamble: The rise in ICT R&D is part of a broader push to position China at the forefront of research in S&T

- Chinese government has encouraged the country to **embrace innovation** through a variety of measures:
 - Increase in overall R&D budget for the country
 - Introduction of tax breaks and monetary incentives to increase **indigenous** innovation
 - Continuous investment in nation's academic institutions
- Chinese R&D expenditures and intensity are growing quickly → can ICT R&D expenditures replace an **eco-system** geared towards innovation?
- China is by far the largest exporter and importer of ICT goods → who captures the **value** of processing trade?
- Deeper integration into Asian/regional **networks of production** → implications on R&D and on non-regional players?

Preamble: Tearing down an iPhone

iSuppli Apple iPhone 4 (16GB) Teardown Analysis

Exploded View
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Materials Suppliers*

SOUTH KOREA		
LG (or possibly TMD) **	LCD display	\$28.50
Samsung	Flash memory chip	27.00
Samsung	Applications processor	10.75
Samsung	DRAM memory	13.80
UNITED STATES		
Broadcom	Wi-Fi, Bluetooth, GPS chips	9.55
Intel	Radio frequency memory	2.70
Texas Instruments	Touch-screen control	1.23
Cirrus Logic	Audio codec pack	1.15
GERMANY		
Infineon	Receiver/transceiver	14.05
Dialog	Power management	2.03
ITALY / FRANCE		
STMicroelectronics	Accelerator and gyroscope	3.25
JAPAN		
AKM	Compass	.70
OTHER		
Wintek or TPK/Balda†	Touch screen	10.00
Not known	Camera, 5-megapixel	9.75
Not known	Camera, VGA	1.00
Not known	Battery	5.80
Not known	Other parts	46.25

*Teardown costs account only for hardware and do not include other expenses like software, royalties and licensing fees. Profit does not include sales and marketing costs.

**TMD is Toshiba Mobile Display of Japan

†Wintek is an American company. TPK Holdings, a Taiwanese company, is partly owned by Balda, a German company.

Sources: iSuppli, Needham & Company

THE NEW YORK TIMES

Breakdown of the iPhone 4 (Total paid to Apple = \$600)

Materials	Misc.	Profit	Assembly
\$187.51	\$45.95	\$360	\$6.54

Who reaps the **benefits**?

Preamble: Does higher R&D spending ensure better performance?

- According to Booz & Co (2009) there is **no statistical relationship** between R&D spending and:
 - Sales growth
 - Gross profit growth
 - Operating profit growth
 - Operating margin
 - Net profit growth
 - Net margin
 - Market cap growth
 - Total shareholder return
- Positive correlation between R&D expenditure and the number of patent applications by industry and by country/region

Preamble: Thinking differently about innovation

- Forget the idea that the rise of Chinese competitors simply means cheap, low-quality imitations flooding world markets:
 - Chinese companies are starting to disrupt global competition by **breaking the established rules of the game**
 - Their tool of choice is **cost innovation**, using cost advantage in radically new ways to offer customers around the world more for less
- Western companies often think of innovation in terms of:
 - **Adding** features, functions or sophistication to an existing product
 - Selling it for a **premium price**
- Chinese firms find ways to deliver **more value at lower prices**:
 - Incorporating high technology in low-cost products
 - Offering more product choices for a lower cost
 - Turning high-end specialty products into low-cost, high-volume items

Source: Zeng, M. and P. J. Williamson (2007). Dragons at your door : how Chinese cost innovation is disrupting global competition. Boston, Mass., Harvard Business School Press.

Assessing policies: mega-projects

- Out of 12 government-funded mega-projects, **4 related to ICT**:
 - Core electronic components
 - High-end generic chips and basic software
 - Extra large scale integrated circuit manufacturing and technique
 - New-generation broadband wireless mobile telecommunications
- Policies include:
 - Preferential taxation
 - High-technology industrial zones
 - Assimilation of foreign technology
 - Diversified funding support in S&T

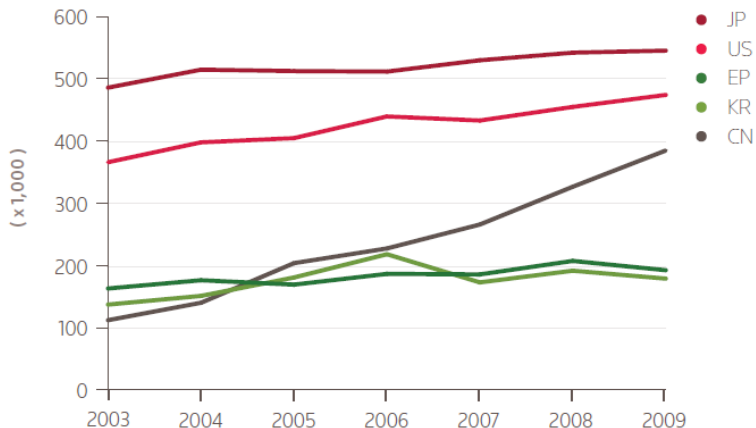
Source: European Commission (2010) EU-China Cooperation on Information and Communication Technologies in RTD

Measuring innovation at the domestic level

- China has become the 3rd largest patent office in the world by annual invention patent applications

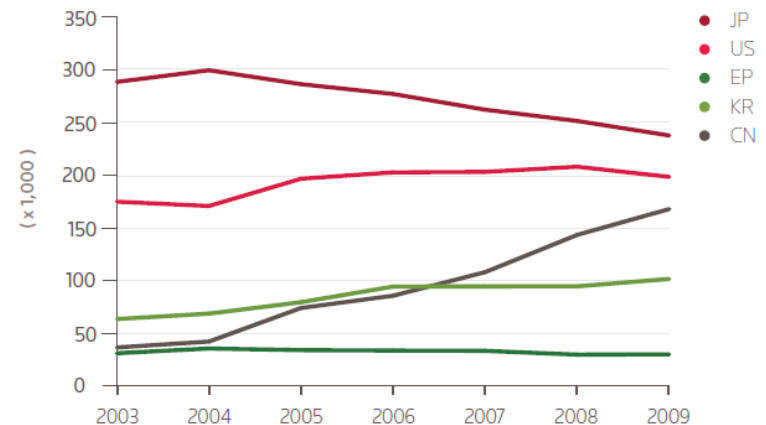
TOTAL PATENT VOLUME

FIGURE 1



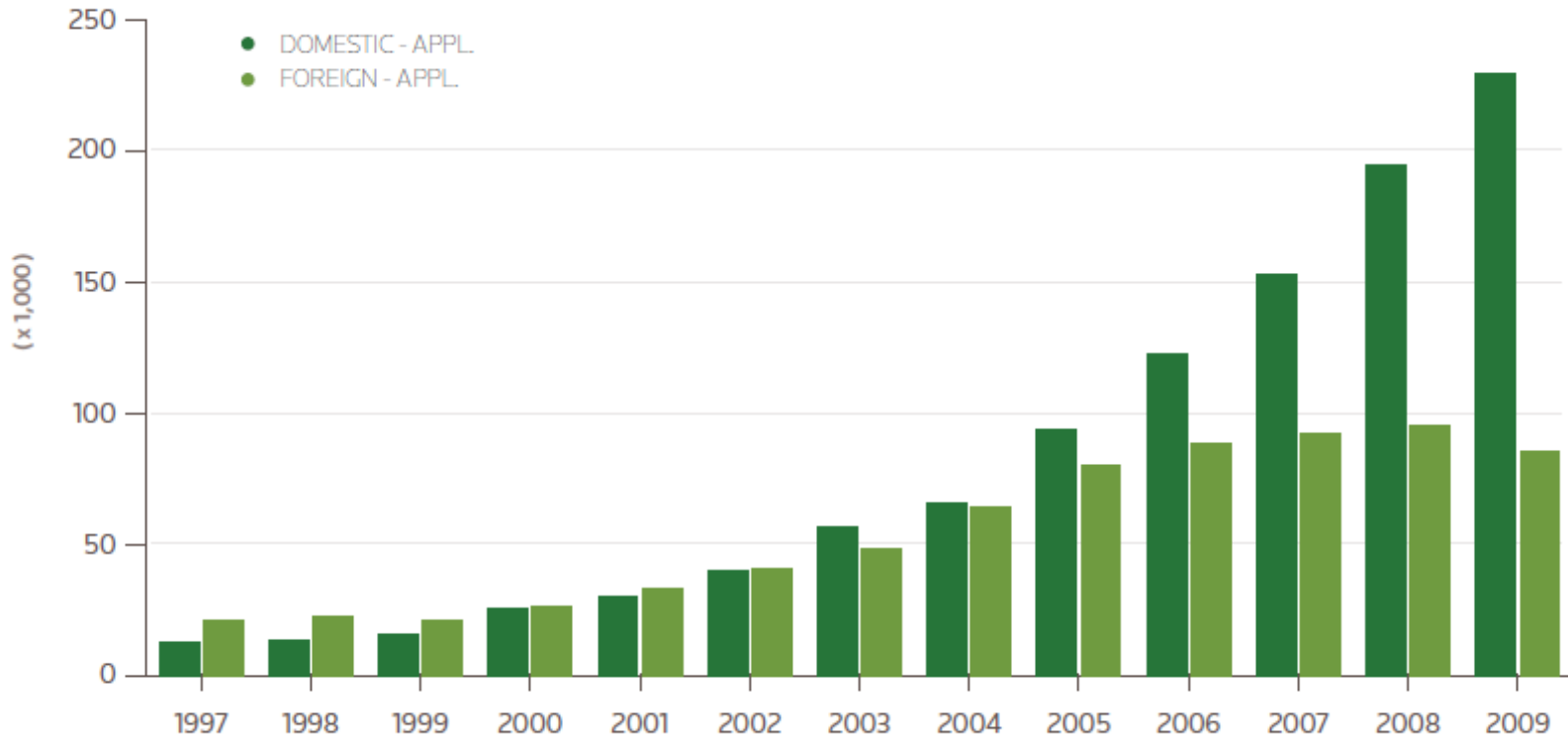
BASIC PATENT VOLUME

FIGURE 3



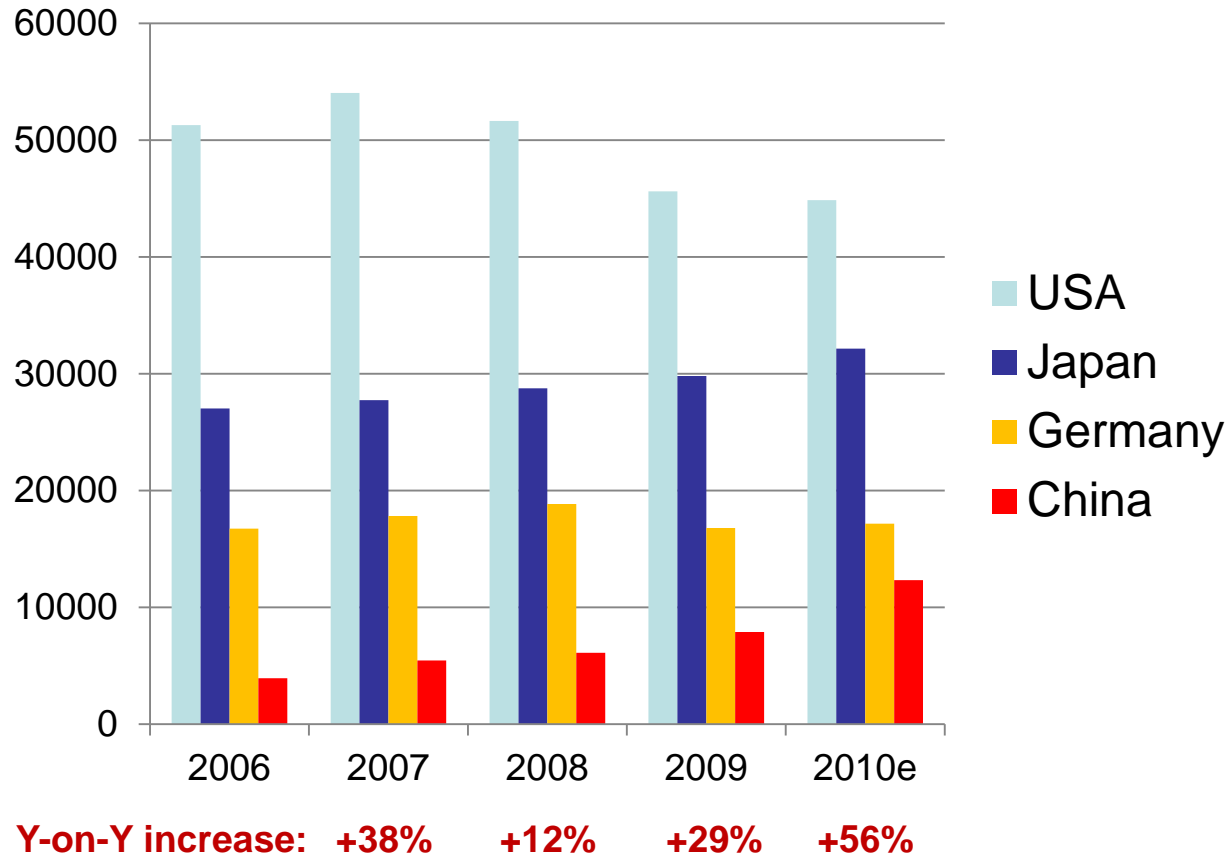
Source: Thomson (2010) Patented in China – The present and future state of innovation in China

Domestic vs. foreign Chinese patent filings (applications)



Source: Thomson (2010) Patented in China – The present and future state of innovation in China

International patent applications (PCT)

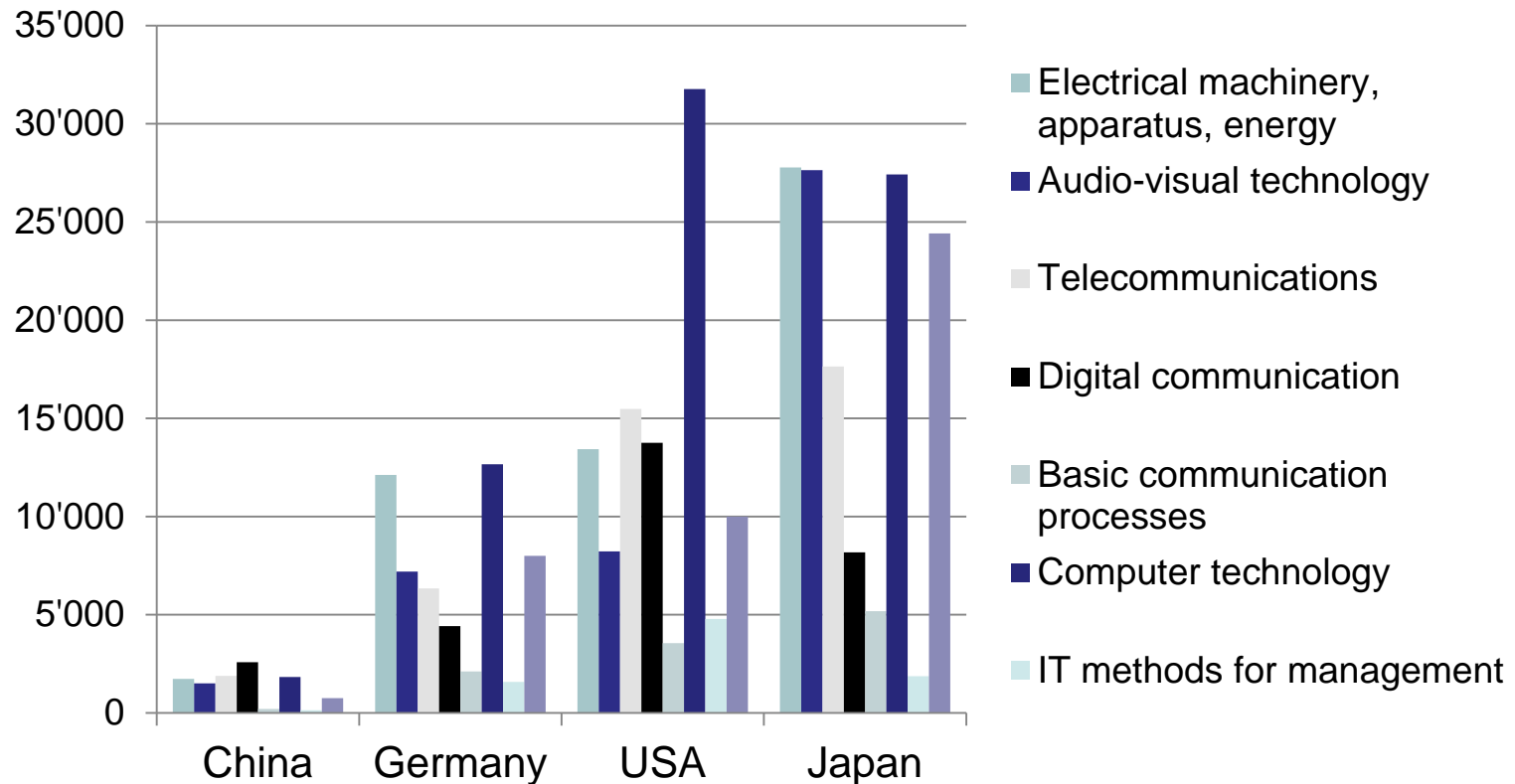


Source: WIPO (2011)

Is Chinese R&D going international?

A long march ahead but...

Foreign-oriented patent families by field of technology and country of origin, 2003-2007



Source: WIPO Statistics Database and EPO PATSTAT Database, June 2010

...serious intent to play in the big league

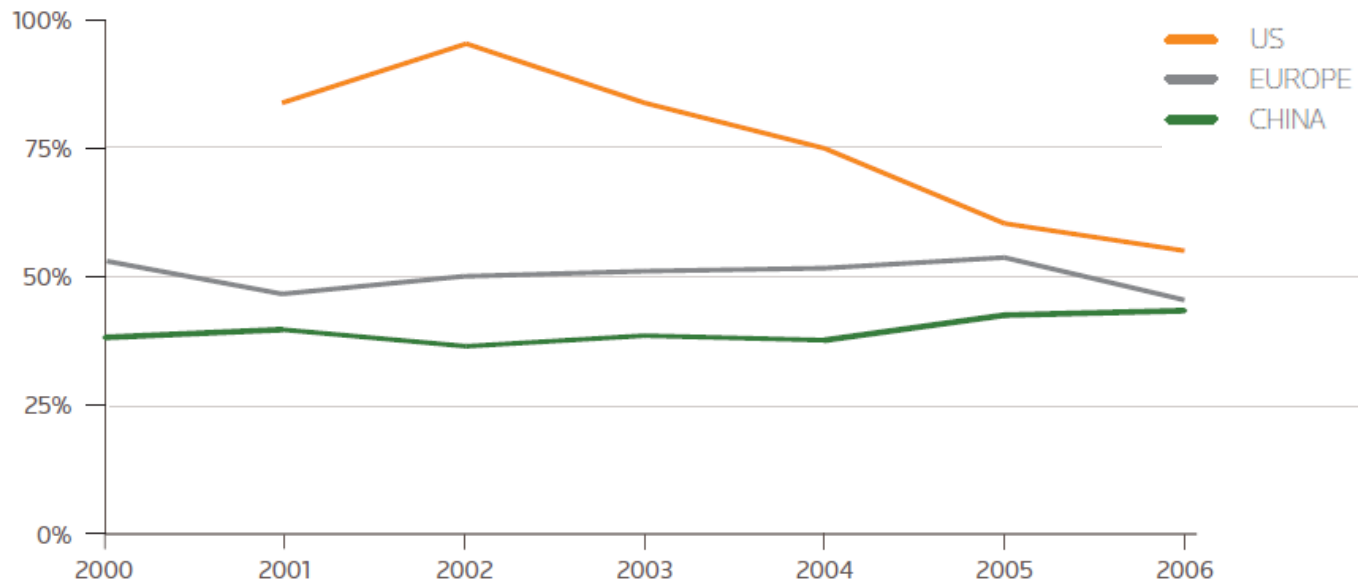
China's top 5 areas of focus

Year	Top Five Fields	Patent Applications
1998	Natural Products and Polymers	2,864
	Digital Computers	2,161
	Telephone and Data Transmission Systems	2,067
	Broadcasting, Radio and Line Transmission Systems	1,986
	Audio/Video Recording and Systems	1,592
2008	Digital Computers	44,585
	Telephone and Data Transmission Systems	29,510
	Broadcasting, Radio and Line Transmission Systems	19,750
	Natural Products and Polymers	17,250
	Electro-(in)organic Materials	17,107

Source: Thomson (2010) Patented in China – The present and future state of innovation in China

What about the quality of patents?

- The quality of invention patents can be evaluated (in part) based on the rate of conversion of applications to granted patents



Source: Thomson (2010) Patented in China – The present and future state of innovation in China

Still doesn't tell us about the **success in the market**

Assessing policies: micro perspective

- Most of China's top ICT companies remain unheard of outside of China... can you cite 5 Chinese companies active in ICT?

Telecom equipment

- Huawei
- ZTE
- Datang
- Great Wall
- Konka
- Ningbo Bird
- Kejan

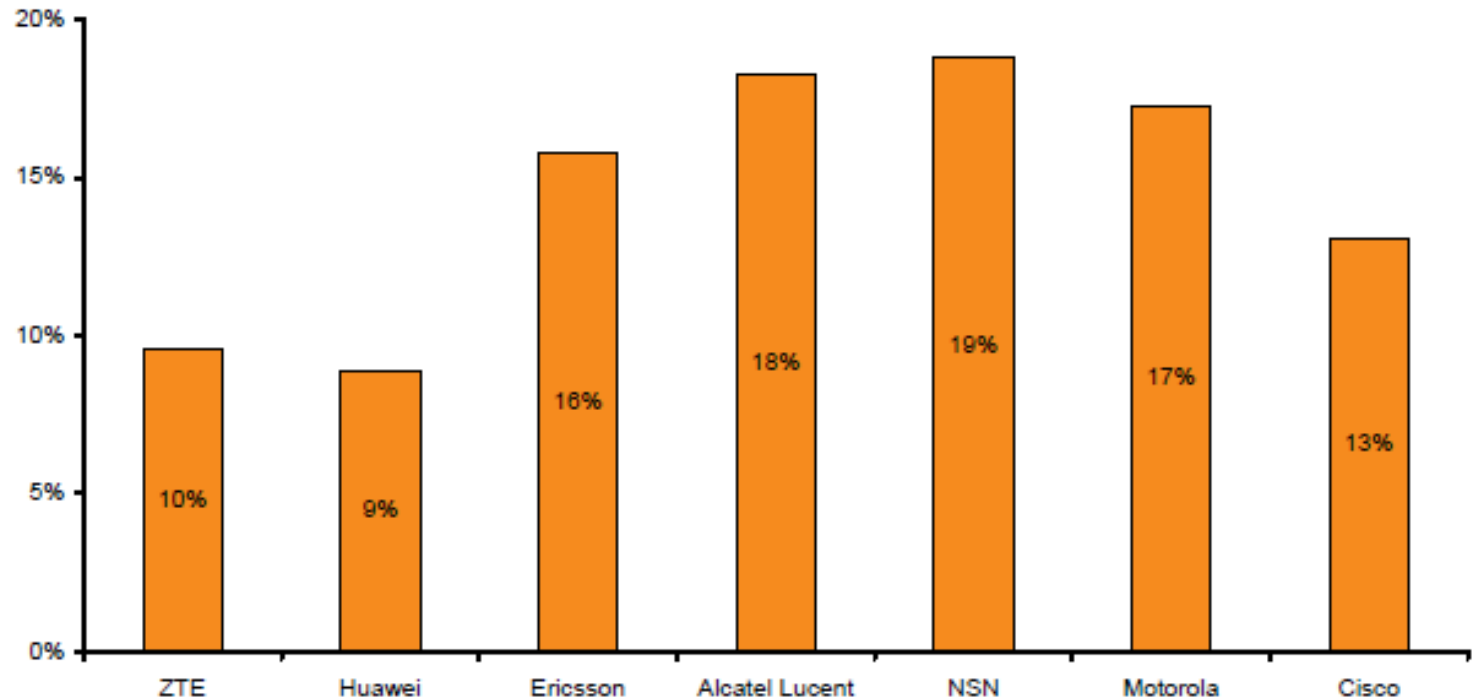
Software

- Beyondsoft
- CDC Software
- Chinasoft
- Integrated Solutions
- Kingdee
- Neusoft
- UFIDA

- Some of these take R&D **very seriously**:
 - Huawei has 17 R&D centers globally (Alcatel has 50...); 43% of entire workforce engaged in R&D; ranked 5th most innovative company in the world for 2010 by Fast Company
 - ZTE employs 25,000 researchers around the world; more than 30,000 issued and pending patents

Some Chinese firms start to compare with global firms but...

R&D cost-to-sales ratio, 2009



Source: Company data, RBS calculations

...some data points downplay the emergence of Chinese firms as ICT R&D challengers

- World top 250 ICT firms spent on average **USD 1 billion** for R&D in 2009 (OECD, 2010) → need to segment by type of ICT (telecommunications, Internet, etc.)
- World top R&D spenders: Microsoft (software), Nokia (telecommunications equipment), Samsung (telecommunications), IBM (IT services and hardware)
- No Chinese company in top 20 (OECD, 2010) but 2 in the **top growth** between 2000 and 2009: Huawei (+29%) and ZTE (+24%)
- Top 250 ICT firms spent on average **6% of R&D** in 2009 → no Chinese firm in the top 20



Is the **pressure** mounting on MNCs when it comes to R&D?

Published PCT international applications in 2010: 2 Chinese firms in the top 5

Name	Published 2010	Increase from 2009	Position Δ
Panasonic	2154	263	0
ZTE	1863	1346	+20
Qualcomm	1677	397	+2
Huawei	1528	-319	-2
Philips	1435	140	-1

Source: WIPO (2011)

- China **as a country** jumps from 7900 applications in 2009 to 12337 in 2010 (+56%) but....
 - No other Chinese company in the top 100...
 - No Chinese university in top 600 applicants

Are these 2 **trees** masking the forest or is there **no forest**?

Broadening the perspective on Chinese ICT R&D

- Top 100 Chinese ICT companies invested RMB 40 billion in R&D in 2008 (**3.5% of total revenue**);
- Top 100 companies applied more than **40 000 patents** in 2008 → Chinese scientific output ranked globally 5th after the USA, UK, Germany and Japan (8% of the world's output)
- MNCs R&D institutions are encouraged to drive **indigenous** firms to develop in a favorable and rapid manner → 1200 MNC R&D centers in 2008 with a budget for R&D about USD 2.0 billion



Does amount spent in R&D **correlate** with success in the markets?

Chinese firms still suffers from weak industrial innovation capacities

- Chinese manufacturing companies spend **just 1.9 %** on R&D (against 7 to 11% in France, Germany, Japan, US and Korea)
- For high-tech manufacturing companies, China's ratio is **4.6%** (Korea; 20%; up to 30% in the US and Japan)
- Only 0.03 % of Chinese firms own the **core intellectual property** in their products
- **Home-grown** technology accounts for just 4% of China's exports
- Only 6 % of China's total R&D is spent on **basic research** (14% in Korea and Russia)

Need to solve both **macro and micro** issues

The days of industrial policy are not over: let's hope that those of education policy aren't either in the EU

- **Targeted policies** of the US government created **lead** in radio technology, telecommunication, microelectronics and the Internet...
- US government “never” picked winners in the form of national champions but consistently **earmarked support** for particular sectors deemed to **define the future**
- Having strongest capacity not only to acquire modern technologies but also to **implement** and to **exploit** them
- The importance of ICT both in the domestic and global economy make it a place for **tensions in international trade**

Conclusion (1/3): A great leap forward but a long march ahead

- China's S&T strategy is:
 - **Well grounded**: Research institutes (CAS, etc.), Chinese MNCs positioning, other tigers/Japan
 - **Causing worries**: R&D and education growth, Western MNCs structural handicap
 - **Partly "misguided"**: national programs and champions can't replace entrepreneurship and other factors (financing, openness, etc.)



Potential to **disrupt** current **division** of knowledge creation and to re-define **technological trajectories** on a **global scale**

Conclusion (2/3): not “if” but “when” and “how”


- Are the ICT policies working?
 - Result against objective (2.5% of GDP in R&D by 2020 + world scientific leader by 2050)?
 - Ability to transform R&D expenditures into market share and/or profits?
 - Comparison with other technological/R&D “powers”?
 - No longer simply an **assembler** but already an **innovator**?



Still waiting for a Chinese firm or research institution to come up with leading-edge innovation in ICT → not a “if”, but rather “**when**” and “**how**”

Conclusion (3/3): the jury is still out as to how quickly China can move on the institutional fabric

- Is China's institutional framework ripe to support **sustainable** R&D in ICT?
 - Size alone only matters if accompanied by the spread of innovative capacity
 - Involves application of new ideas and methods through wide range of applications and supportive **institutions**:
 - Research universities with high level of academic freedom (free enquiry, skepticism about fact and theory)
 - No barriers to ideas generated elsewhere
 - Meritocratic organizational structure
 - Government needs to be “smart” enough to **exit** at right time



Necessity to **constructively engage** both the Chinese government and the firms into a **fair/level playing field** but it will be a tough battle for EU and RoW