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Enterprise, Industry and Country Perspective"

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Development of National Innovation System in China

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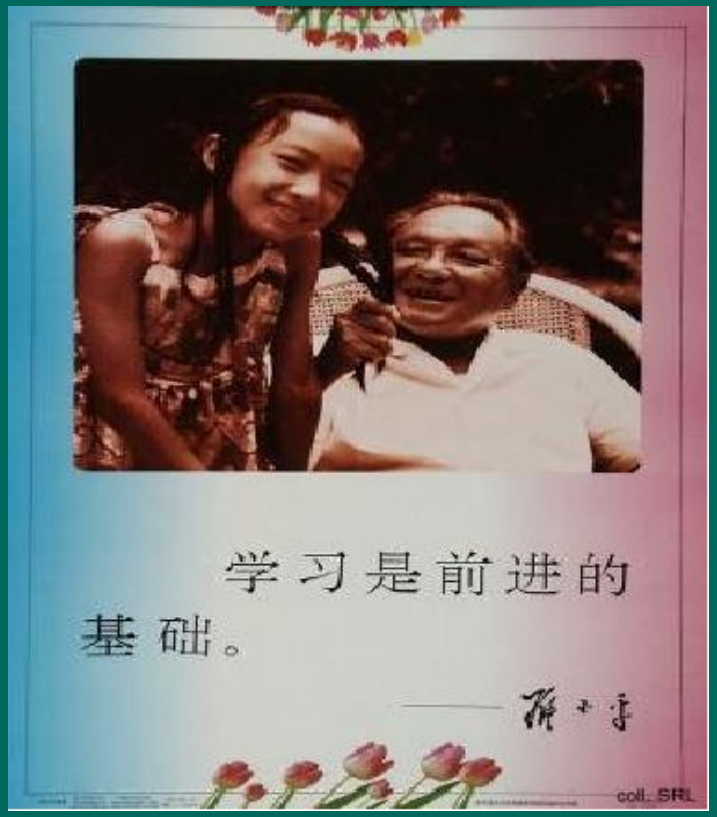
Outline

1. Historical overview of China's NIS
2. Key actors
3. Performance of China's NIS
4. Main Science and Technology programs
5. Science and Technology in the Thirteenth Five Year Plan
6. Regional systems of innovation

Science and Technology in China after 1978

- Four modernizations: agriculture, industry, national defence, **science and technology**
- Self-reliance replaced by **foreign technology**
- Reforms of universities and public research institutes
- *„China will step up science and technology innovation and improve the technological sophistication, quality and brand awareness of Chinese industry."* (Li Keqiang at the World Economic Forum in Tianjin, 2014)



The key actors in China's NIS (1)

Government: State Council's Steering Committee on S&T and Education, National Development and Reform Commission, Ministry of Finance, Ministry of Science and Technology, Ministry of Education.

- sets up R&D goals, provides support and chooses key technologies
- promotes interactions among key actors
- mobilizes human capital and material resources
- government share in GERD has been declining from 29,9% in 2003 to 23.4% in 2009 (OECD, 2010).
- government directly integrates a few entities with required capacities – China's NIS - "islands of innovation" (Kroll and Schiller, 2010).

The key actors in China's NIS (2)

Public Research Institutes - *The Chinese Academy of Sciences*

- China's most prestigious research institution (**"locomotive" and the "backbone" of the Chinese NIS**)
- 50,000 research staff - best scientific and engineering talents
- 100 research institutes and laboratories
- CAS reformed with the aim of creating 30 internationally recognized research institutes of which 5 were to be world leaders by 2010
- Leader in basic and strategic research in the fields of natural resources and the environment, agriculture, medicine, and public health
- Faced with a challenge of delivering multidisciplinary research as it has problems with connecting disciplines and institutes

The key actors in China's NIS (3)

Universities

- insufficient supply of **qualified faculty**
- Spends little on R&D, less than PRIs
- 39% of university graduates in **science and engineering** (2005) but low quality
- **low quality** of educational system and of management schools
- **passive learning** system
- great **inequalities** both in access to and in quality of education (*hukou* system)
- academic **corruption** – plagiarism, nepotism, bribery, exchange of favors
- **mismatch** between the education offered by universities and the skills demanded in the labor market
- Tertiary enrollment: 22.9% (Brazil 30%, Thailand 48%, India 11%)

Leading universities: Beijing University, Renmin University, Tsinghua University, Fudan University, University of Science and Technology of China, Nanjing University, Shanghai Jiao Tong University

The key actors in China's NIS (4)

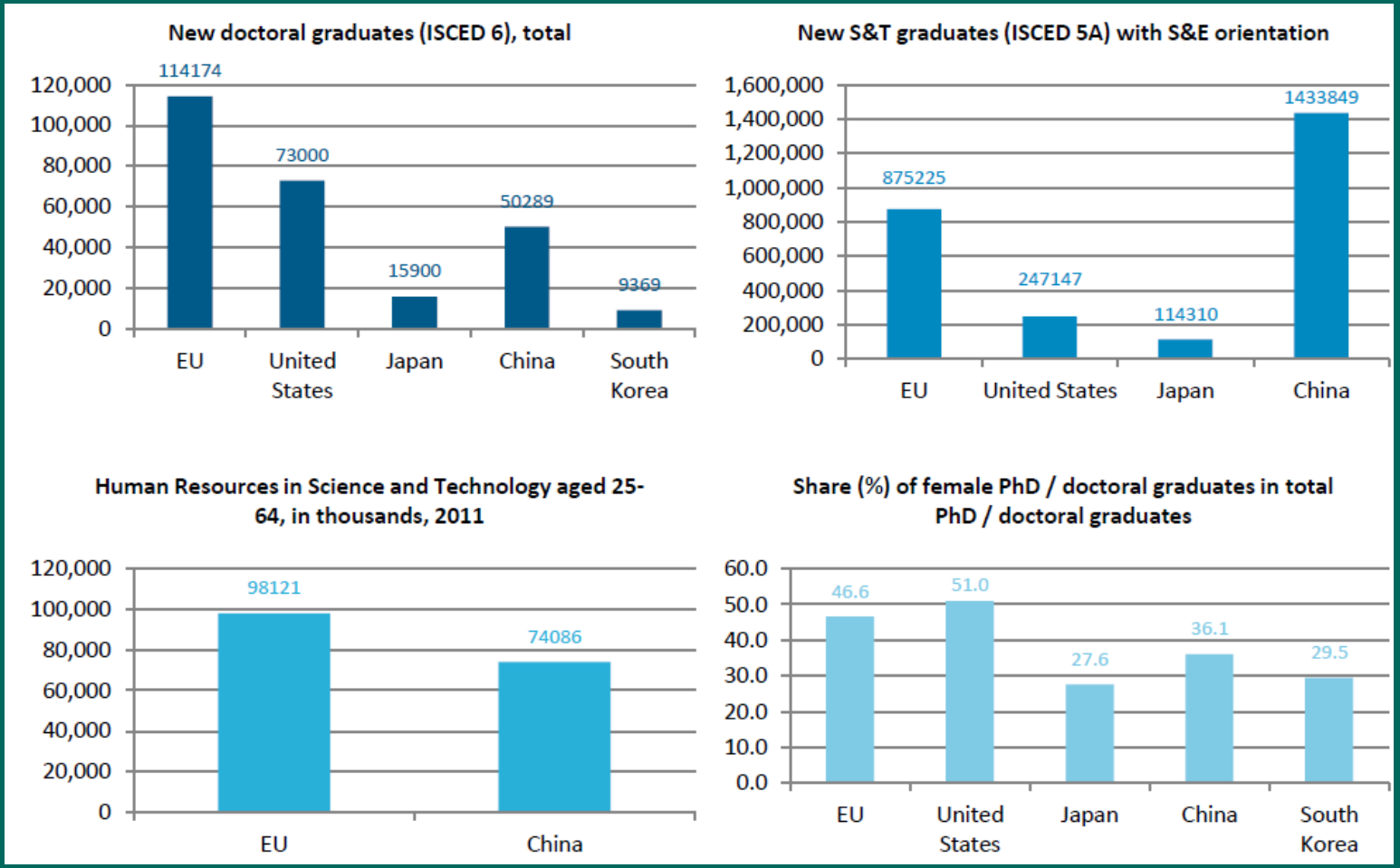
Business sector

- Largest R&D performer in terms of inputs and outputs (share in GERD: from 57.6% in 2000 to 71.7% in 2009; domestic patent applications: 64.6% in 2005, OECD, 2012)
- R&D activities focus on experimental development and applied research

China's innovative products and companies

- Micropayments – Tencent
- E-commerce – Alibaba
- Delivery services
- On-line investment products - Alibaba's Yu'e Bao
- Cheap smartphones – Xiaomi – 60 million smartphones sold in 2014
- High-speed rail – 7000 miles of track in 2013
- Hydroelectricity – 330 dams in 74 different countries since 2000
- DNA sequencing - Beijing Genomics Institute accounts for about half of the world's global genetic sequencing capacity

Performance (1)



Source: SPI, UNU-MERIT, Austrian Institute of Technology (2014). STI Performance of China

Performance (2)

Patents increase steadily since 2000

- 17000 patents in 2011 (40% of US patents)
- China's patents accounted for 10% in global patenting in 2011
- economic output in terms of licence and patent revenues from abroad has remained very limited

Scientific research shows specialisation pattern **different from that of global research** output

- China has a competitive advantage in natural sciences: **Engineering, Computer science, Materials science**.
- Research in social sciences (Psychology, Arts, Humanities) lags
- Increase in collaboration in high impact journals, esp. with scholars from the US.

The National Program 2006–2020 for the Development of Science and Technology in the Medium and Long Term

- From “made in China” to “innovated in China”
- China is to become an innovative nation by 2020 and a world power in science and technology by 2050
- By 2020 China should reduce its degree of dependence on foreign technology to 30% or less
- To raise the ratio of R&D to GDP to 2% by 2010 (*it was 1.77%; 1.98% in 2012*) and to 2.5% or more by 2020

Other NIS related programs

Hundred Talent Program (1994 – now)

- Recruiting 100 outstanding scholars from both home and abroad

Action Plan for Invigorating Education (2003-2007)

- Extend 9 years compulsory education to rural areas and eradicate illiteracy in the backward Western regions
- Developing China's leading universities into world-class teaching and research institutions

National Talent Development Plan (2010-2020)

- the increase of: overall talent number from nearly 114 million in 2008 to 180 million in 2020; number of people in labor force with higher education from 9.2% in 2008 to 20% in 2020

Science and Technology goals in the Thirteenth Five Year Plan (2016-2020)

13th FYP priorities: development, emphasis on reform and **innovation** , transforming development pattern and resolving deep-seated problems

Continuation of targets from 12th FYP:

- Creating advanced service sector
- Promoting competitiveness of manufacturing
- Promoting development of emerging industries
- Promoting green development

Energy-saving and environmental protection – targets of 12th FYP were not achieved (such as raising non-fossil energy as a percentage of primary energy, increasing energy efficiency, and reducing carbon emissions)

- Introducing limits to carbon emissions or coal consumption, the expansion of existing pilot emissions trading schemes or the introduction of carbon taxes.
- renewable energy technologies

Regional innovation systems "islands of innovation"

Beijing: strong science base, with many PRIs such as Chinese Academy of Sciences (CAS), and top universities; national R&D centres with global connections.

Shanghai: has a large-scale, R&D-intensive industry base.

Guangdong province (esp. Shenzhen) has a foreign (manufacturing) firm-based innovation system; more than half of China's PCT patent applications (almost 2/3 in ICT).

China's western regions lack the absorptive capacity.

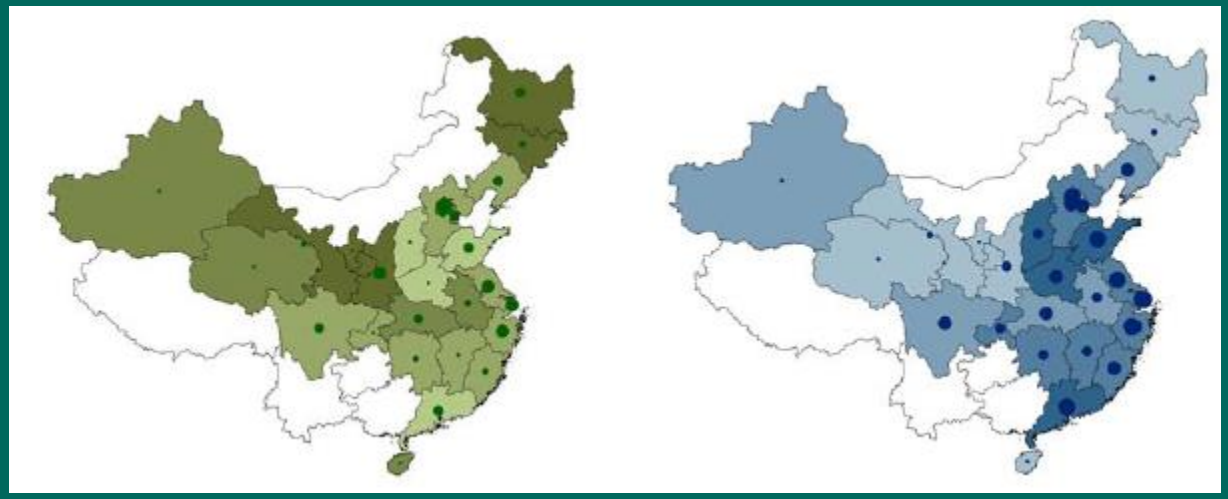
Weak collaboration among regions

China's regional innovation systems

Differ in S&T structure

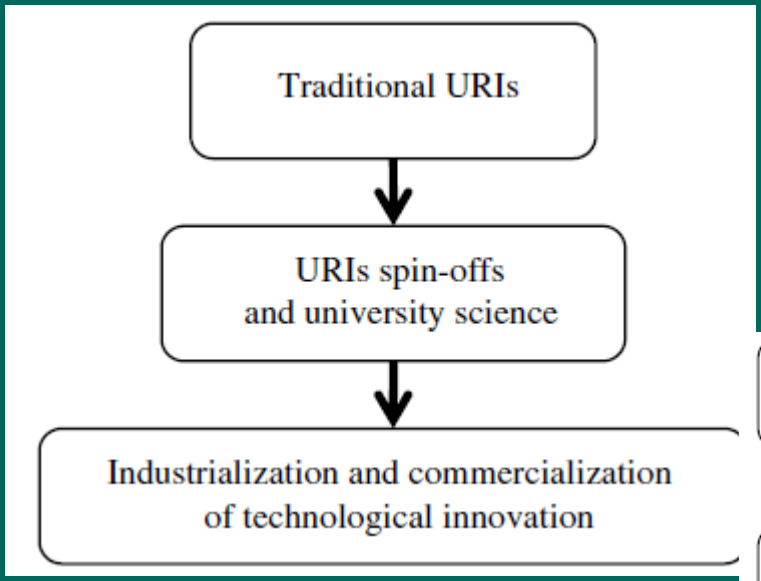
- some are publicly dominated research system and culture (Heilongjiang, Jilin, Bohai region, Shaanxi) – state-owned enterprises, large national RIs.
- Other provinces – dominance of business in R&D expenditures (Guangdong, Shandong)
- Mixed structure – Yangtze River Delta – foreign-funded firms' R&D centers, public RIs, domestic firms

Public and Enterprise Sector R&D Expenditure in China (shading: share)

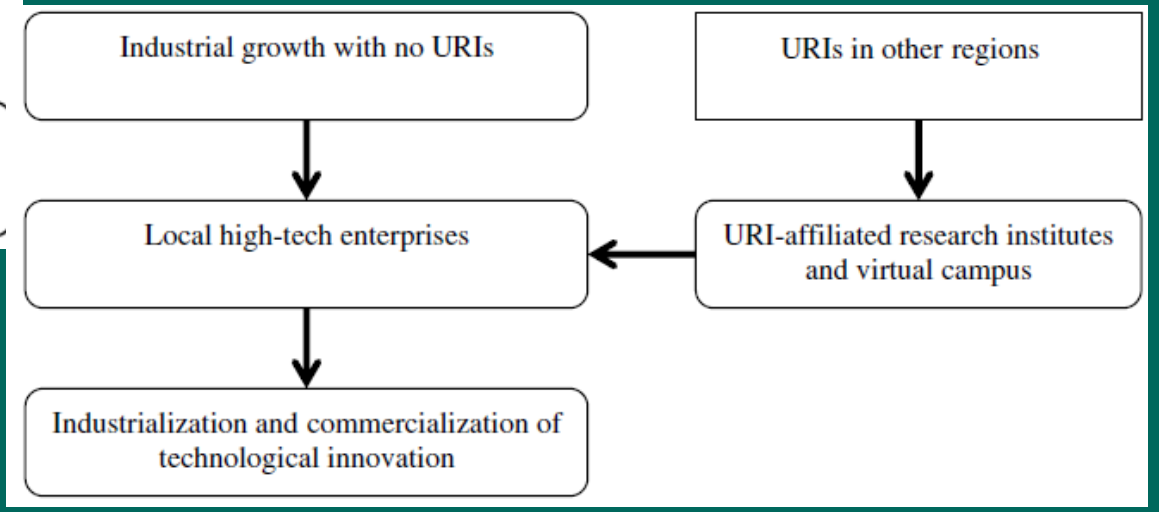


University/PRIs – industry linkages: Beijing vs Shenzhen

Beijing model

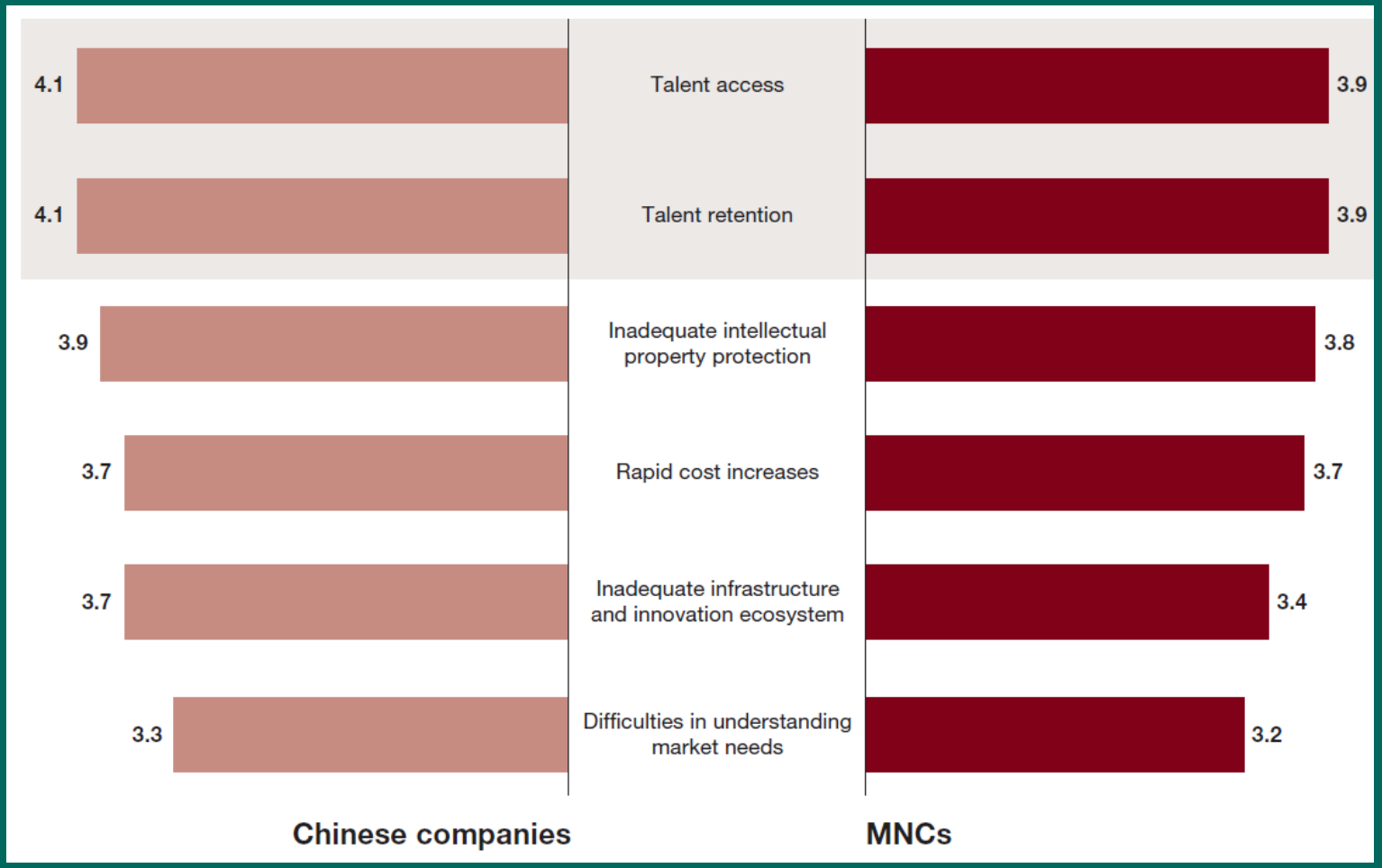


Shenzhen model



Source: Chen and Kenney, 2007.

Key innovation challenge – lack of skilled labor



Source: Strategy& 2014 China Innovation Survey

Thank you!

Q&A