Innovation in China

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INRIA

Innovation
is a top priority in China

- Economic growth
- Defense
- Sustainable development
- Pride and prestige

much like in many countries…

Innovation
is a top priority in China

- Economic growth
  - From the factory of the world to its lab
- Defense
  - US and EU Embargo
- Sustainable development
  - #1 for CO2 emission
  - New emerging diseases (SARS, Flu, etc.)
- Pride and prestige
  - no Nobel prize in China yet

well, not quite like other countries…

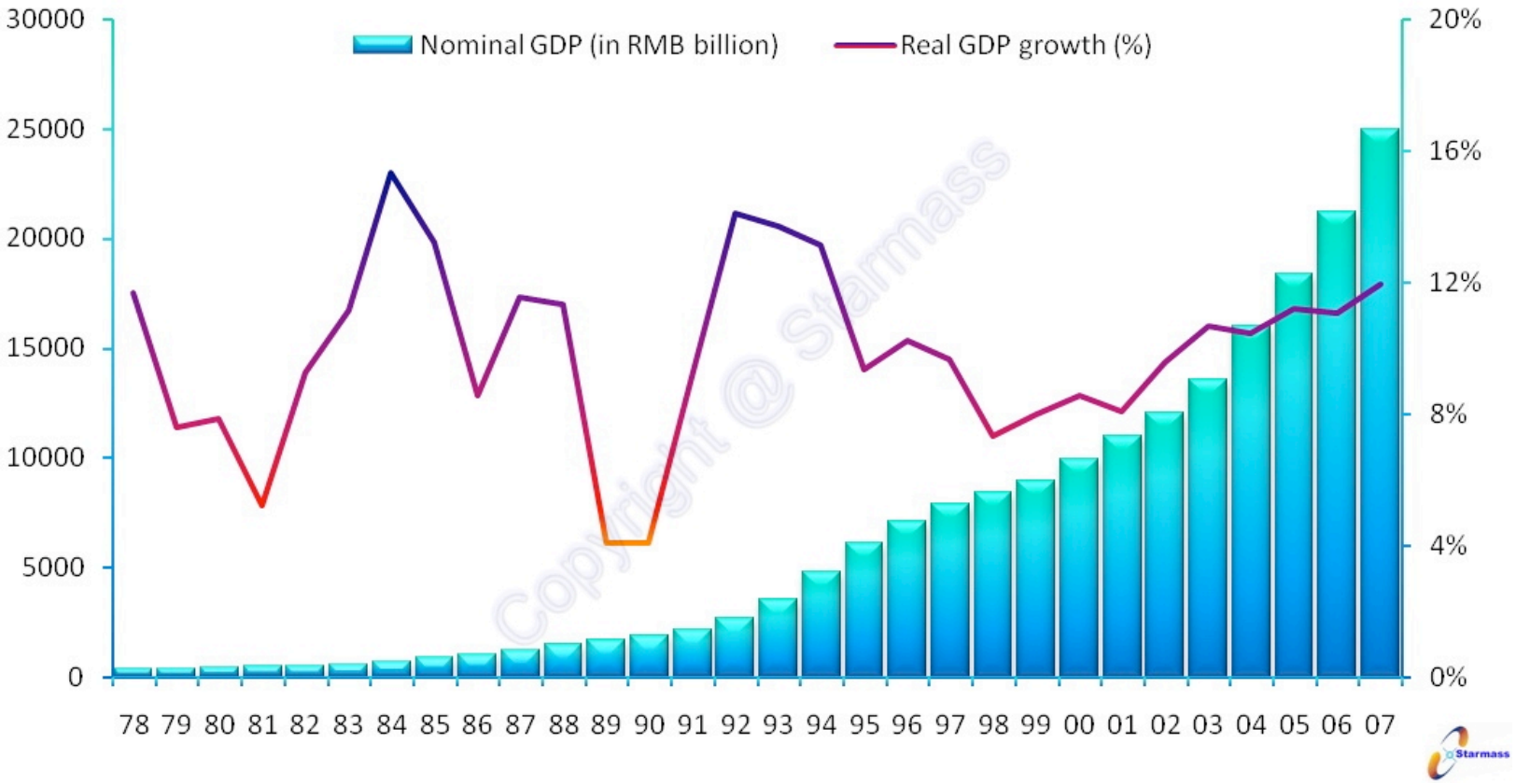
China is not quite like other countries

- Population: 1.3 Billion
  - More than any other continent
  - ca 200 cities of more than 1 million inhabitants
- GDP :
  - 8 trillions US$ (PPP) (US: 15 US$, EU: 18US$)
  - #1 FDI
  - ca 10% growth since 1990
  - 8.5 in 2009 (World Bank est.)
- Foreign exchange reserve:
  - 2 Trillions US$ (Japan 1 TUS$)

China is #1

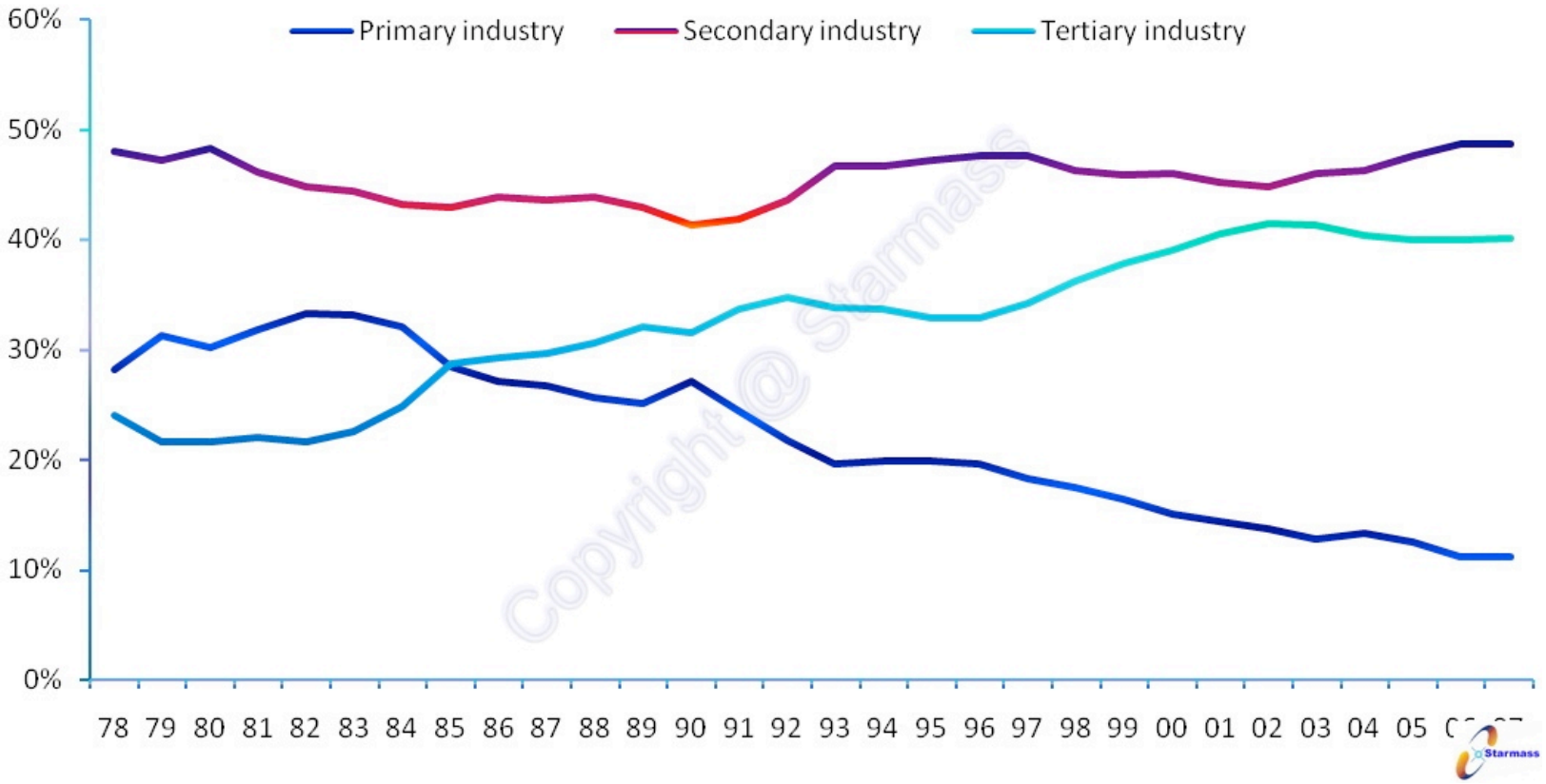
- Raw materials: steel, coal, cement, etc.
- Manufacturing: toys, computers, cameras, CD/ DVD players, etc.
- Agriculture: 15% fruits, 18% cereals, 28% meat
- 600 millions mobile phones
- 350 millions online
- 21% CO2 emission (USA 20%)
- #2 Energy consumption

30 years of sustained growth



Source: www.starmass.com

Drastic changes in the society



Source: www.starmass.com

A world player

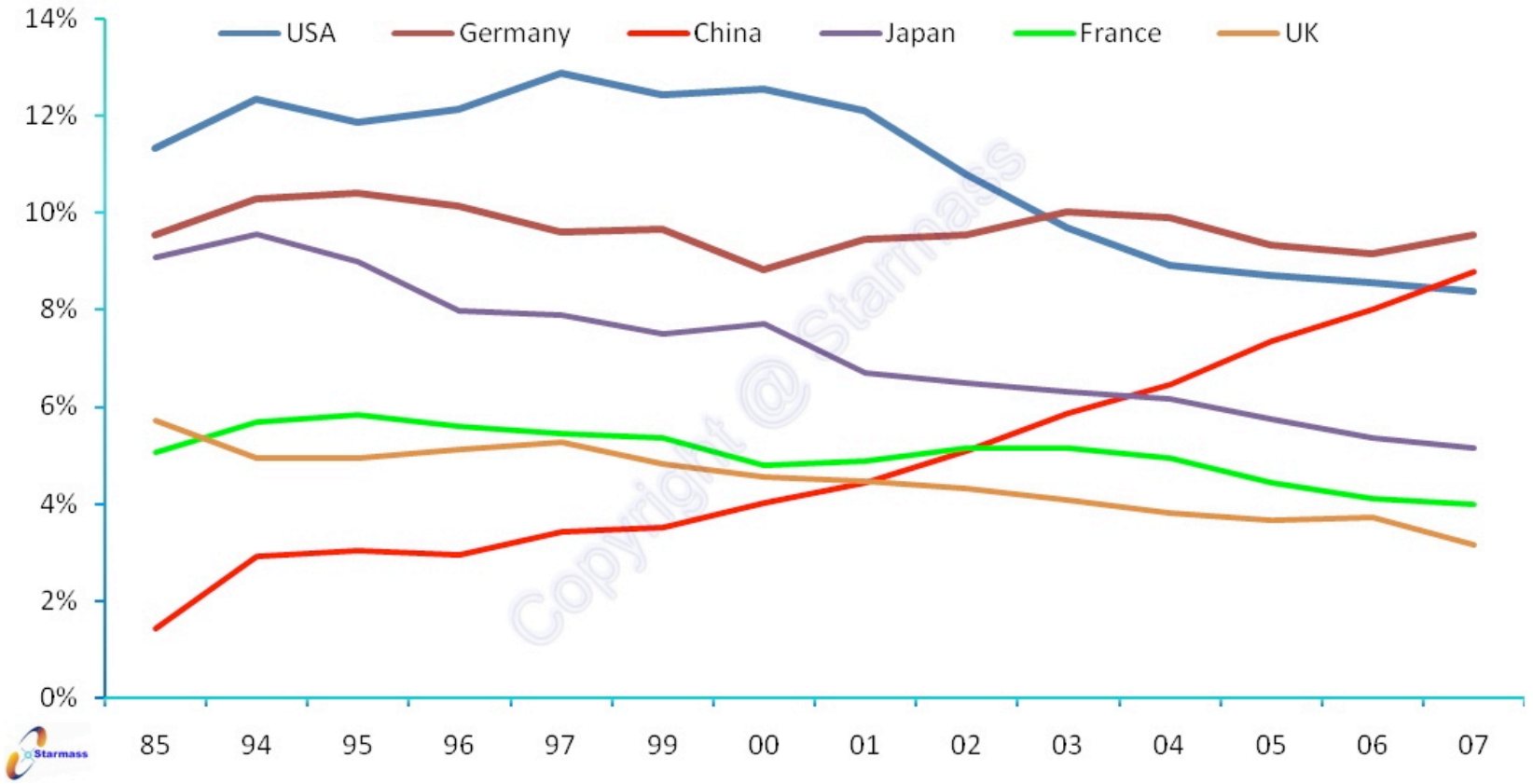
2001 WTO

2008 Olympic games

2010 Universal exhibition in Shanghai

#1 Global trade

Export and import's shares



Source: www.starmass.com

A culture of increasing impact

In China:

classical culture rehabilitated

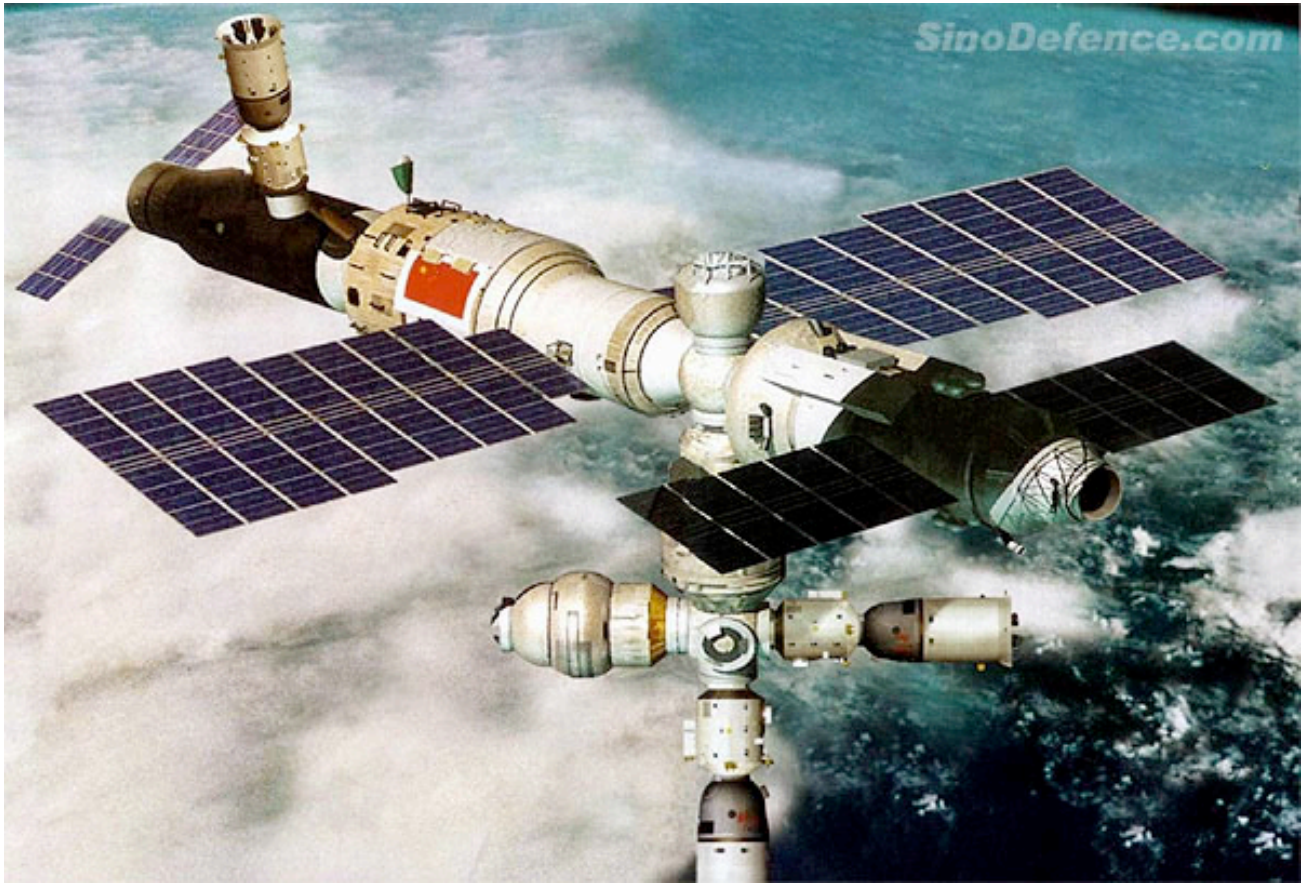
Abroad:

Chinese novels, movies, artworks

New international media

Chinese New Year celebrated all around the world

An emerging scientific power



I The Chinese innovation system

Historical perspective

Organization and reform

II Impact and potential

Investment, HR, publications, patents, …

I

The Chinese innovation system

From Chinese sciences …

Four Great Inventions of ancient China:

Compass, gunpowder, paper making, printing

Water regulation: hydraulic systems

Mathematics: algorithms vs deductive

Observation of astronomical phenomena

Metallurgy : iron (6th c. BC) et steel (3rd c. BC)

Navigation : vertical axial rudder,

Wheelbarrow, harness, …

Propulsion,

China, silk, …

remains of the supernova observed by Chinese astronauts in 1054

… to modern science

During the 18th century, China is the first industrial power

Scientific exchanges with Europe (Jesuits in the Manchu court)

High technological level

- Length of the "li" relative to the earth meridian (1702)
- Smallpox vaccine (since the 16th century)

Modern science penetrates China: 2nd half of the 19th century

Brutal confrontation with the Western countries (Opium war, concessions)

Translations of numerous foreign scientific books

Students sent abroad (USA, Europe)

Foundation of the first universities (Tianjin, Tsinghua, Beijing)

Emerging fields: naval construction, mathematics, physics, chemistry, geology

The People's Republic

1949 Establishment of the PRC

Reorganization of the academic institutions

with the assistance of the USSR

Creation of the Academy of Sciences (Nov, 1 1949)

Reorganization of universities

Development of a military industry (space, nuclear)

1956 1st Conference on science

Creation of the Commission for scientific planning (future MOST)

Launch of the first 12 year plan (1956-1967)

1966 Cultural Revolution

Universities are closed

Interruption of research in most fields

S&T achievements of the 1960s

1960 : 200kg rocket launched at 10.000 meters

1964 : Atomic bomb

1965 : Synthesis of insulin

1967 : H bomb

1970 : Red Orient Satellite

launched by the Long March Rocket

30 years of reforms

1976 Death of MAO

1978 DENG Xiaoping

Four modernizations : agriculture, industry, S&T, defense

A slogan : « *science and technology: first production force* »

2nd Conference on science

S&T development plan 1978-1985
Universities are reopened
Reconstruction of research centers
Hundred of thousands of students are sent abroad

The fundamental tools of the 80's

Fundamental research

- National Science Foundation (1986)
  inspired by the American NSF

Applied research

- State key labs (1984)
  150~200 labeled labs (5 year evaluation)
- 863 program for high tech (1986)
  More than 5000 projects

Development

- Key technology for industry (1982)
- Spark (1986) for the modernization of agriculture
- Torch (1988) for technological parks (53 parks)

1995, a turning point

Reform of Premier ZHU Rongji

Separation production / administration

Launch of the **National Innovation System**

in universities, institutes and companies

1995 3rd Conference on science

Slogan « *rejuvenate the nation with science and education* »

Massive increase of R&D spending (Objective: 1,5% PIB en 2000)

New HR policy (contracts, bonuses, life standard, reverse brain drain)

1997-99 Launch of new programs

973 for fundamental research

978 for research universities (38 universities)

211 for postgraduate universities (100 universities)

Innofund (1999) for venture capital

The Chinese Academy of Sciences

The main research organization of China

- Based on the Russian model
- ca 100 institutes
  (one third in Beijing)
- A university (Hefei)
- The Academy
- 25% of scientific output

A 12 year reform

Phase I (1998-2000)
- 1/3 of the institutes closed (119 to 84)
- Focus on a restricted set of fields

Phase II (2001-2005)
- Complete reform of the management
- Thematic clustering to foster synergies

Phase III (2006-2010)
- New organization in the institutes
- New institutes (mostly in life sciences)

Tech parks and policy

A large area of the city with special status (fiscal, jurisdiction)

- 40 universities, 500.000 students,
- 150 research centers,
  incl. dozens of Foreign R&D Centers
  Motorola, IBM, Intel, Microsoft, Google, ...
- Tens of thousands of high tech companies, incl. sea turtles

Strong tax incentives

- Free income tax for several years
- Tax free importation of R&D equipments for research institutions

Public procurement

- 60% at least on domestic firms

Zhongguancun in Beijing
the « *Chinese silicon valley* »

Medium and Long term plan for S&T

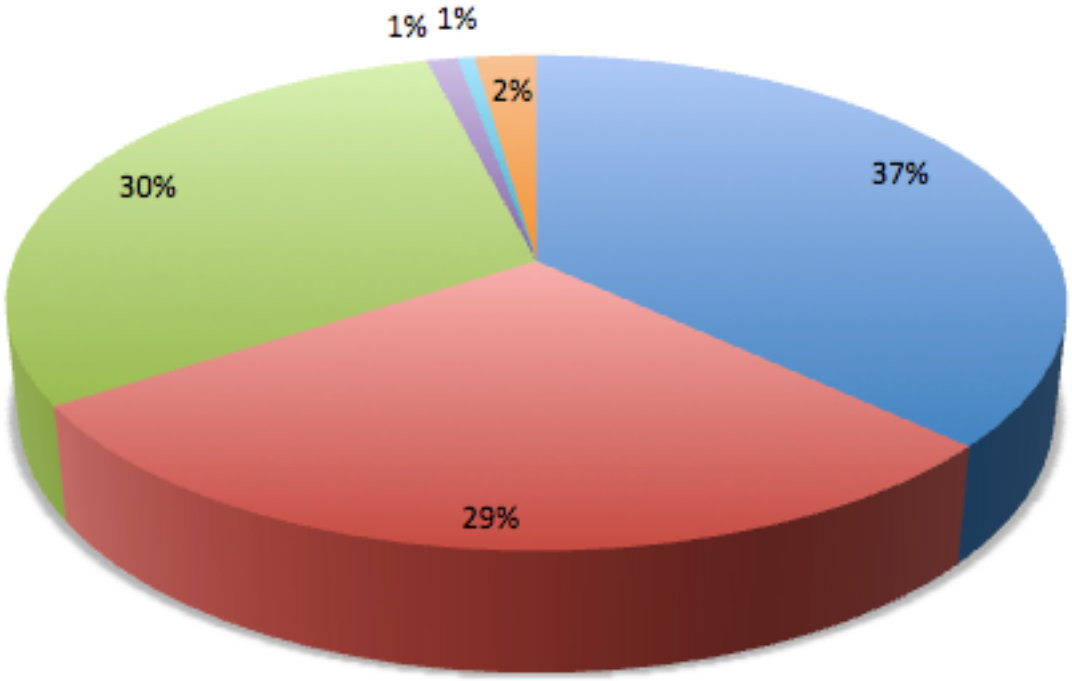
(2006-2020)

- A long preparation with an international high level panel
- Objectives
  - Increase intensity to 2% in 2010 and to 2.5% in 2020
  - S&T contribution to 60% of growth
  - Dependence on foreign technology reduced to 30%
  - China #5 for patents and citations of publications worldwide
- First period: 11th Five year Plan (2006-2010)
  - 16 megaprojects

II

Impact and potential

Global R&D expenditure 2008



1 Trillion US$

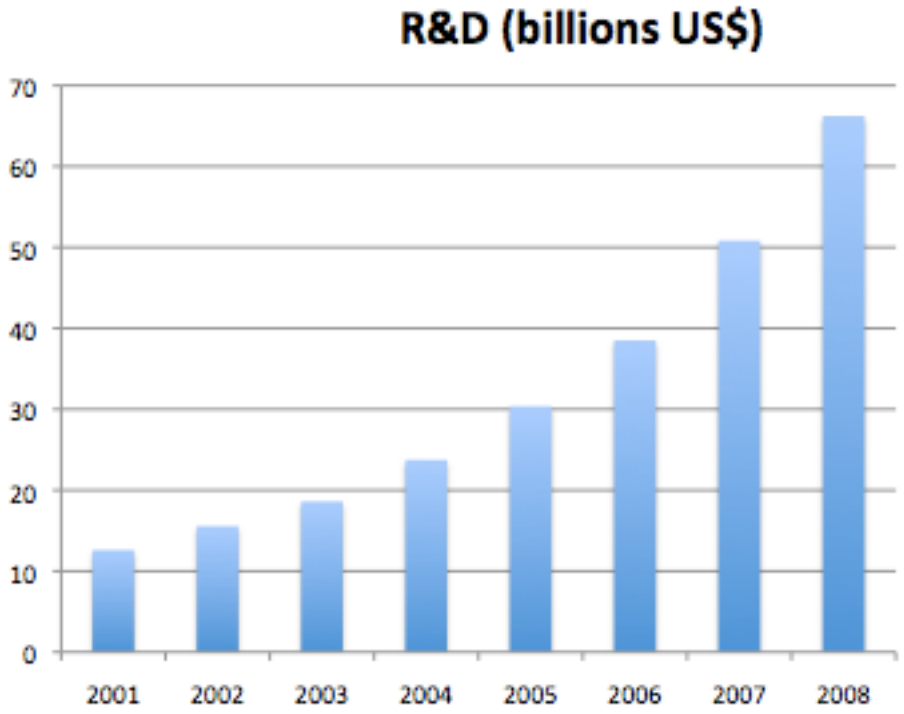
- North America
- Europe
- Asia
- Oceania
- Africa
- South America/Caribbean

Source: OECD

Strong increase in China

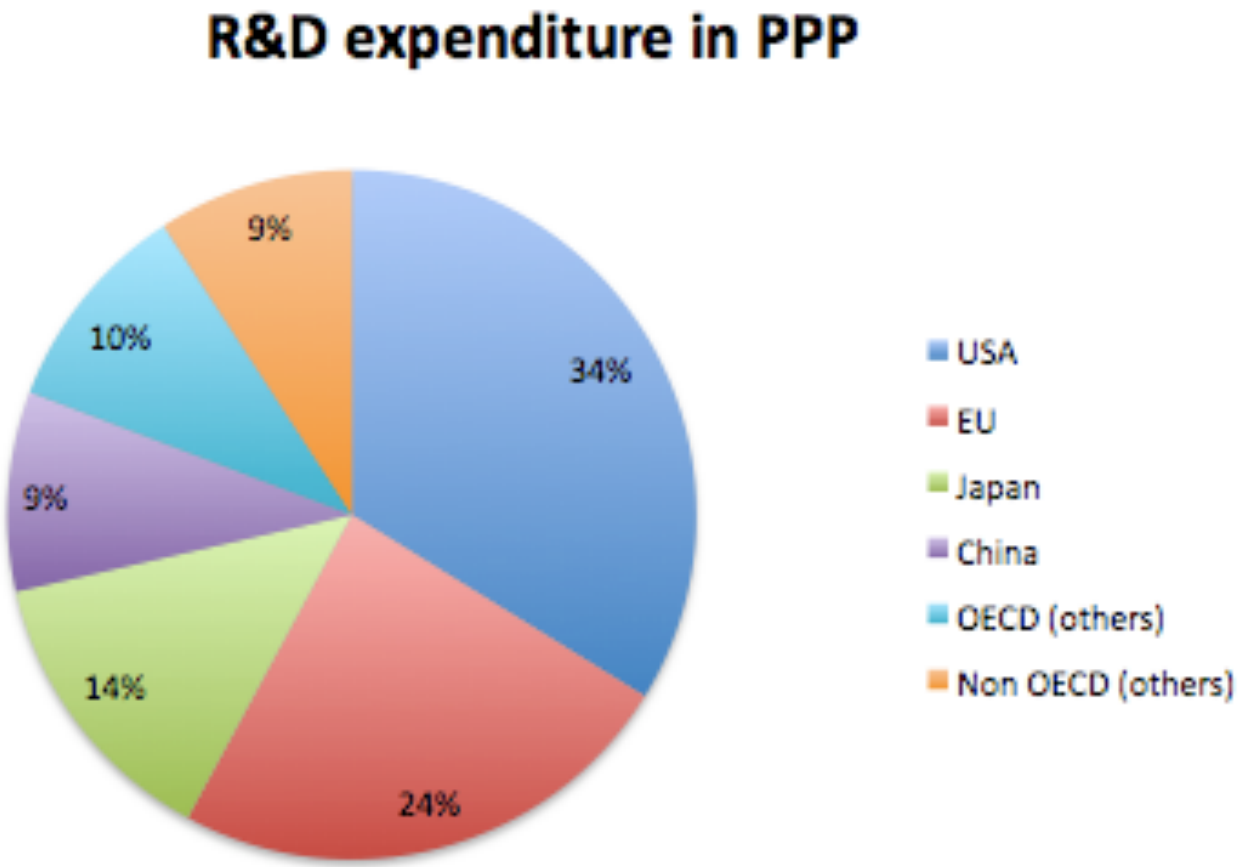
R&D expenditure

- Yearly growth
  - 20%
- Intensity
  - 0.6% in 1995
  - 1.35% in 2004
  - 1.5% in 2008



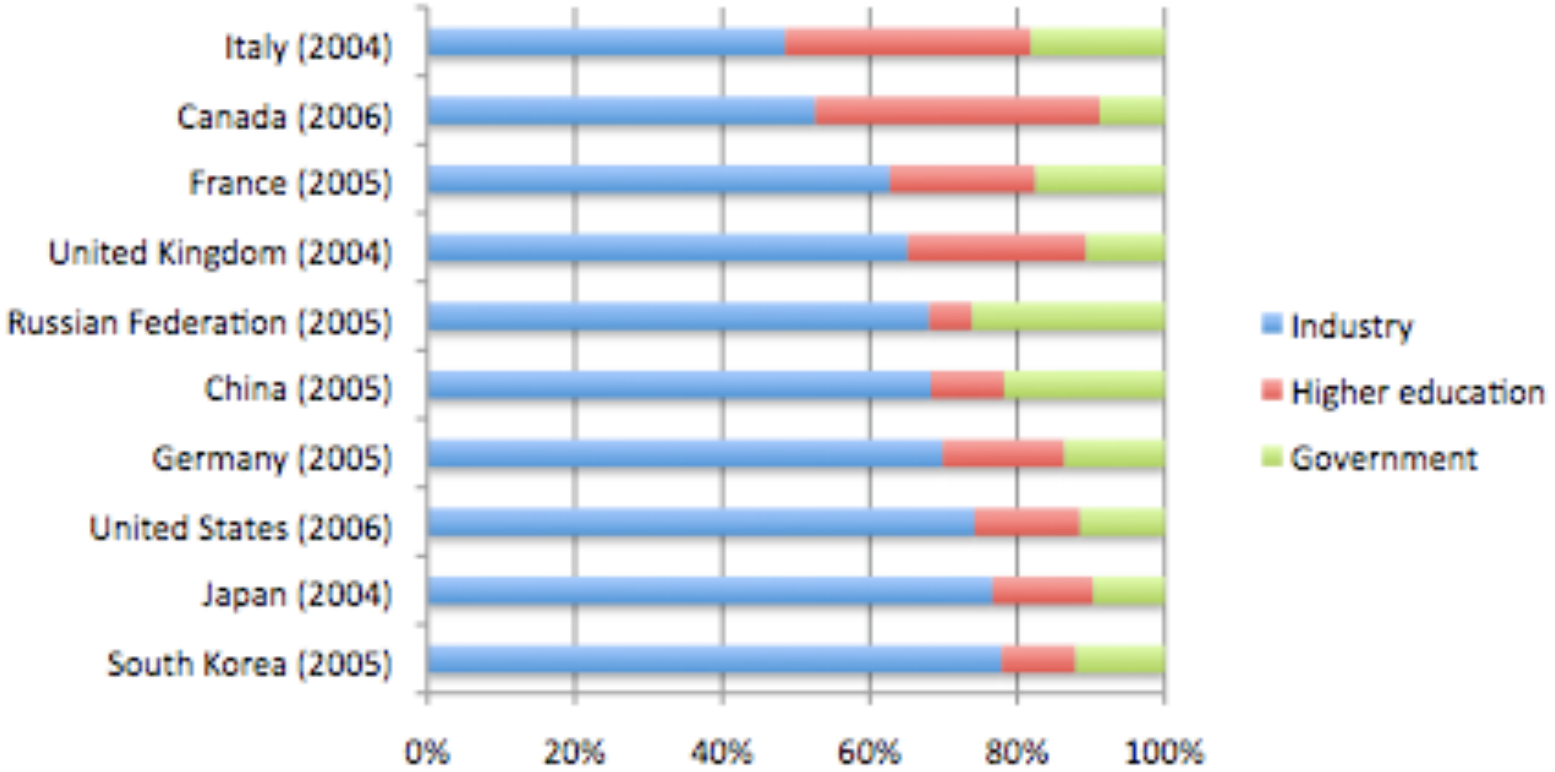
Source: MOST

China's position in 2008



Source: OECD-MSTI'09

R&D expenditures by performing sector



Industry represented only 45% in 1998

Source www.nsf.gov/statistics

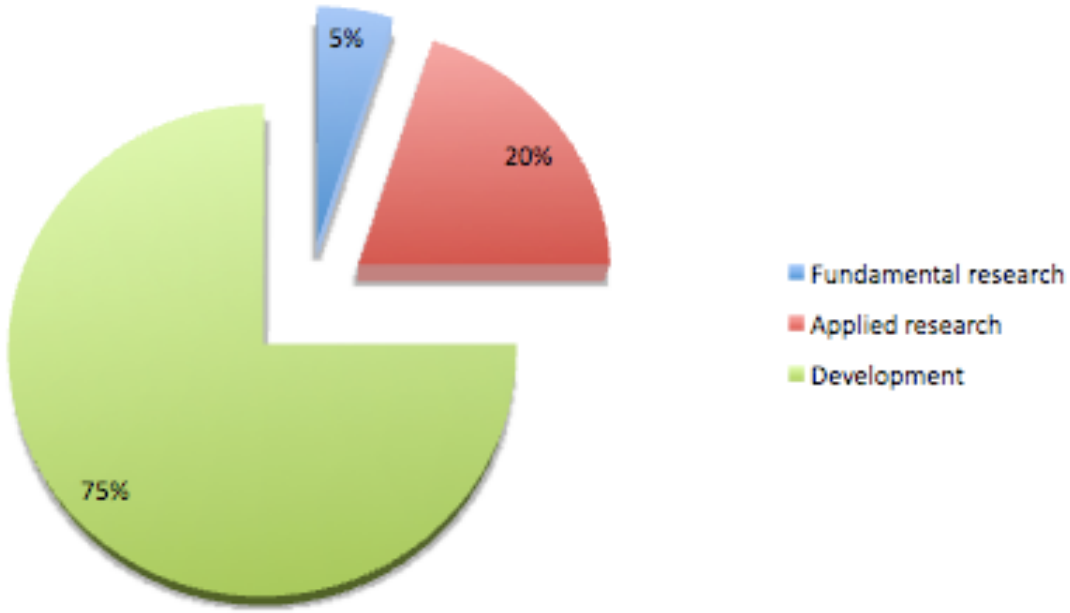
Expenditure by domain

Weak fundamental research: 5%

OECD average: 20%

Still a logic of developing country

Technological catch up



Source: MOST

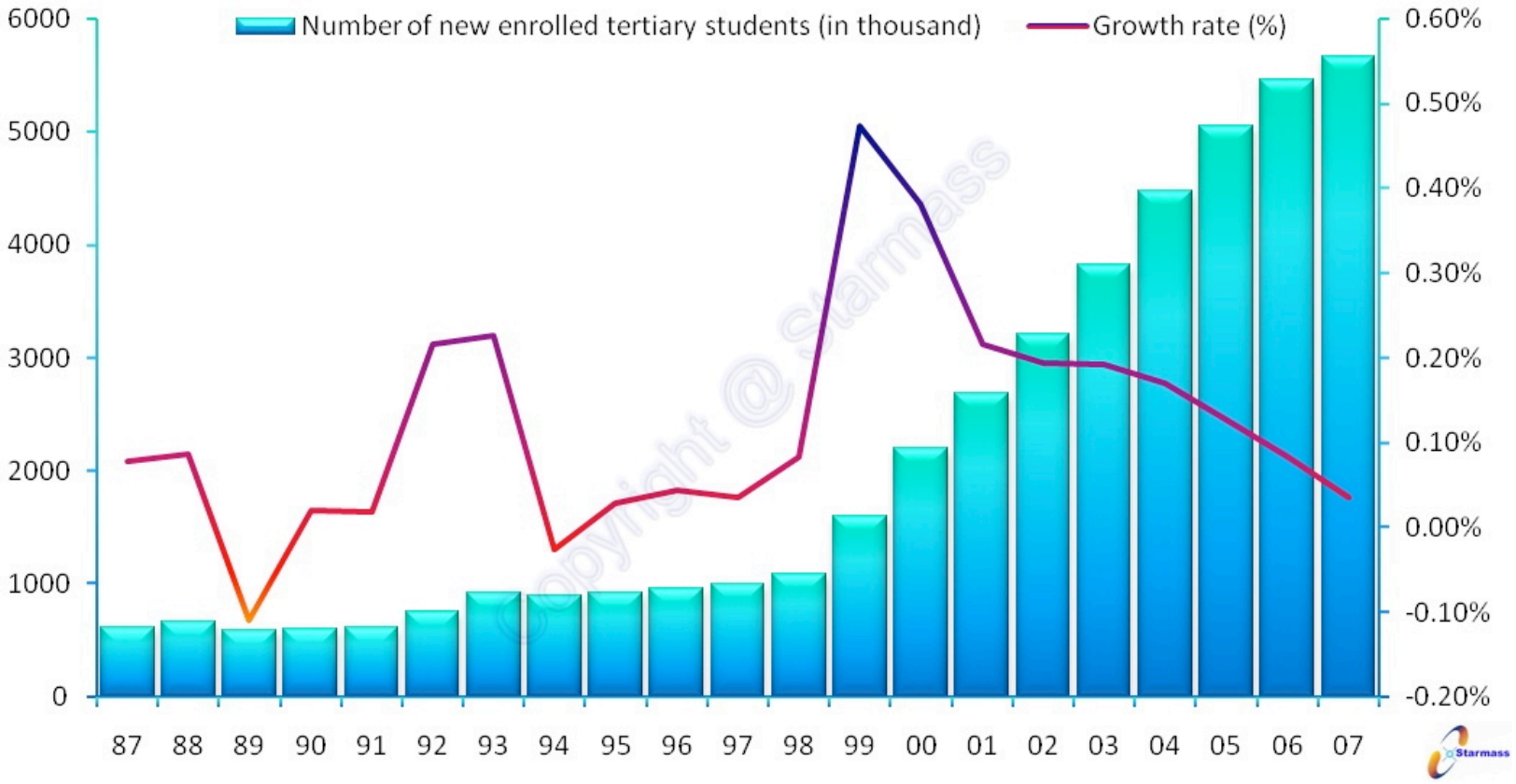
Human resources

- The first potential of the country
  - 20 millions students
  - 5% tertiary education (USA 37%)
  - New promotion 15% of an age group

- But an unbalanced pyramid

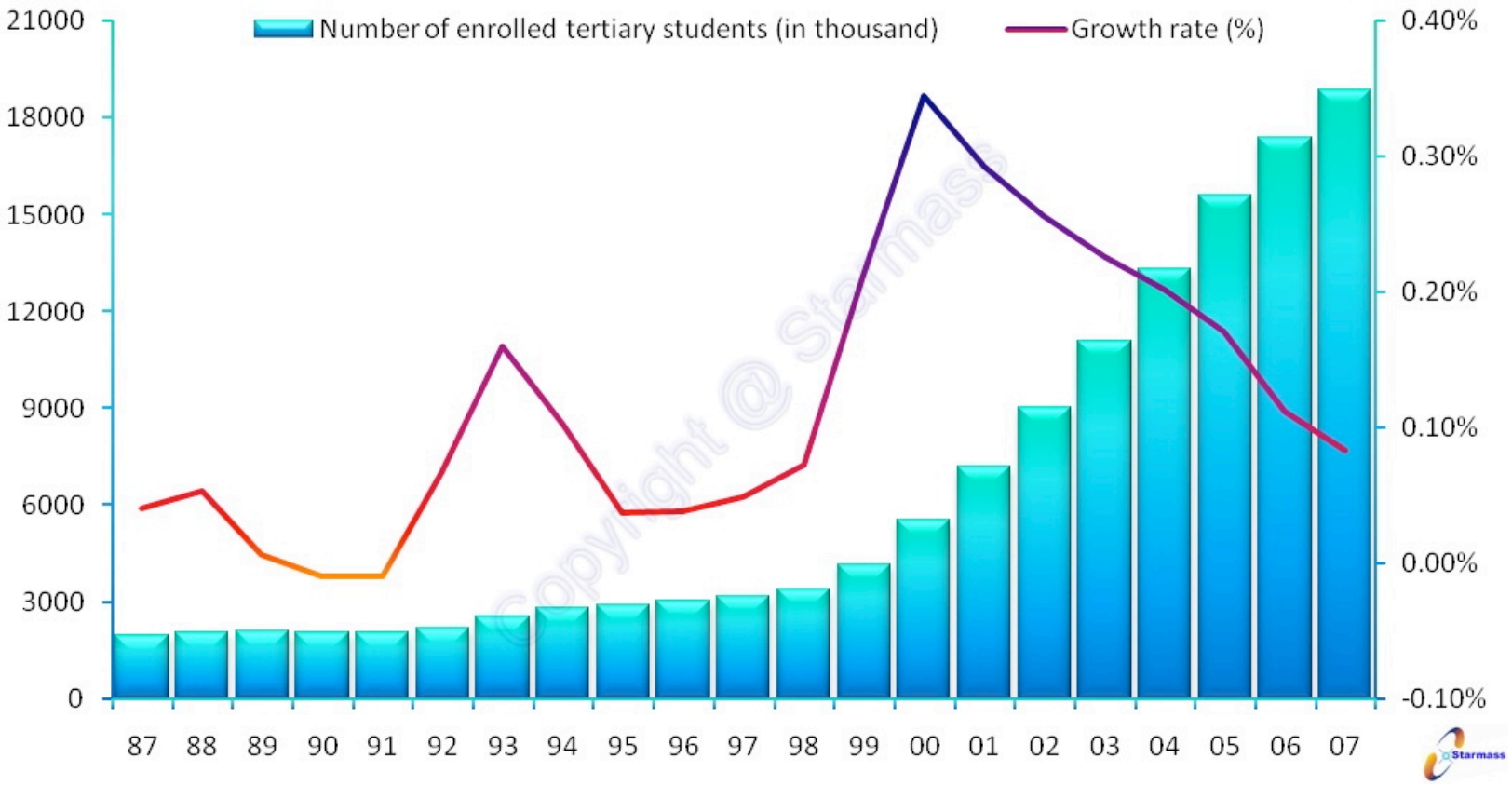
  aftershock of the Cultural Revolution
  - Few scientists above 50
  - Extremely large student pool

Strong increase of the enrolment



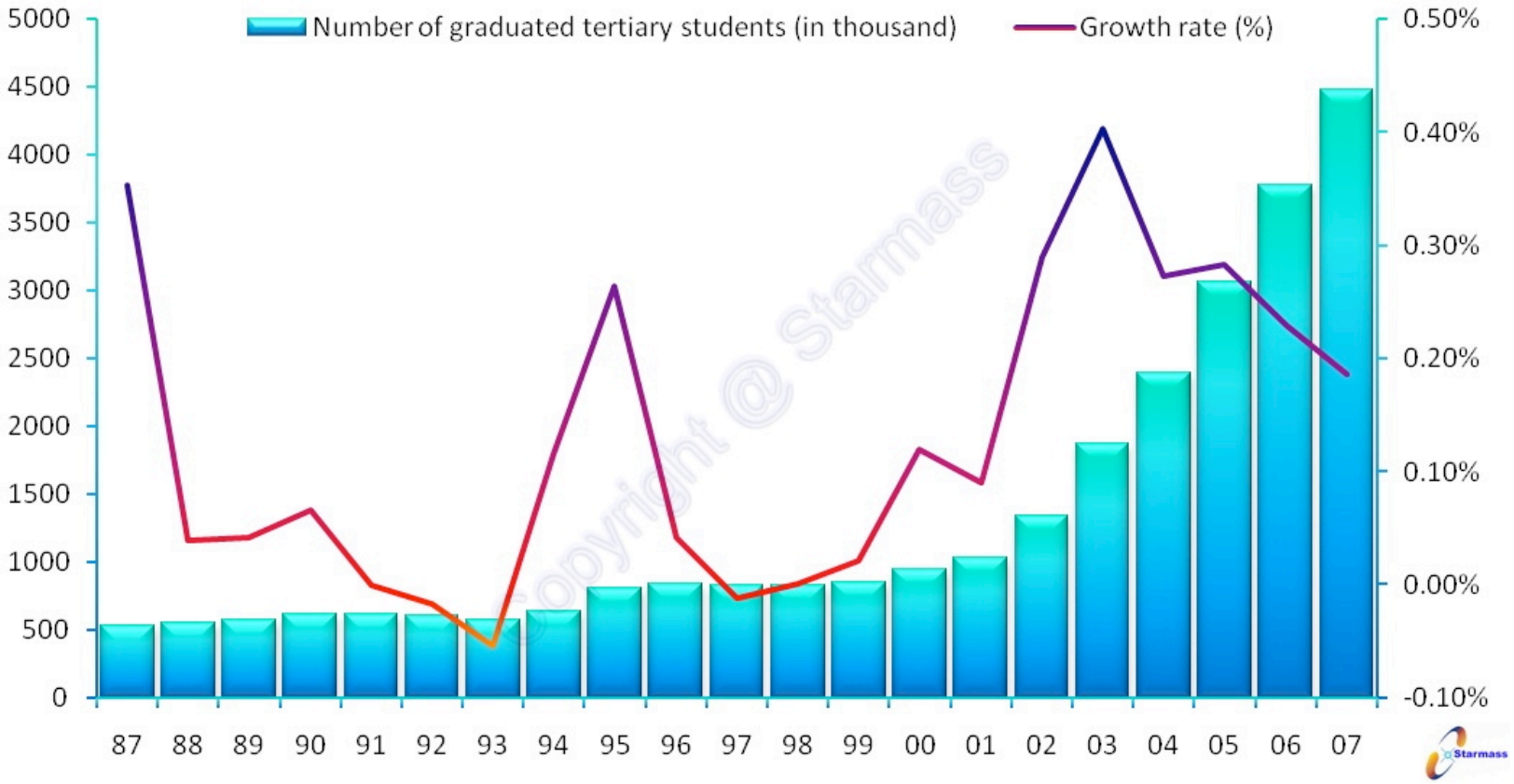
Source: www.starmass.com

Increasing student population



Source: www.starmass.com

Largest pool of graduated



Source: www.starmass.com

Strong international presence

Chinese students abroad

- 800.000 students sent abroad 1978-2005
- 124.000 chinese students in OECD in 2001

Proportion of Chinese students among foreign students

- in the USA: 11%
- in Japan : 43%
- in the EU : 3%

Major impact of expatriate Chinese researchers

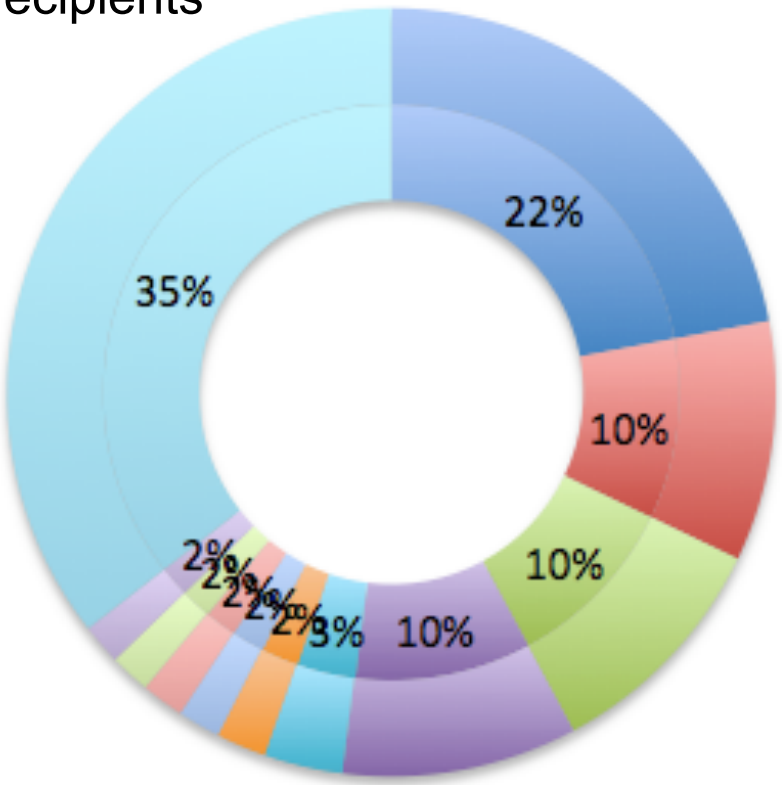
15.000 in the USA

- Chenning YANG, Nobel physics 1957, in Tsinghua since 1999
- Andrew YAO, Turing award 2000, in Tsinghua since 2004

Chinese students abroad

Foreign recipients of U.S. S&E doctorates, by country 1985–2005

189.346 recipients

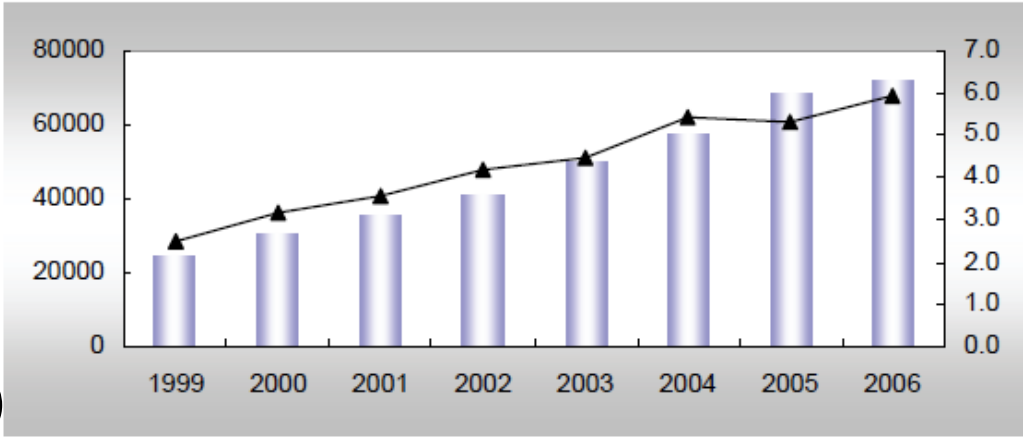


China
Taiwan
South Korea
India
Canada
Turkey
Thailand
Iran
Japan
Mexico

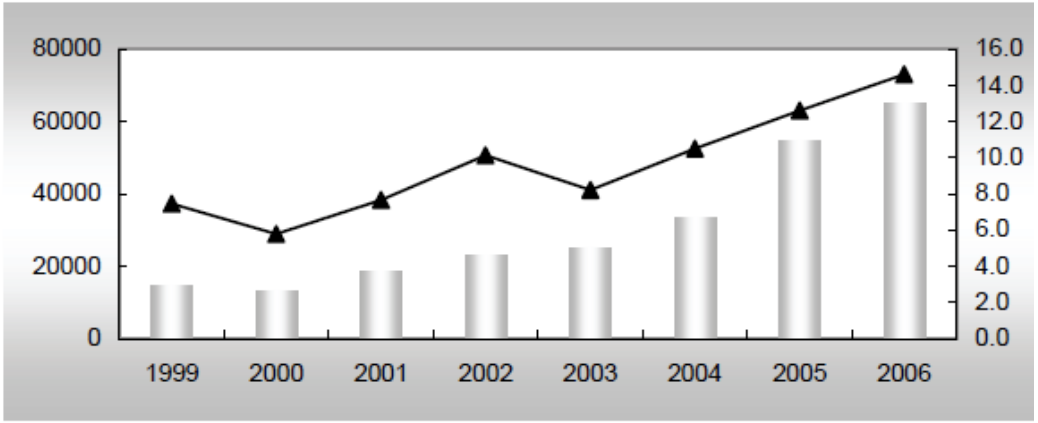
Source www.nsf.gov/statistics

Publications

SCI:
6% of world total
15% yearly growth
#5
(behind US,JP,GB,DE)



EI:
14% of world total
30% yearly growth
#2 (behind US)



Source: 中国科技论文统计结果*2007*

Impact and visibility

Strong evolution of the citation rate of publications

- 13th position (18th in 2003)
- Progression of citations: 28% in 2006
- Publications SCI 1997-2006
  - 40% of articles never cited
  - 225 articles cited more than 100 times (129 in 2005)

Impact

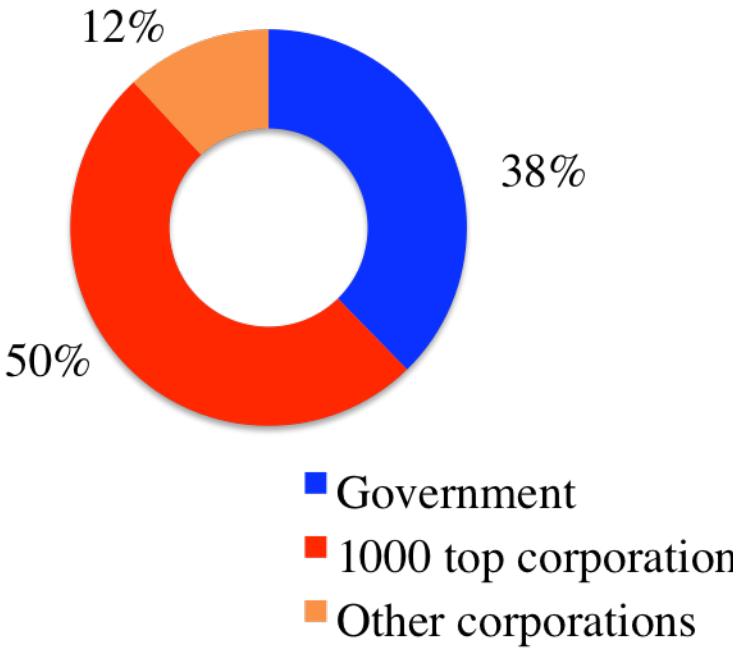
Reasonable in new materials, mathematics, chemistry, physics

Low in life sciences

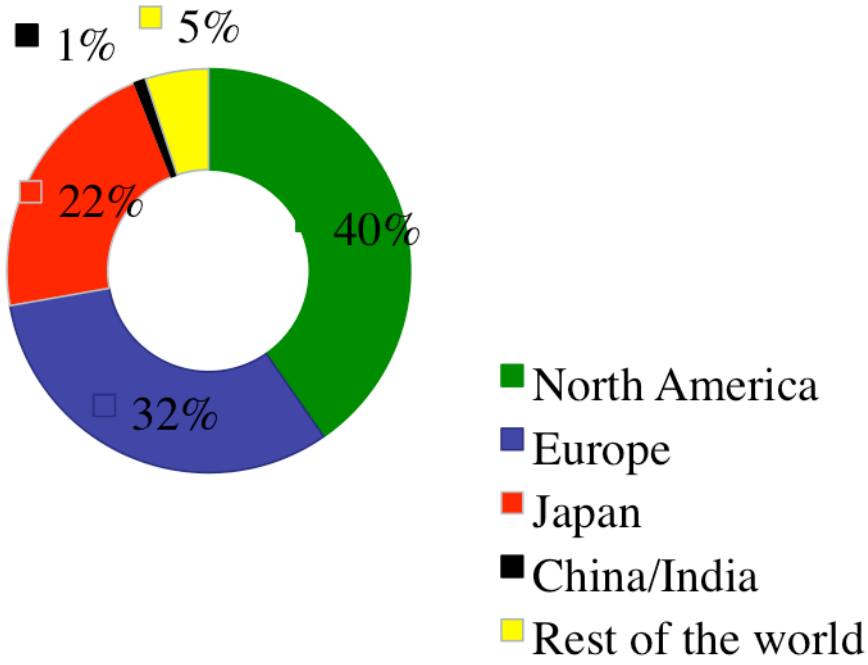
Source: 中国科技论文统计结果*2007*

Industrial R&D spending 2008

Circa 1 Trillion US$



For the 1000 top corporations



Source: Booz Global Innovation 1000

Few Chinese corporations in R&D

2008 investment in R&D

A dozen Chinese corporations among the top 1000

None in the top 100

- PetroChina 818.26 Million Euros, (intensity 0.7%)
- ZTE (telecom equip.) 450.52 Million Euros, (9.6%)
- China Petroleum & Chemical
- China Railway Construction
- China Coal Energy
- China Communications Construction
- BYD Electronic equipment
- …

Source: 2009 EU Industrial R&D Investment Scoreboard

Globalization of R&D

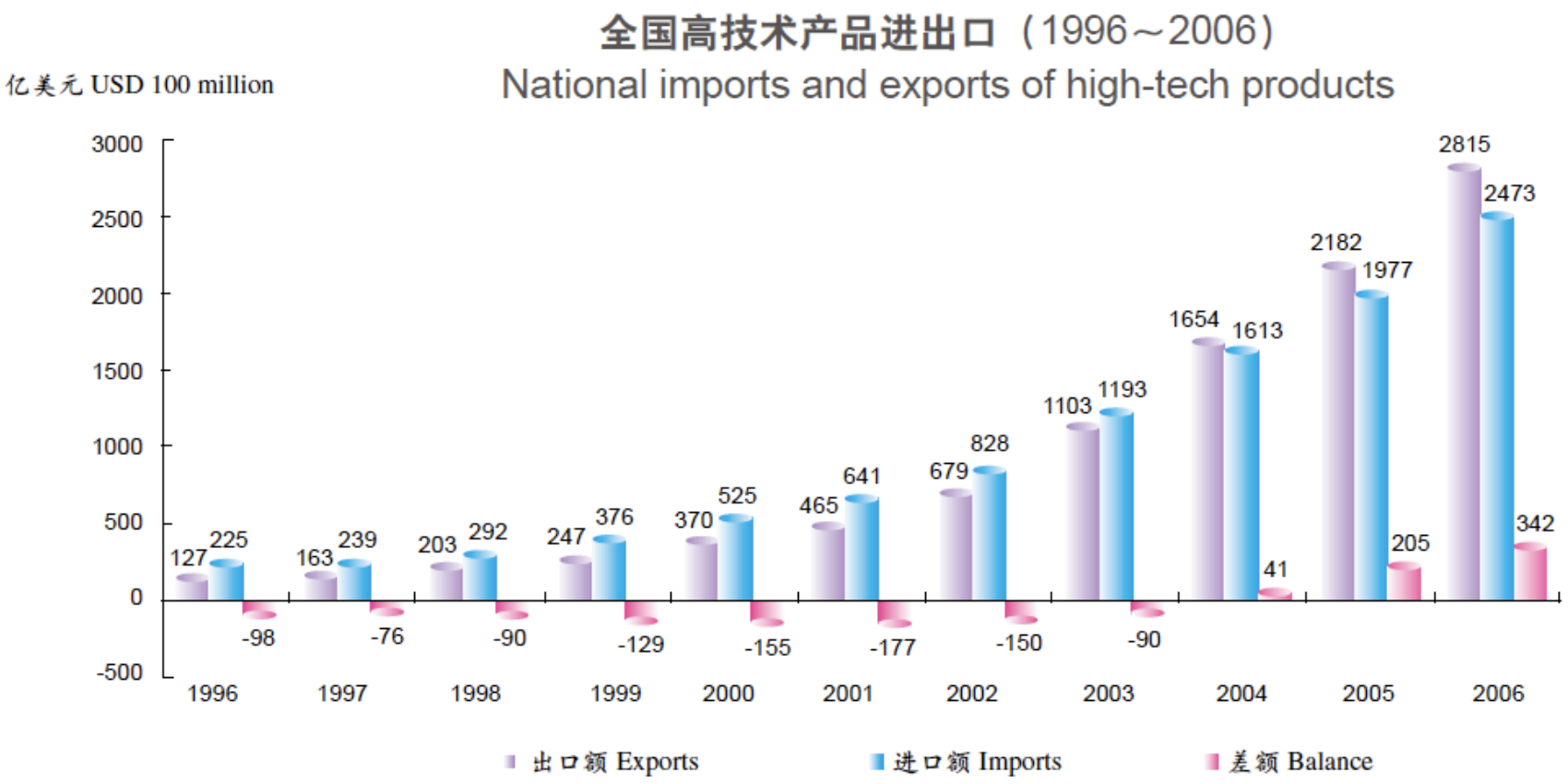
1993: First foreign R&D center (Motorola)
2004: 700 foreign R&D centers
2005**: China 1st localization for new R&D centers ahead of the USA and India**

Objectives

1) adapt products to local market
2) technological intelligence
3) global R&D

Attractiveness of China

1) market shares vs. technologies
   participation in the design of Chinese standards
2) talents
3) costs

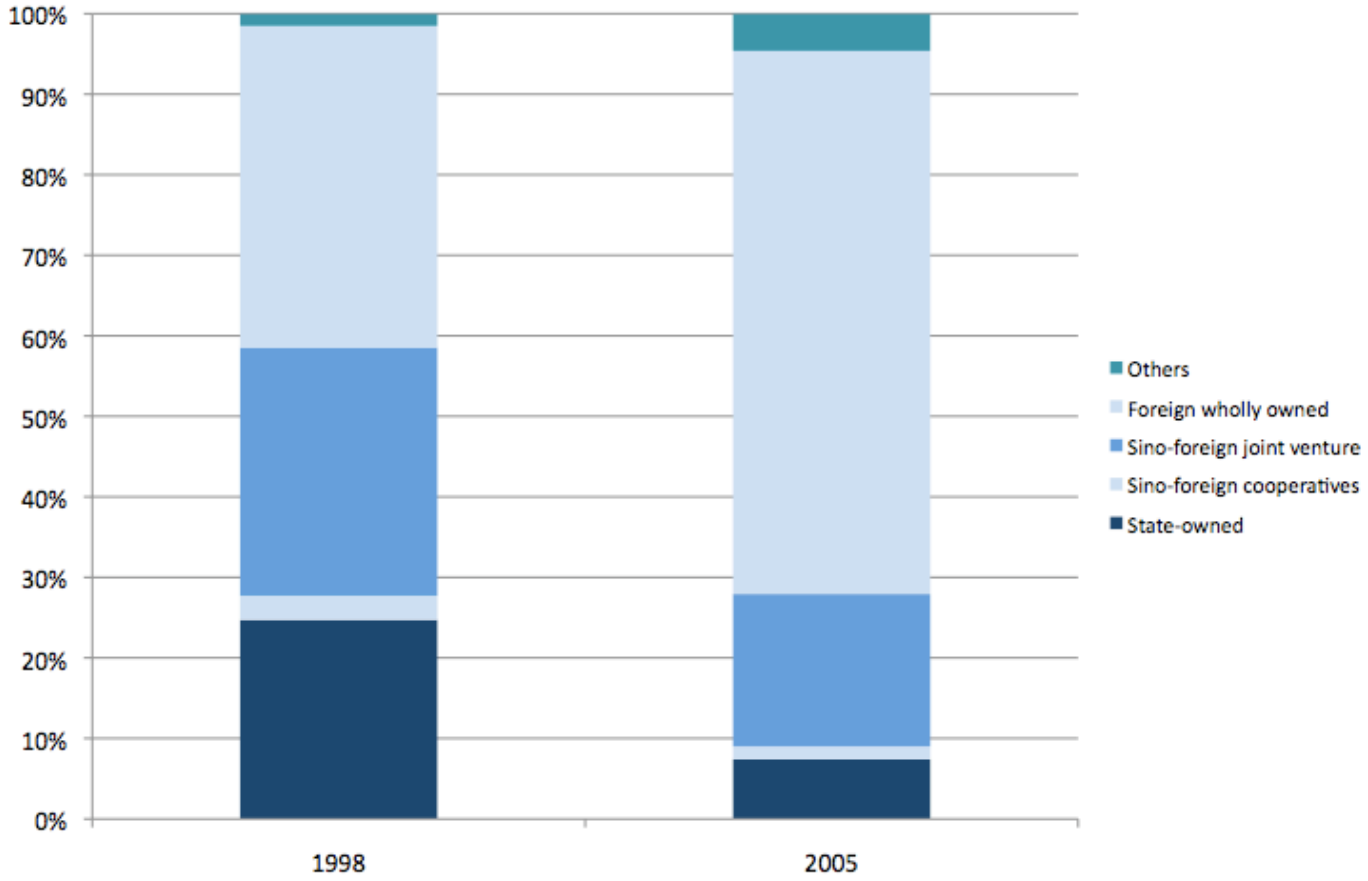


#1 for ICT exports since 2004

High-Tech exports mostly under foreign brands

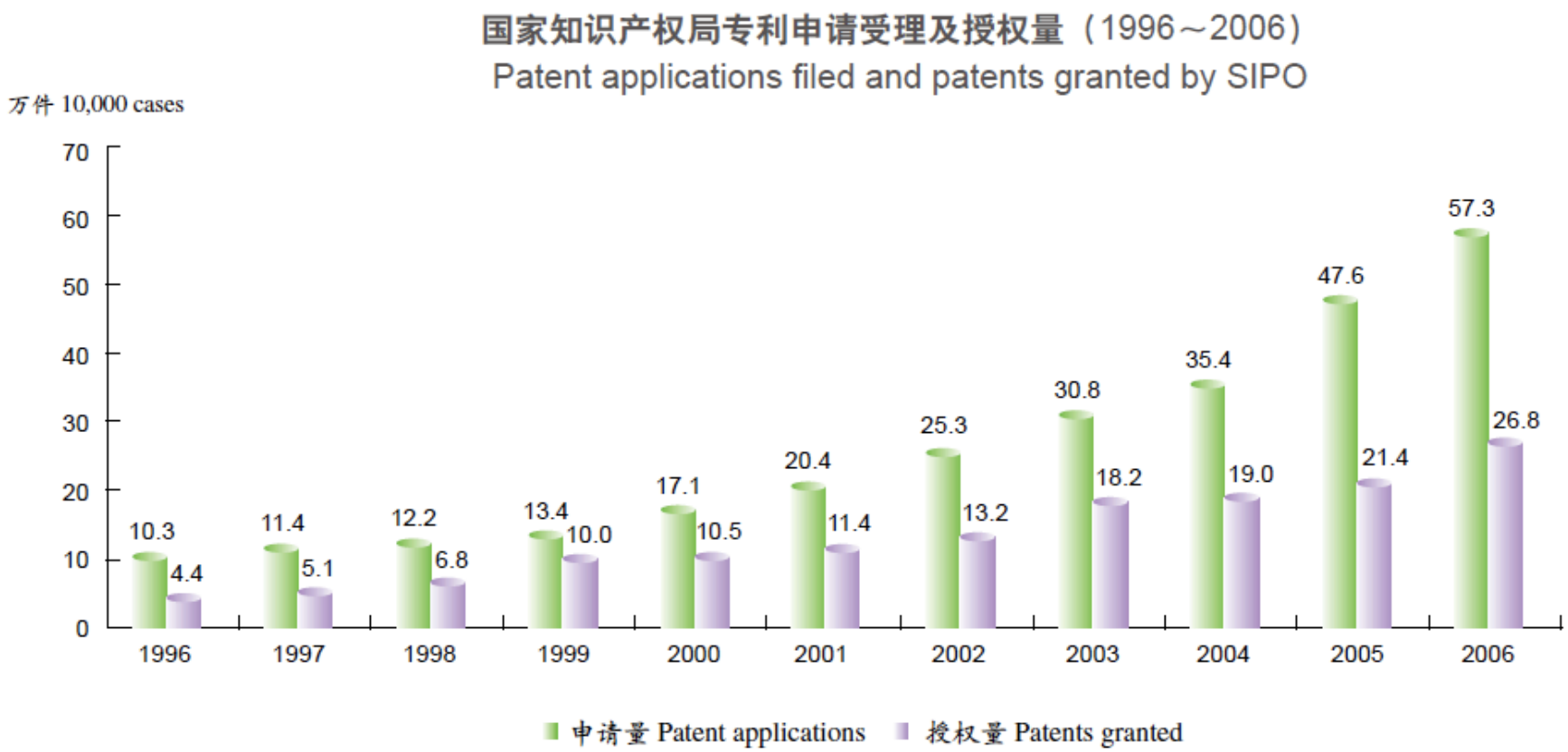
Source: MOST

High-tech exports by firm ownership



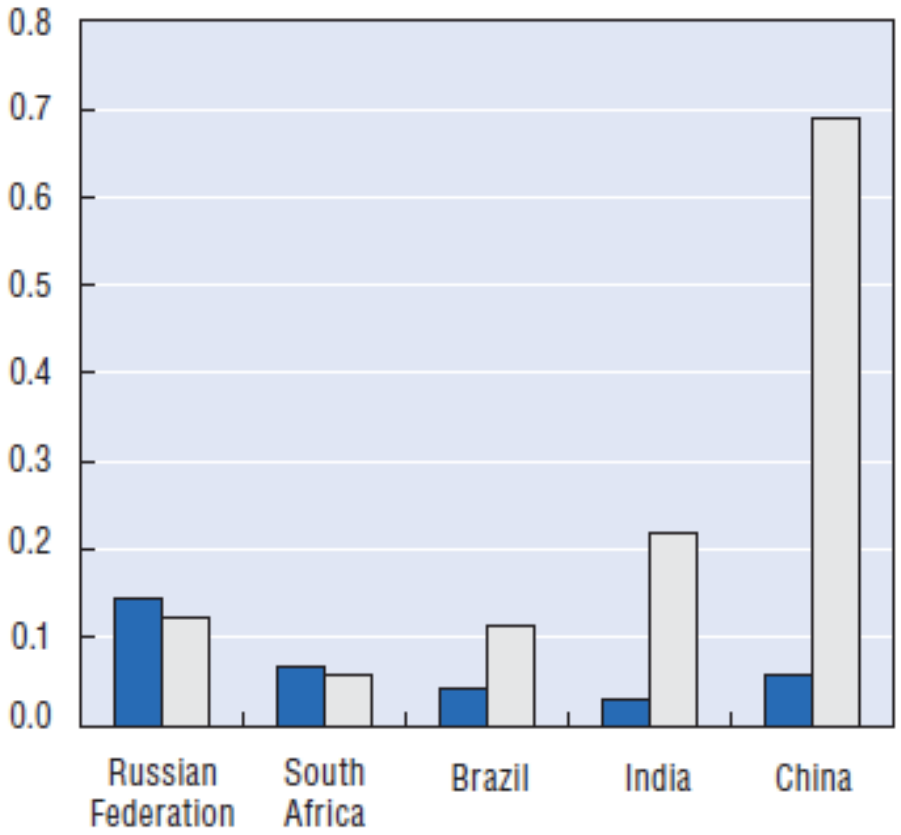
Source: OECD-STI 2008

IPR, national SIPO



Source: MOST

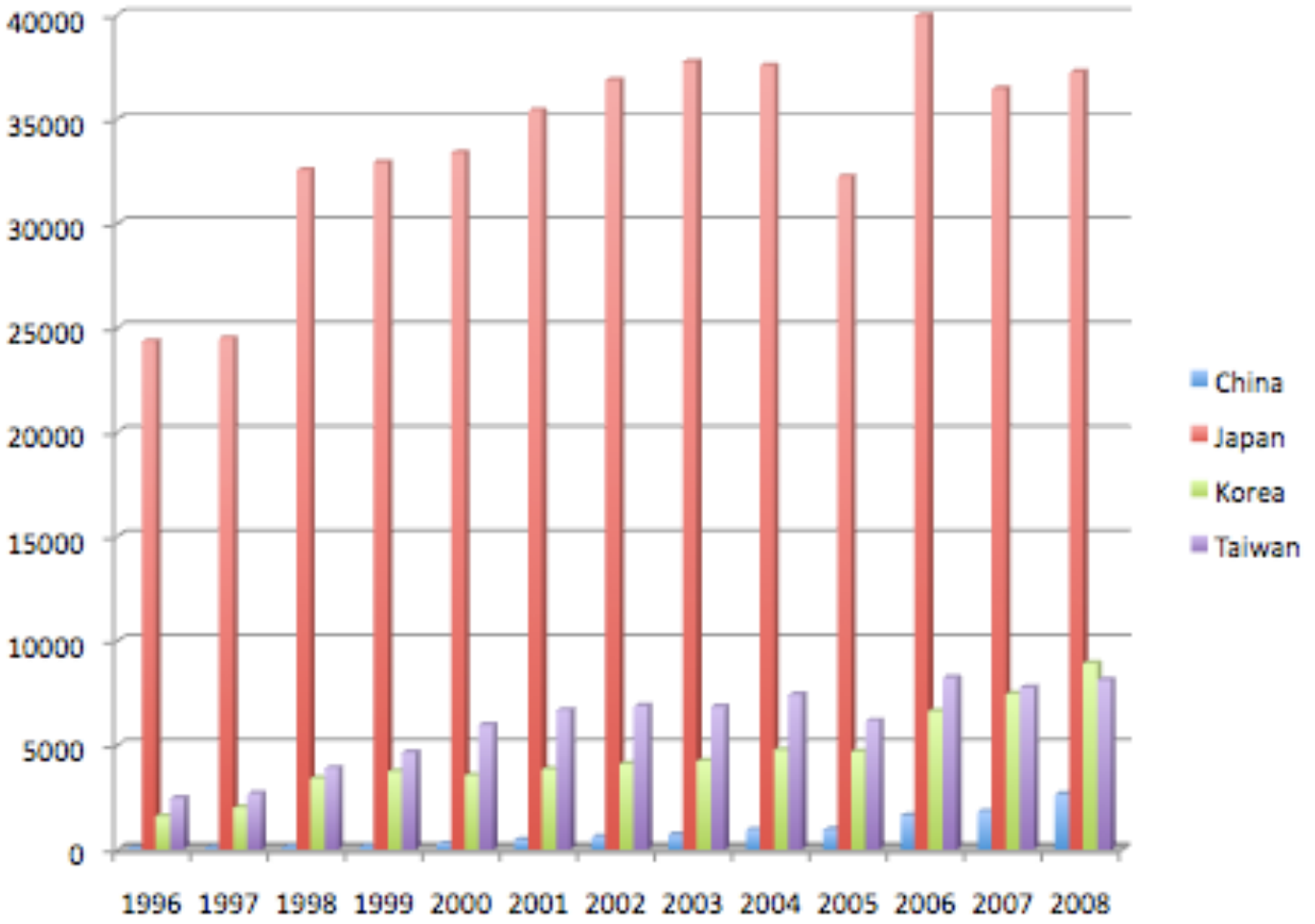
IPR: triadic patents



Global share
1995 - 2005

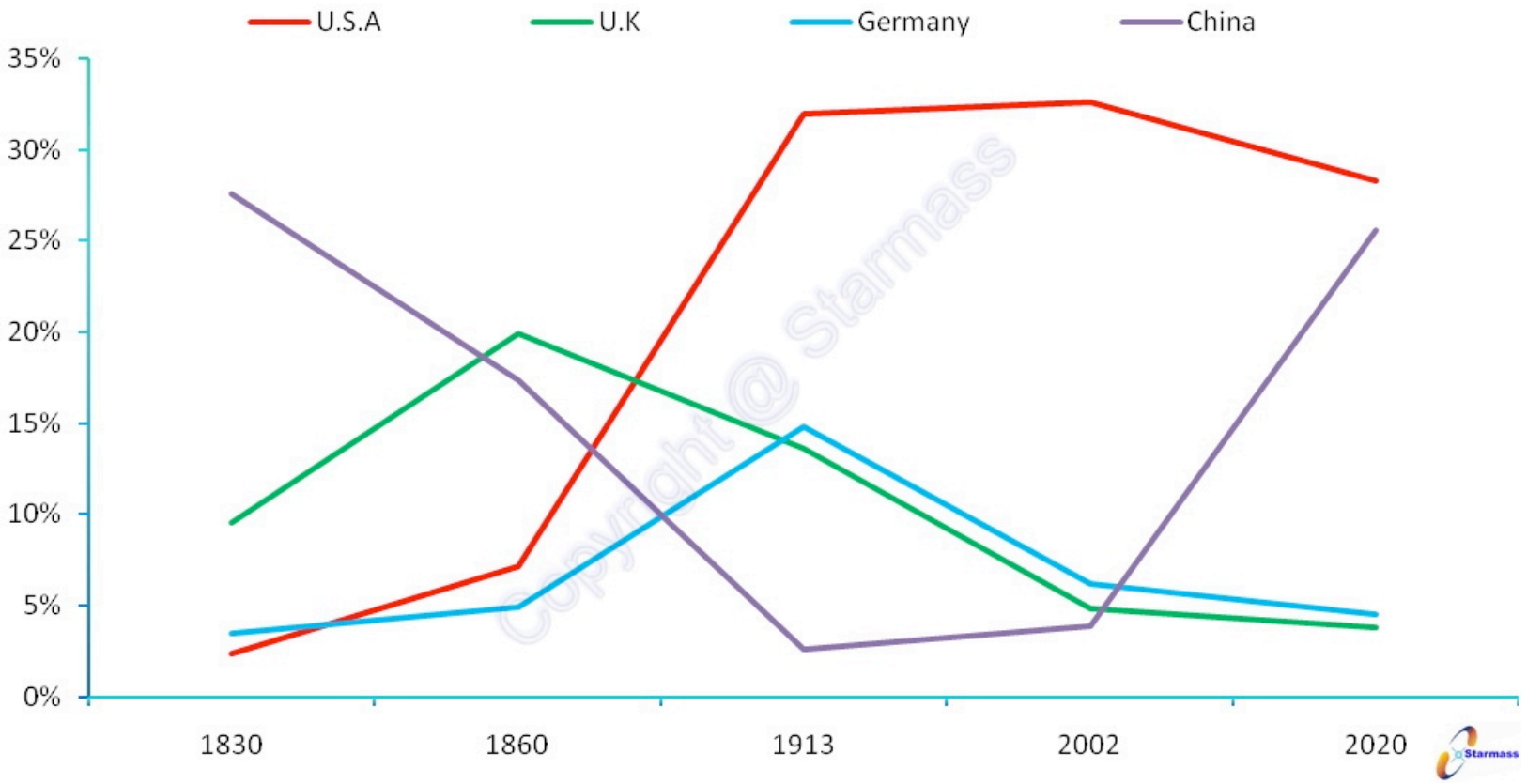
Source: OECD-STI'08

US patents



Source: www.patft.uspto.gov

Concluding remarks
Towards the recovery of its past potential
percentage of China's contribution to global economy



Source: www.starmass.com

Concluding remarks

- Objectives of China:
  - 2.5% of GDP in R&D by 2020
  - World scientific leader by 2050
- Strengths
  - Political ambition
  - Human resources
  - Huge national market
  - Unbalanced knowledge
- Weaknesses
  - Scientific culture
  - Fundamental research
  - IPR

References

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