

# **Innovation and Cluster Development in China**

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**December 2008**

# Presentation Structure

- China's innovation capacity in global comparison
- Benchmarking China's innovation system from a knowledge economy perspective
- A brief overview of China's enterprise clusters
- Challenges for SME innovation in China
- Enhancing talents management
- Strengthening industry-university linkages
- Improving innovation services

# China's S&T Strengths

- Rapidly increasing R&D spending: China's R&D expenditure as a share of GDP (%) rose from 0.5 percent in 1995 to 1.43 percent in 2006.
- Critical mass of scientists and engineers in R&D. China boasts one of the world's largest forces of scientists and engineers. Number of researchers in R&D is second only to the US, and the S&T journal articles only after US, Japan, and Germany.
- Strong business participation in R&D. The business sector accounts for over 60% of R&D funding & spending. Public enterprises are still the dominant force.
- Rapid increase of S&T output. Among developing economies, China ranks 2<sup>nd</sup> in terms of international patents applications filed at USPTO; and globally No. 11.
- Well-established state key labs and techno parks. China has built some national key labs in the fields of physics, chemistry, biotech, pharmaceuticals, optics, spaces, etc.

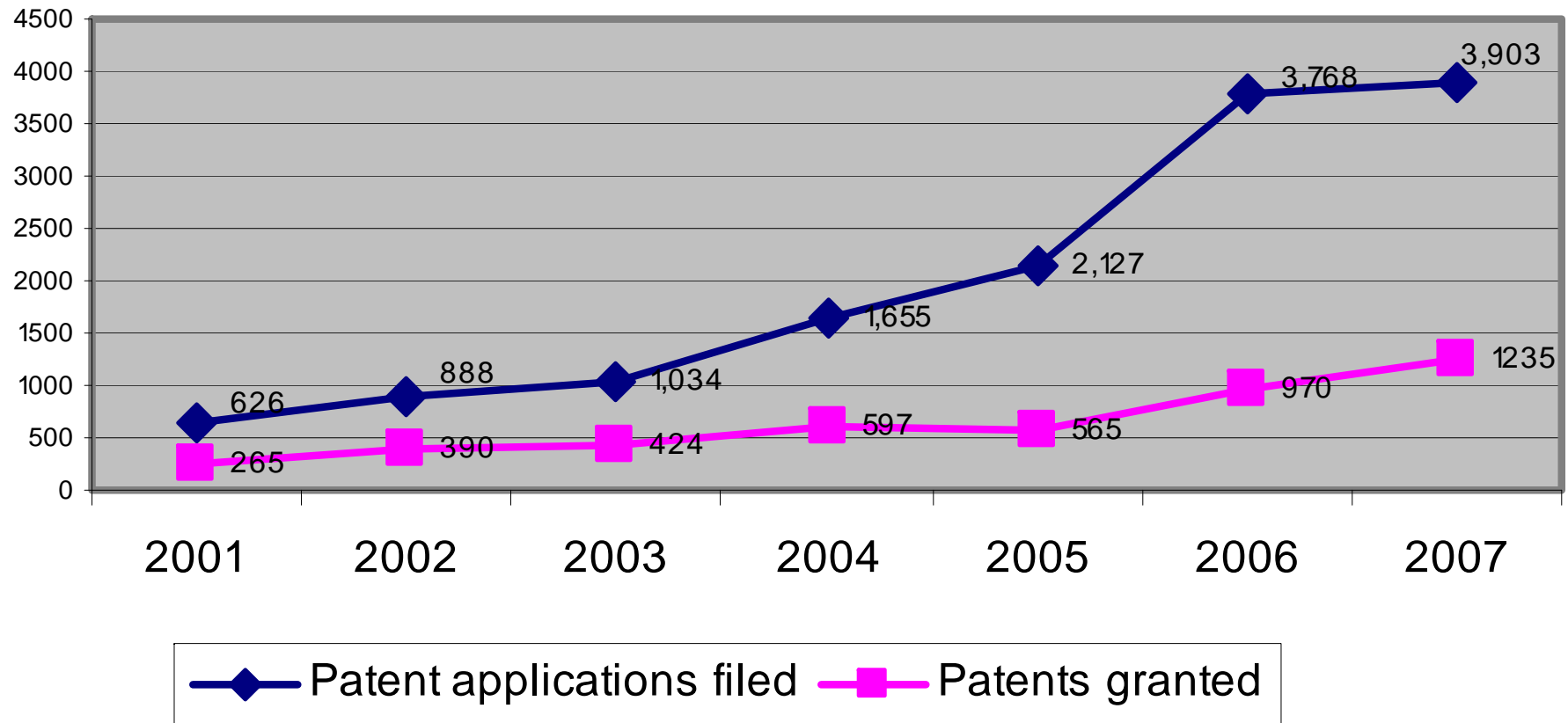
# A Comparison of S&T Strengths

	US	Germany	Japan	China	Russia	India
<b>Science and Engineering Enrolment Ratio (%), 2006</b>	16	29	20	43	50	20
<b>Researchers in R&amp;D, 2006</b>	1,334,628	268,100	677,206	926,252	464,577	117,528
<b>Total Expenditure for R&amp;D as % of GDP, 2006</b>	2.68	2.51	3.18	1.43	1.07	0.61
<b>Scientific and Technical Journal Articles, 2005</b>	205,320	44,145	55,471	41,596	14,412	14,608
<b>Patents Granted by USPTO, avg 2002-2006</b>	94,217	11,387	35,469	448	194	316

Source: WBI KAM Indicators. 2007.

# Patents by Chinese Residents in the USPTO (2001-07)

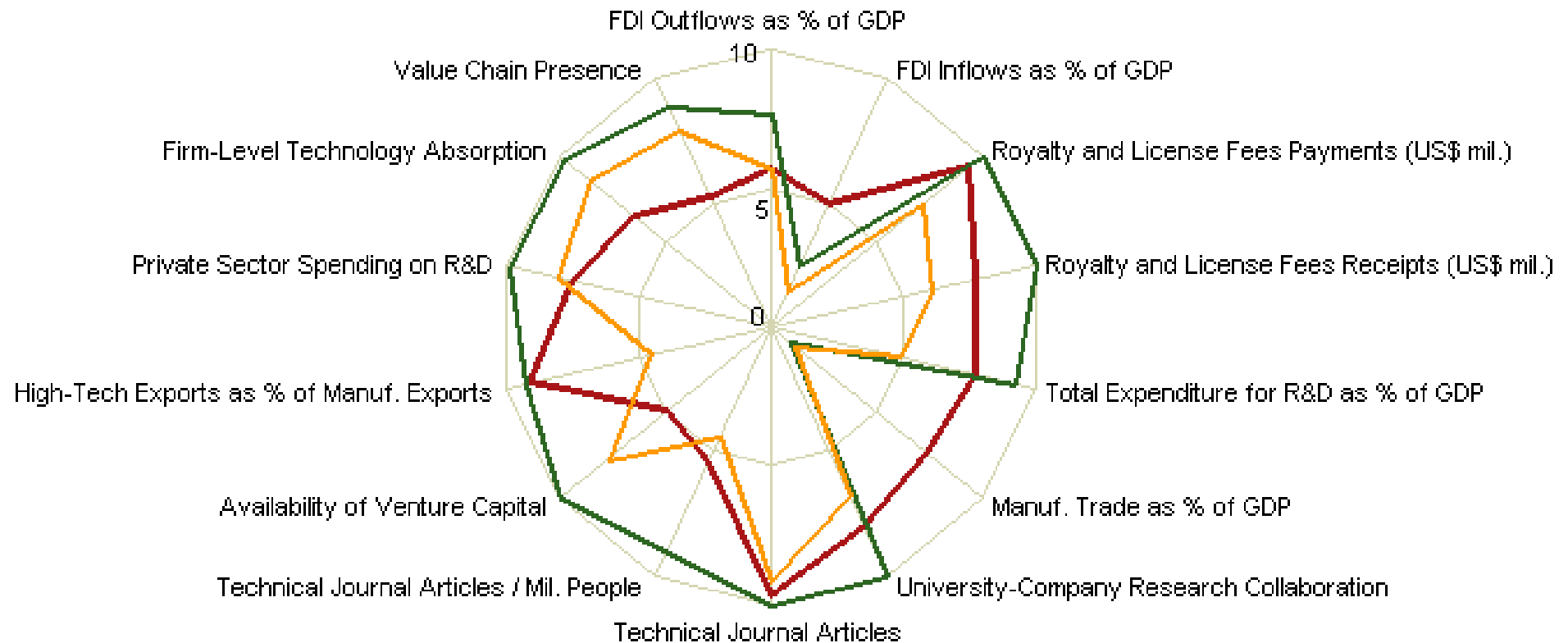
## Patents by Chinese Residents in the USPTO (2001-07)



Source: USPTO.

# Benchmarking China's Innovation System Globally(2007)

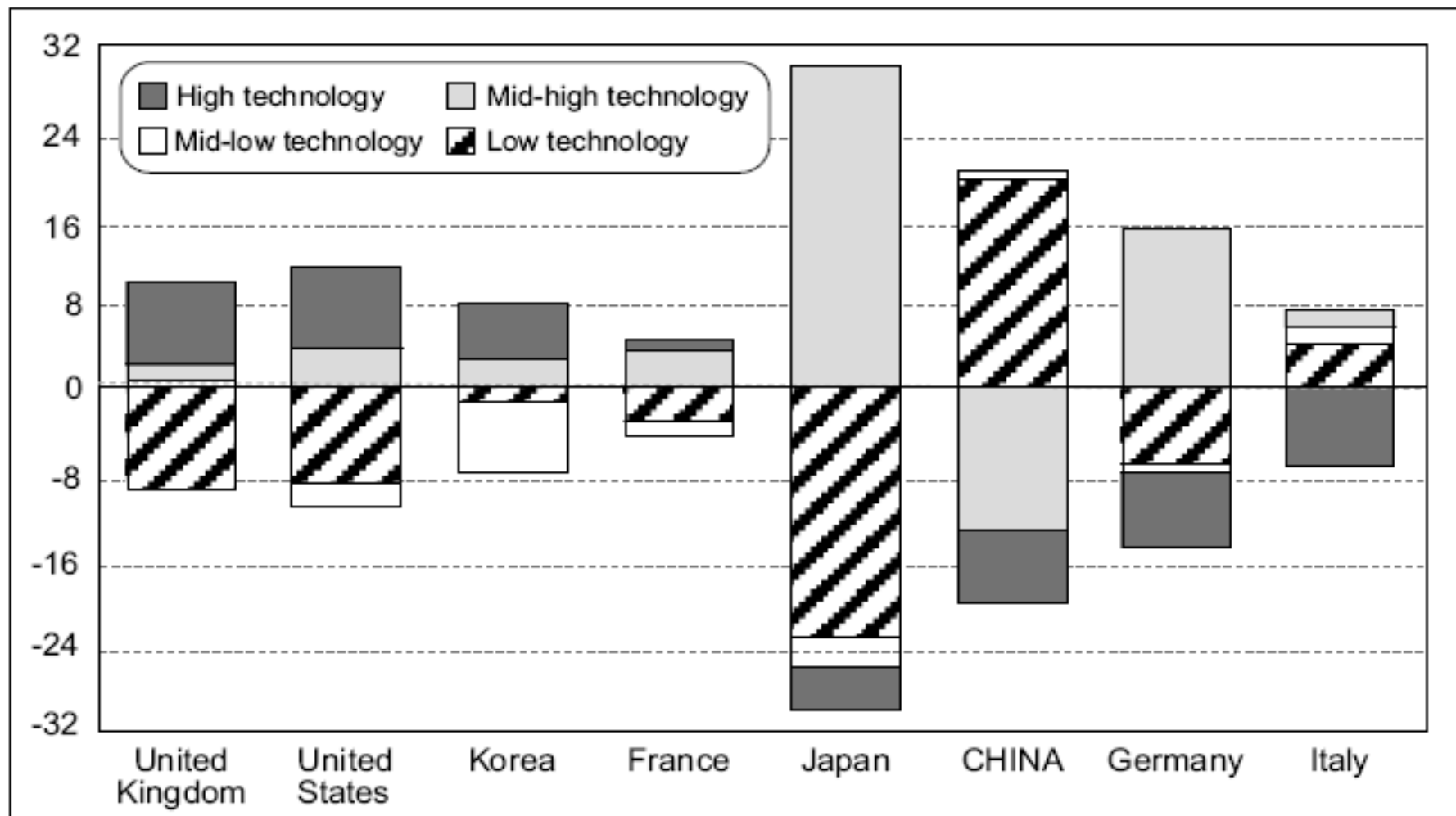
China, United States, India



Source: WBI K4D Program.

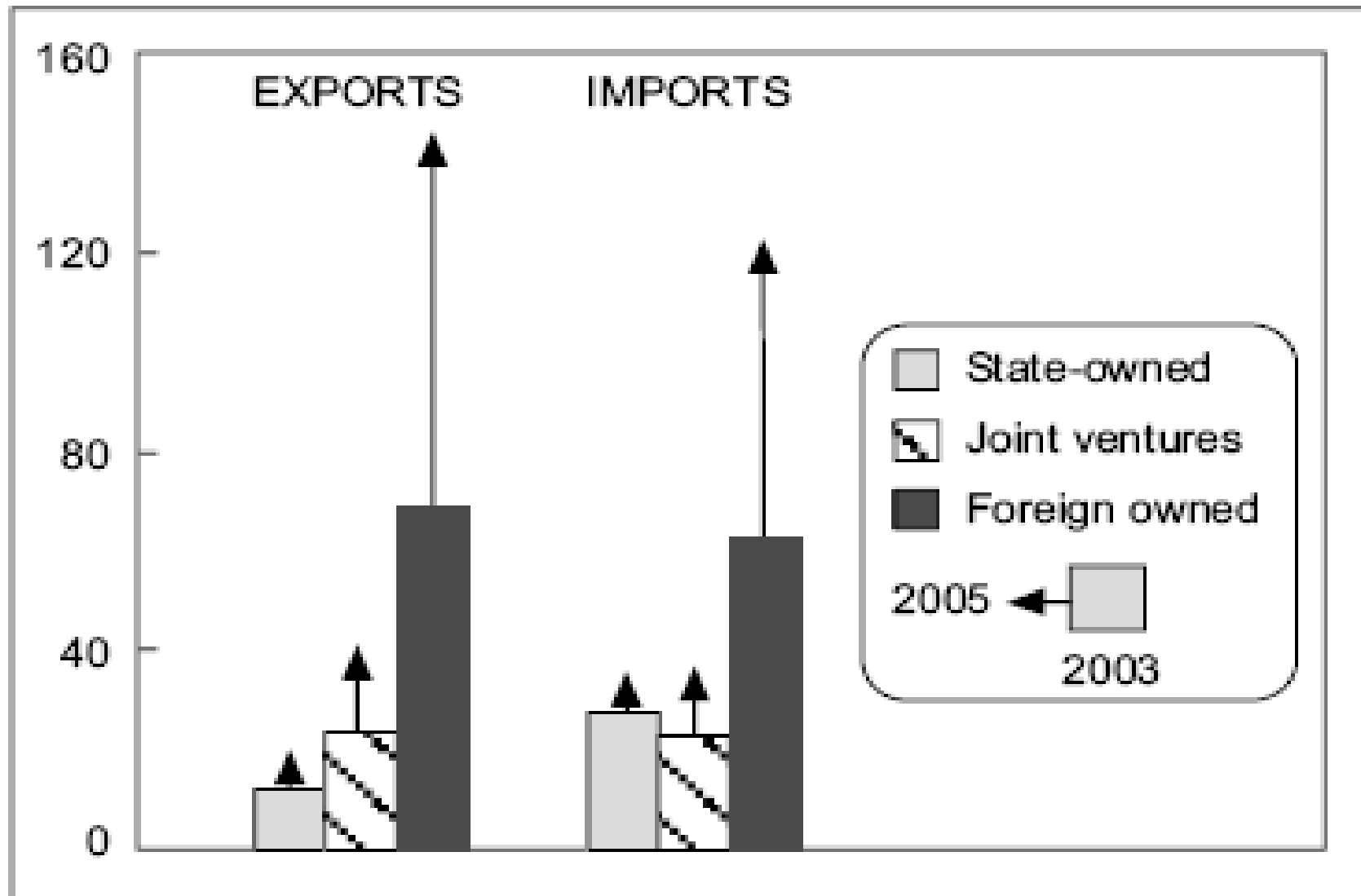
# China's Comparative Advantages Still Lie in Low-tech

Contributions of industries to trade balance  
as % of manufacturing trade by technological intensity, 2005



Source: F. Sachwald (2006) based on data from SYSPROD-IFRI.

## High-Tech Trade by Ownership (billions, US\$)



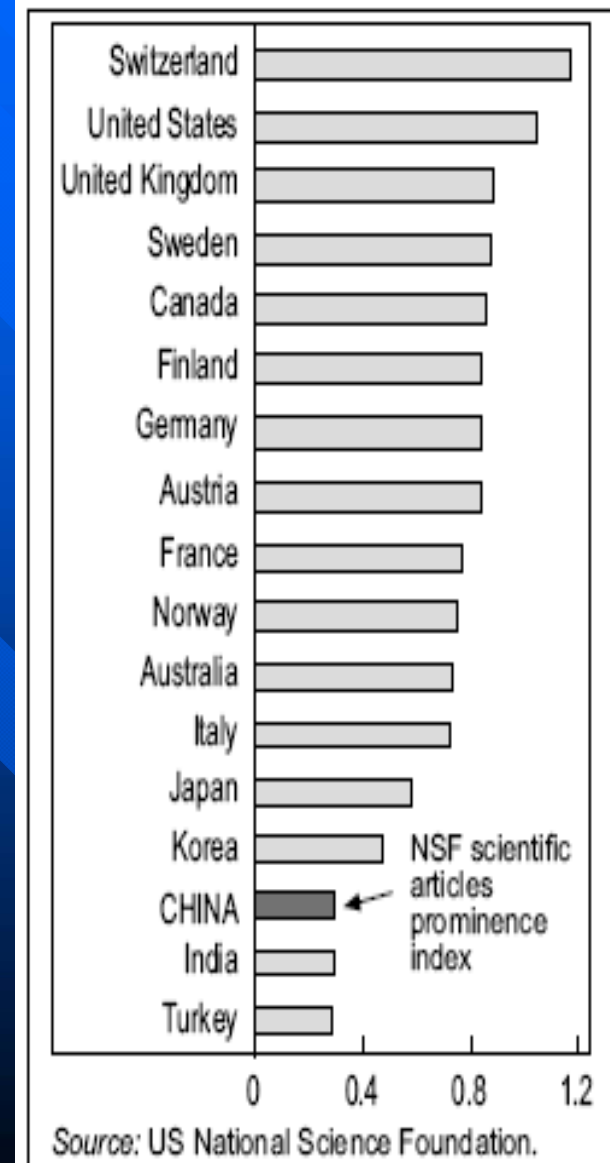
Source: China S&T indicators, Vol. 8.

# The Efficiency and Impact of Chinese Scientific Research are still Relatively Low ...

	% share of world publications		Average citations per paper <sup>1</sup>	S&T journal articles per thousand researchers (2004)
	1995	2004	2003	
CHINA	2.05	6.52	3	~20
France	6.09	5.84	9	~180
Germany	7.62	8.14	9	~180
Japan	8.65	8.84	7	~100
Korea	0.79	2.70	4	~100
UK	8.88	8.33	10	~320
US	33.54	30.48	12	~180

1. Papers catalogued by SCI in 2003.

Source: J. Wilsdon and J. Keeley, *The Atlas of Ideas: Mapping the new geography of science*, adapted from P. Zhou and L. Leydesdorff, *The emergence of China as a leading nation in science*, *Research Policy* 35 (Feb 2006); the World Bank; F. Sachwald (2006), adapted from Seong et al. (2005).

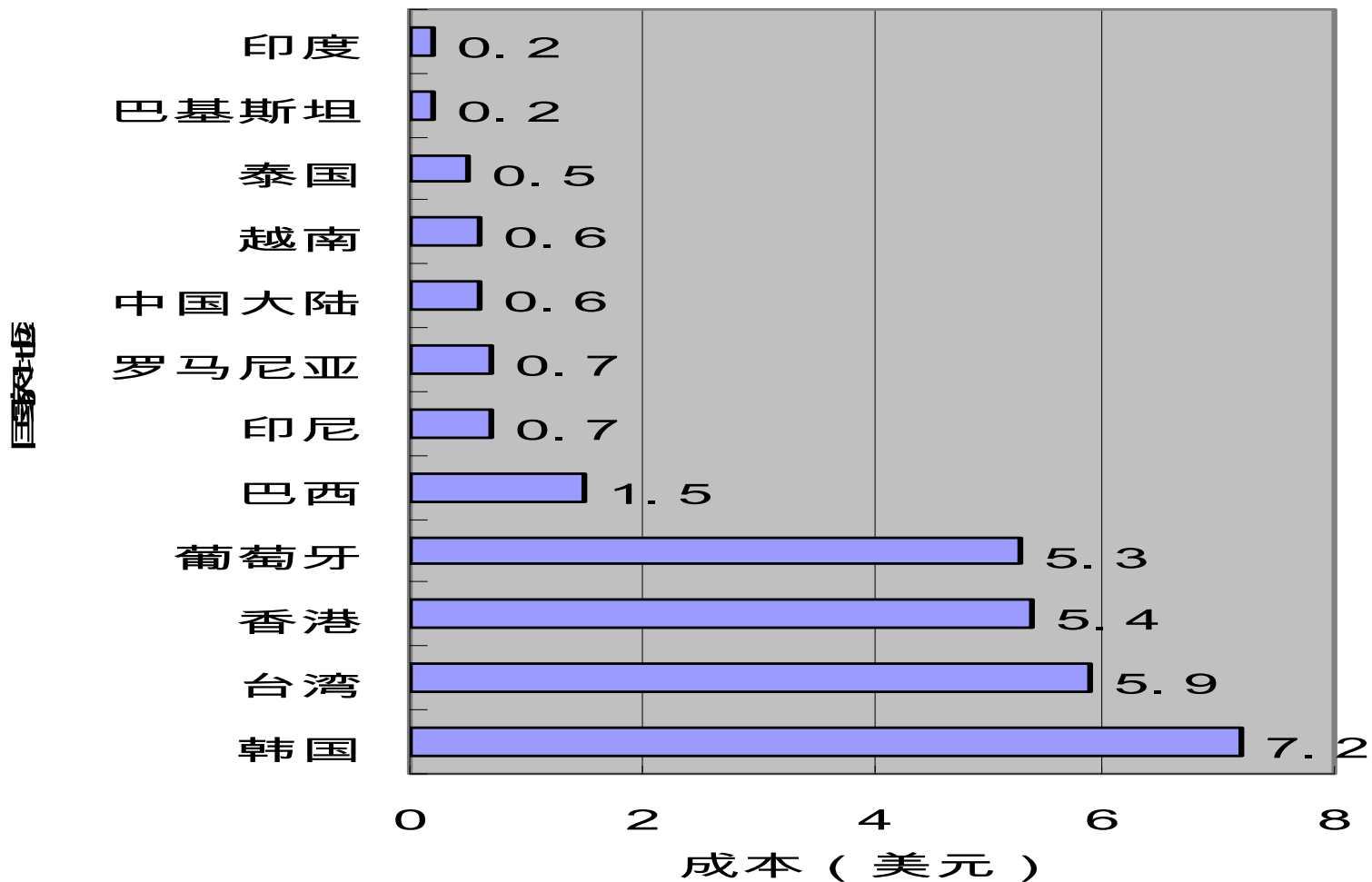


## China's SME Clusters: How do They Fare?

- China's clusters are mostly consisted of SMEs and in general constrained by lack of access to information, finance, human capital, technologies, and various supporting services due to their ownership, size and informality.
- Most of them operate in low or medium technology sectors and lack R&D capability and re-engineering skills. Many of them also suffer from weak corporate governance and management practice.
- China's underdeveloped financial system has a direct impact on SME business activity, since small firms are more likely to find that financial constraints are binding in the absence of bank loans.

# Cost for Making a Pair of Leather Shoes

世界各国生产一双皮鞋的单位成本



# Major Clusters in China

## Zhejiang:

- Wenzhou: shoes; fire-lighter; and low-voltage electronic appliances
- Zhuji: Datang socks (9 billions pairs), Shengzhou neck-ties (300 millions)
- Haining: leather processing
- Ningbo: men's clothes;
- Zhili: children clothes

## Guangdong:

- Shenzhen (Chenghai): toy
- Chaozhou: wedding & evening gowns (510 millions)
- Dongguan: toy
- Huomeng: women's clothes
- Zhongshan: lamps
- Shongde: home appliances
- Loucong: furniture

Average: 3,427 firms; 160,000 employees; 157 millions yuan annual output.

# Wenzhou Shoe Cluster

- High levels of specialization and interlinkages. Over 200 shoe machine manufacturers; 400 shoe soles manufacturers; over 100 shoe decoration firms; over 200 leather processing firms;
- Strong forward and backward linkages. Many specialized markets for materials supply and product distributions.
- Integration with technological institutes.
- Well-functioning industrial associations – new designs, information dissemination, and study tours.
- Global marketing & distribution network (Diaspora).
- Private lending system based on mutual trust.
- A conducive business environment.



# China: Role of Government in Promoting Cluster Development

- Formulate and implement development strategy;
- Build infrastructure;
- Help build regional brands;
- Assist in developing innovation system;
- Foster a conducive environment: financial services, market institutions, living environment, etc.
- Provide support for cluster development: specialized market, vocational training, up-to-date logistics, professional/industrial associations;

# Major Barriers for Innovation

Barriers	Chongqing	Zhejiang	Total
Too high economic risk	2.53	3.07	2.77
Too high cost	2.69	3.09	2.87
Lack of capital	3.43	3.22	3.34
Stagnant internal mechanism	2.1	3.25	2.74
Lack of technical information	2.47	3.31	2.89
Lack of market information	2.6	3.33	2.97
Lack of qualified talents	2.9	3.63	3.24
Lack of intellectual property protection	2.81	3.3	3.05
Constraining regulations and standards	2.65	3.04	2.84
Lack of venture capital	2.99	3.08	3.03
Insufficient feedbacks of customers to new products	2.59	3.23	2.91
Lack of technical promotion services	2.48	3.47	2.94

Source: World Bank SME Survey of 367 Chinese firms, 2007.

# Key Issues for Human Capital Management

- *Managing in-house R&D talents.* The World Bank 2007 survey shows that SMEs have great difficulties in many fronts of human capital, especially managing and retaining R&D talents
- *Building innovation management capacity.* The “lack of experiences for managing innovation” is an important concern for SMEs. A sector-based analysis shows that human capital constraints seem especially serious for “home appliances”, “agriculture”, “textile & garments”, & “daily grocery & other light industries”.
- *Adapting to the labor market conditions.*

# Challenges for Managing Human Capital

Items	Chongqing	Zhejiang	Total
a. Lack of experiences for managing innovation	2.62	3.24	2.92
b. We are not sure whether there are talents wanted in the market or not	2.27	3.25	2.78
c. We are sure that there are talents wanted in the market, but we can not find them	2.55	3.37	2.95
d. We can find talents wanted, but can not meet their salary demands	3	3.26	3.12
e. It's difficult to keep R&D talents	3.11	3.3	3.19
f. We can not prevent R&D talents from letting out some technical secrets after their resignation	3.39	3.55	3.46

## Enhancing Talents Management for Innovation

- Establish at least one SME Skills Development Center in each province: 1) providing various management and technical training ; 2) information on skills demand and supply; 3) collecting and disseminating successful cases.
- Provide strong incentive for enterprise training. Currently the tax deductible training expenses cannot exceed 2.5% of the total enterprise wages. For technology enterprises, the tax credits for hiring technology personnel is based on an ad hoc amount – about RMB 1,600/month per person, much lower than the typical real wage level for technology firms.
- Formulating and implementing training standards.

## Key Issues of Academia-Industry Linkage

- The World Bank 2007 survey shows that the major areas that firms cooperate with universities and research institutes are “technical consulting”, “joint research”, and “training”; and over 16% of the surveyed SMEs do not have any kind of cooperation.
- Various disincentives and obstacles, such as a lack of motivation, an inability to identify and specify needs, and a lack of certain competencies, deter most SMEs from taking full advantage of networking or other opportunities.
- The execution of cooperation contracts between firms and universities/research institutes is far from satisfactory – almost 50% of the surveyed firms answered “so-so” or less

# Strengthening University-Industry Linkages

- Increasing SME access to information. E.g., Canada's Strategis and Innovation Portal launched in 1996 by Industry Canada.
- Strengthening the technology "brokering" programs. Norwegian TEFT (Technology Diffusion from Research Institutes to SMEs).
- Increasing SMEs participation in public-private partnerships (PP/Ps). In France, 29%.
- Developing personnel mobility schemes.
- Encouraging universities and R&D institutes to conduct more joint R&D activities with enterprises.

## Share of SMEs in the Financing of 13 French Public/Private Research Networks, 2001 (Millions of EUR, %)

Type of recipient	Life sciences <sup>1</sup>		Energy, transport, environment, natural resources <sup>2</sup>		Information and communication technologies <sup>3</sup>		Space and aeronautics		Total	
	EUR	%	EUR	%	EUR	%	EUR	%	EUR	%
SMEs <sup>4</sup>	11.39	43	4.34	25	7.34	19	1.78	35	24.84	29
Large firms <sup>5</sup>	0.37	1	1.71	10	6.76	18	0.11	2	8.95	10
Public research labs	11.15	42	6.60	38	12.55	33	1.38	27	31.67	36
Higher education	1.43	5	2.62	15	7.08	19	0.75	15	11.88	14
Engineering schools	0.93	3	0.83	5	2.88	8	0.60	12	5.25	6
Others	1.39	5	1.32	8	1.09	3	0.46	9	4.27	5
Total	26.65	100	17.43	100	37.69	100	5.09	100	86.86	100

1. RNTS, GenHomme, Génoplante, RARE.

2. PREDIT, File à combustible, Matériaux, Génie civil, Eau et environnement, Pollution accidentelle.

3. RNRT, RNTL, RMNT.

4. Enterprises with fewer than 500 employees.

5. Enterprises with more than 500 employees.

## Unsatisfactory Innovation Services

	Chongqing	Zhejiang	Total
Technical consulting and training	3.01	3.52	3.25
Information	2.87	3.45	3.14
Testing & processing center	3.14	3.61	3.36
Technology and intellectual property assessment and technology transfer	2.56	3.30	2.91
Legal and patents services	3.33	3.65	3.47
Head-hunting	1.80	3.30	2.50
Finance and investment consulting	2.49	3.39	2.91
Credit Guarantee Institutions	2.30	3.34	2.78
Industry association	3.06	3.64	3.33
Productivity centers	2.86	3.35	3.06
Incubators	2.32	3.38	2.75

## Improving Innovation Services

- Strengthening government support for innovation services, especially the technology diffusion agencies.
- Establishing a SME Innovation Service Fund: 1) providing grants to intermediary agencies; 2) recommending common key technologies for important industries or sectors; and 3) Providing information service through technology portal. Can be membership fee based.
- Improving the Measurements, Standards, Testing and Quality (MSTQ) services.
- Strengthening the technology market (equal to 40% of efforts dedicated to R&D).
- Strengthening the industry associations.

Thank You!

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