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Transition from STI Policy to Innovation Policy -the Case of China

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Outline

- I. Introduction
- II. Evolution of China's STI policy
- III. New challenges
- IV. A focus on US-China STI competition
- V. How to manage US-China tech. rivalry?

I. Introduction

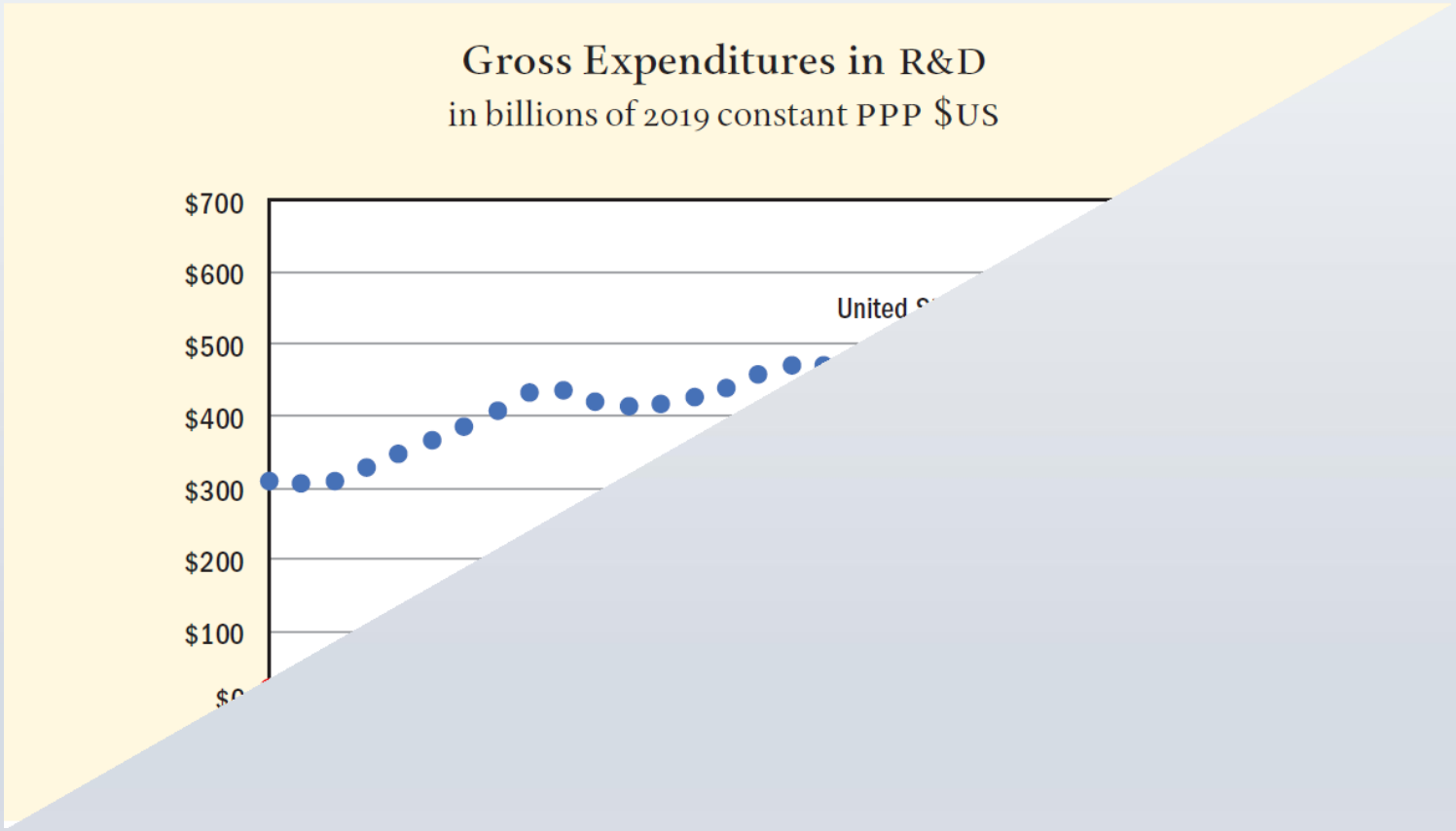
- In the last few years, China has been making progress in promoting innovation-driven development. However, what is the hype vs. reality? What are the roles of government policies? What are the future prospects?
- In addition, The international environment has also undergone fundamental changes, with the US viewing China's S&T development as a threat;
- This presentation tries to examine this issue from the overall context of China's reform and openness, and the evolution of China's Science, Technology, and Industrial policy, and then reflect what can be learned from this process.

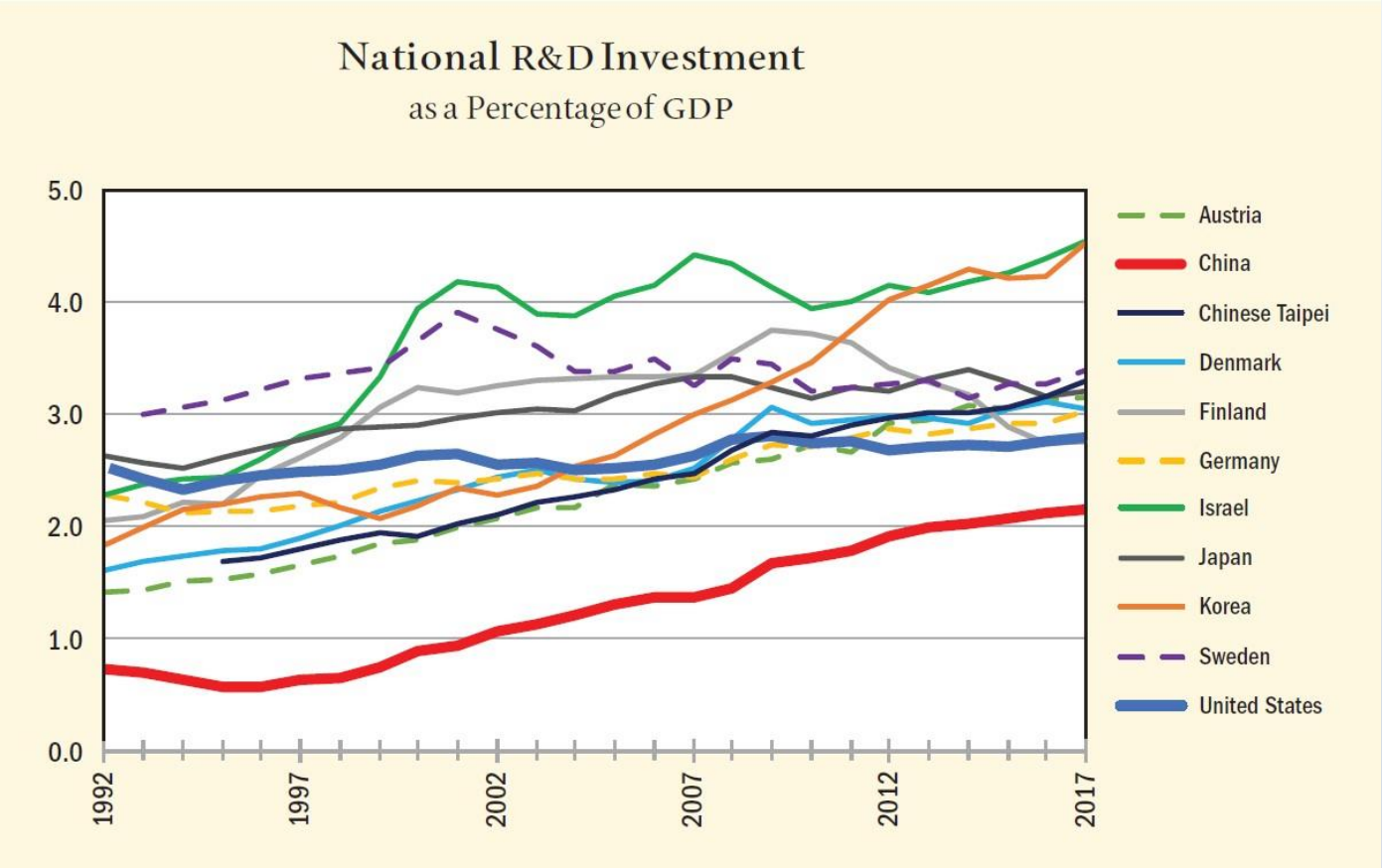
II. The evolution of China's science, technology and industrial policy

- The main objective of China's STI policy over the last 40 years is to promote innovation:
  - Reforming S&T system—market-oriented reform based on incentive and institutional changes;
  - Global integration—domestic institutions trying to integrate into the global system while maintaining their unique identities.
- Four waves of major changes:
  - Mid-1980s: Incentives for public research institutes to work for economic development;
  - Late-1990s: Institutional changes and system reform;
  - 2006-2012: MLP and indigenous innovation.
  - 2013- innovation-driven development

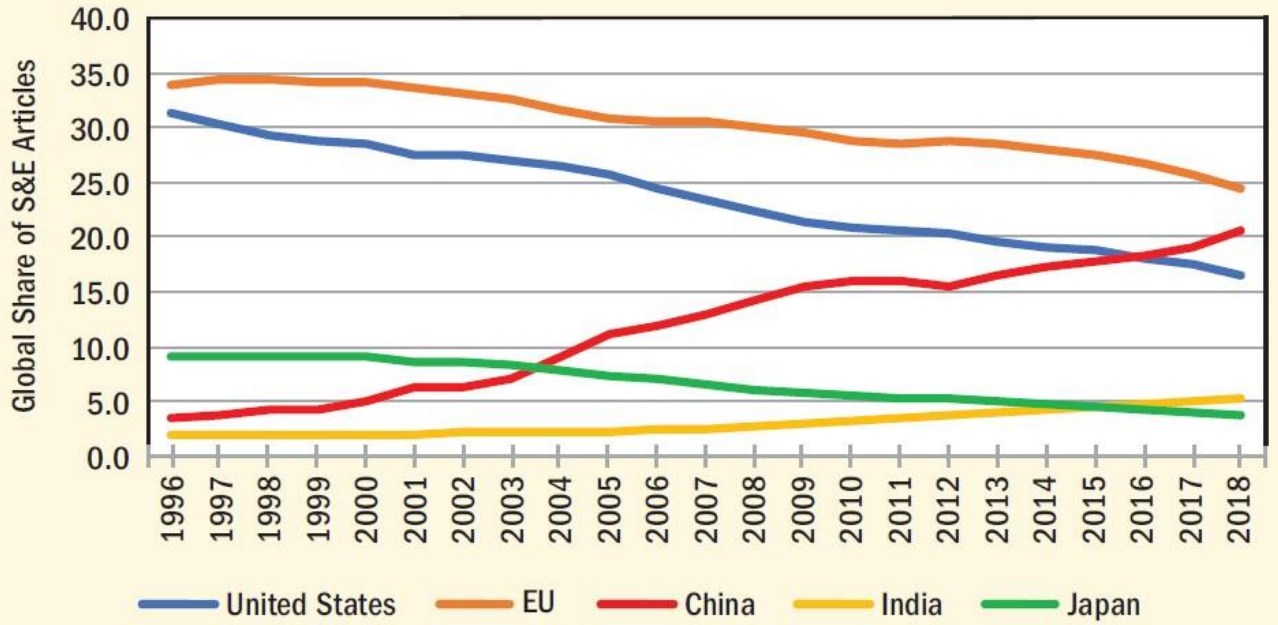
Outcome of the reform—successes

- Sustained growth in total R&D investment(2021=2.44%)
- Greater role of Industrial R&D:
  - 1986=35.3%=>2001=60.4%=>2021=76.9%
- Rapid growth in R&D output (papers and patents)
- Greater participation in the global innovation system
  - Multinational R&D centers and joint publications
- Massive expansion of higher education
  - Gross enrollment rate: 1990=3.7%; 2001=10%; 2021=57.8%
- The emergence of globally known institutions
  - Research universities (30+ in 985 program)
  - Research institutes (CAS, NIBS, BGI, and etc)
  - Multinational companies (Huawei, Lenovo, BAT， and etc)

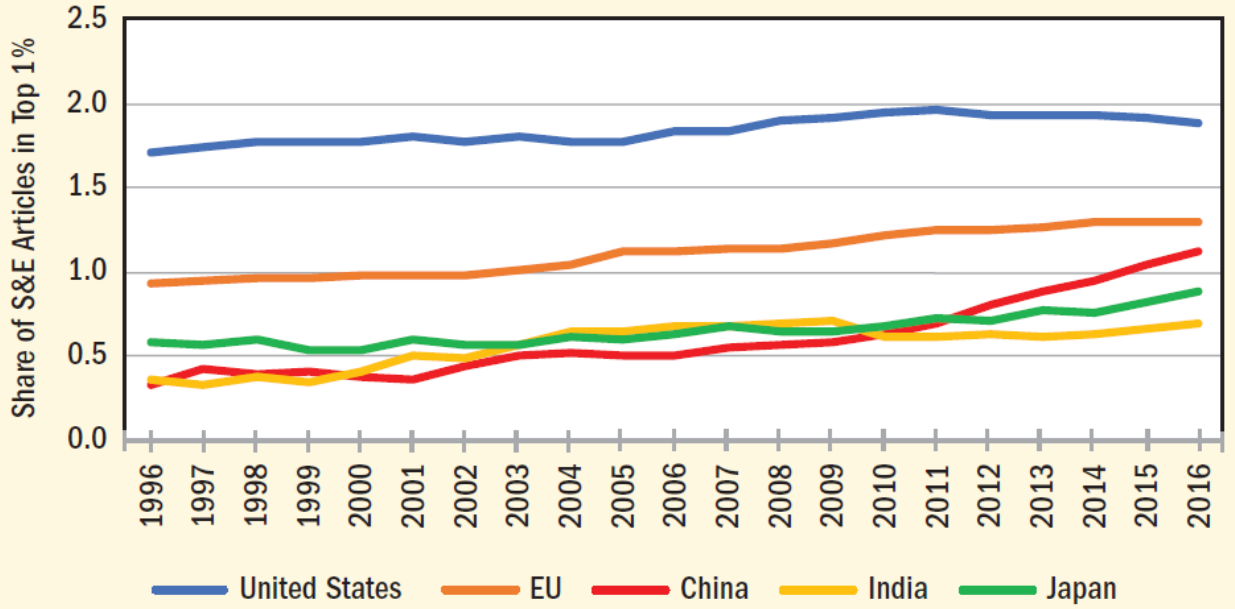

Gross Expenditures in R&D
in billions of 2019 constant PPP $US
$700
$600
$500
$400
$300
$200
$100
United S

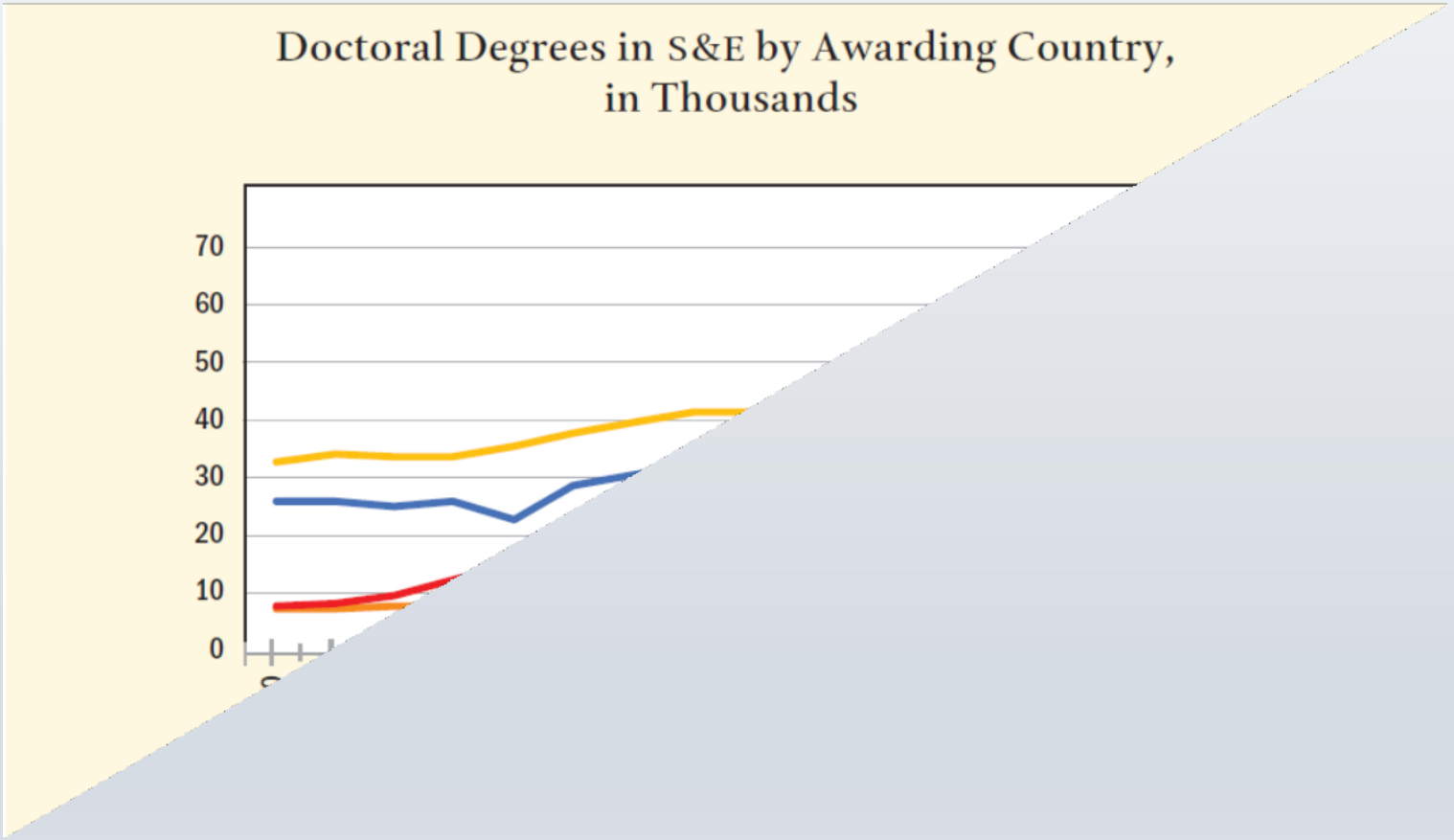

National R&D Investment
as a Percentage of GDP
5.0
4.0
3.0
2.0
1.0
0.0
1992
1997
2002
2007
2012
2017
Austria
China
Chinese Taipei
Denmark
Finland
Germany
Israel
Japan
Korea
Sweden
United States

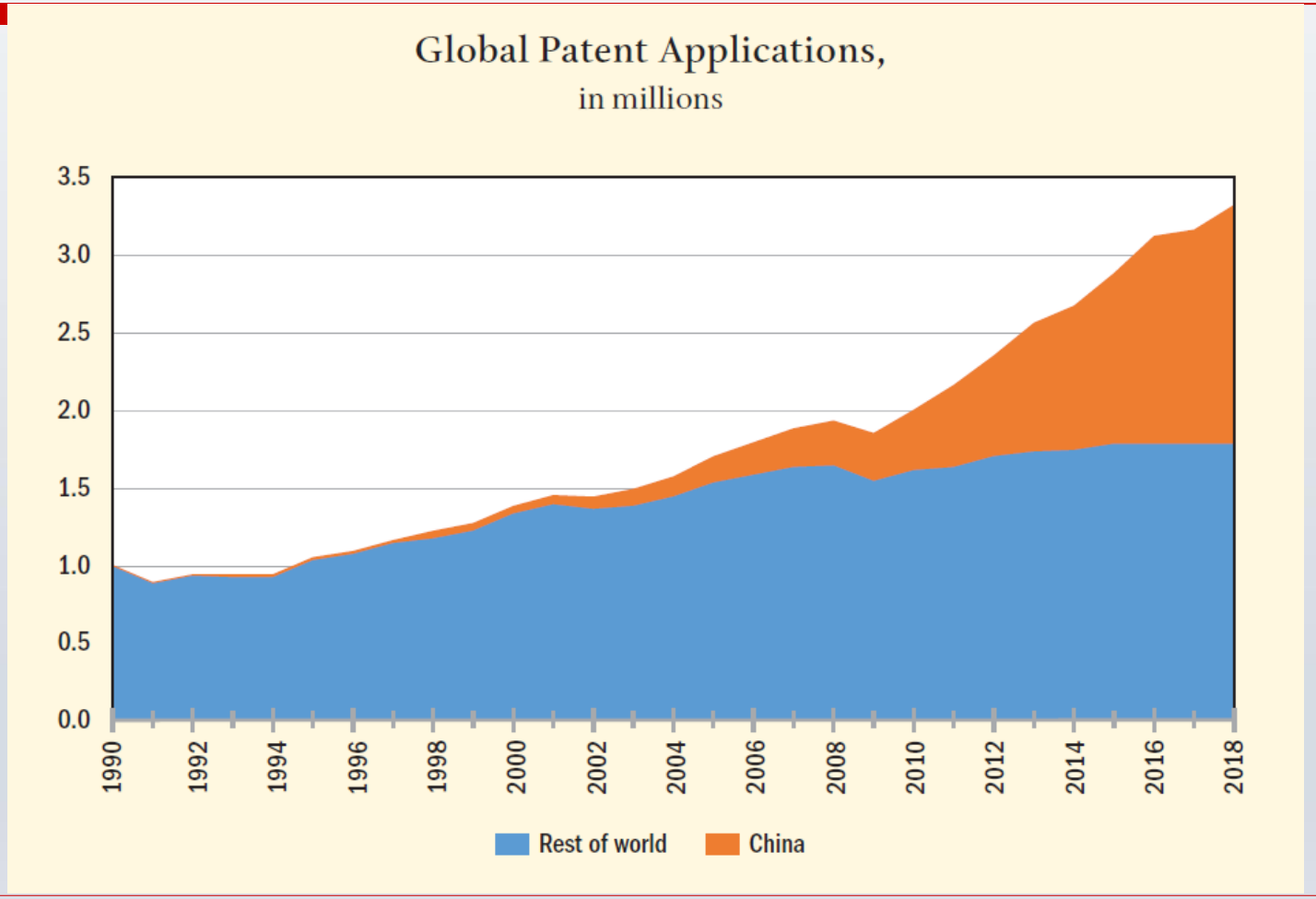
S&E Articles, by Global Share of Selected Region, Country, or Economy

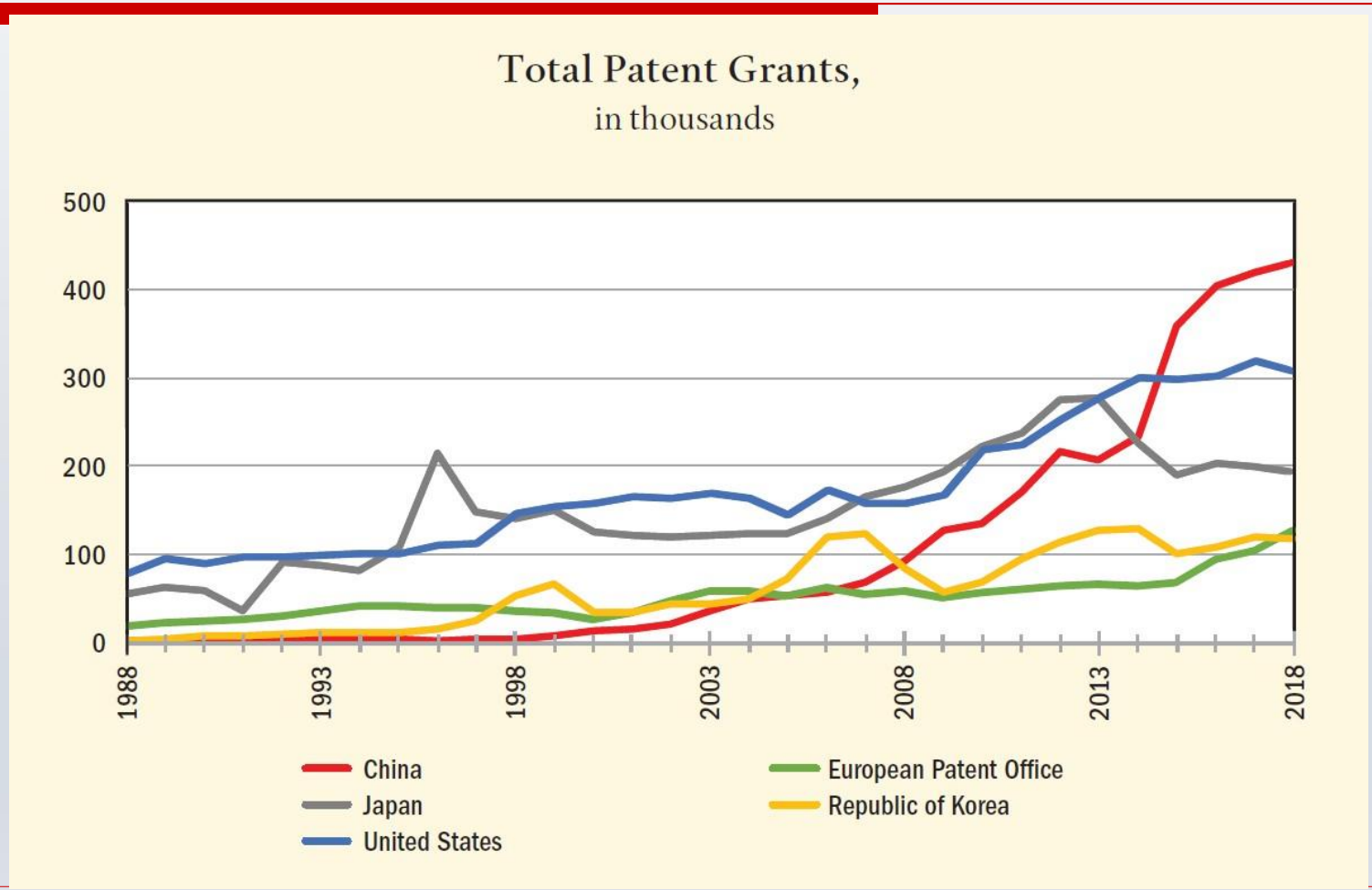


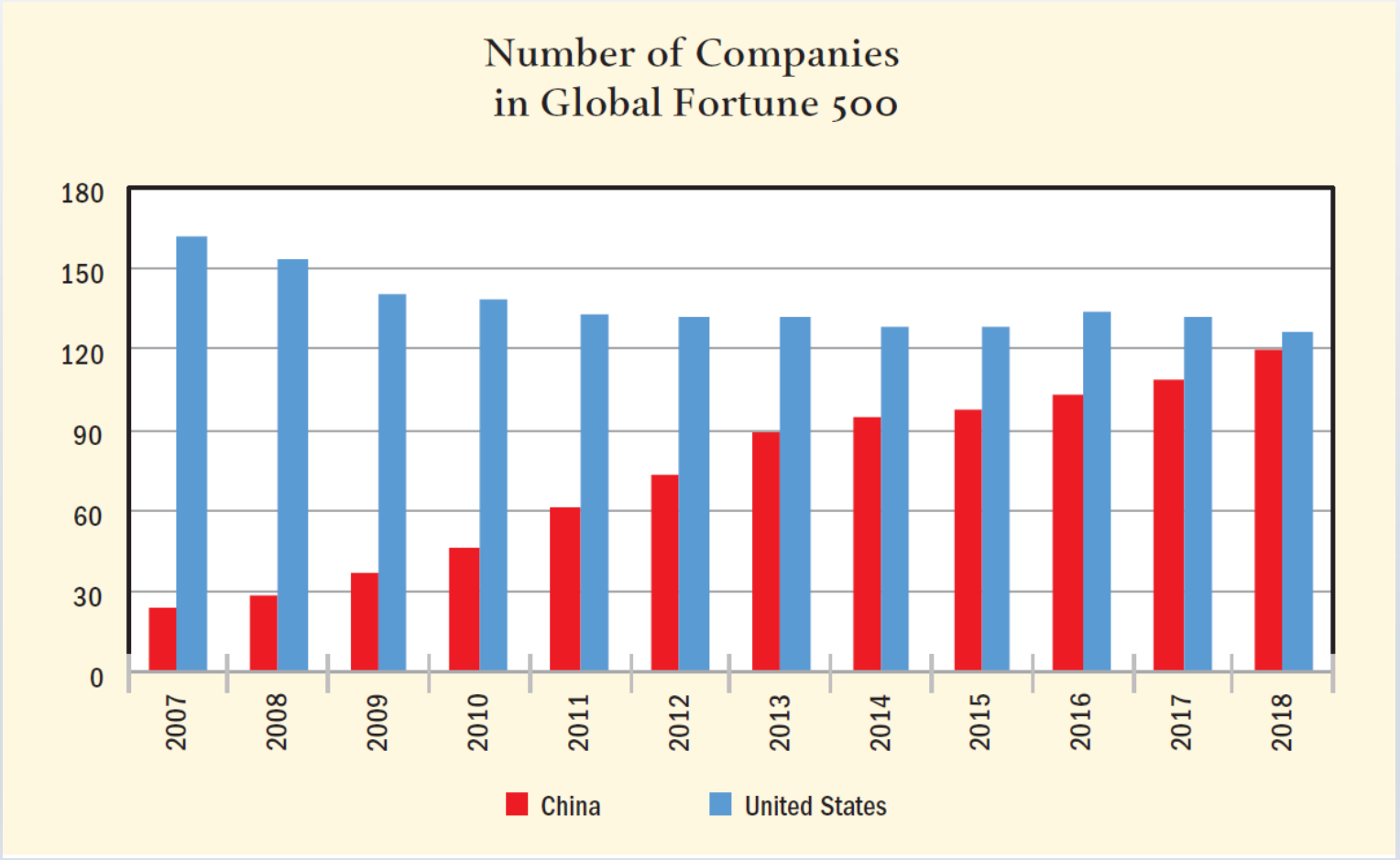
S&E Publication Output in the Top 1 Percent of Cited Publications, by Selected Country or Economy



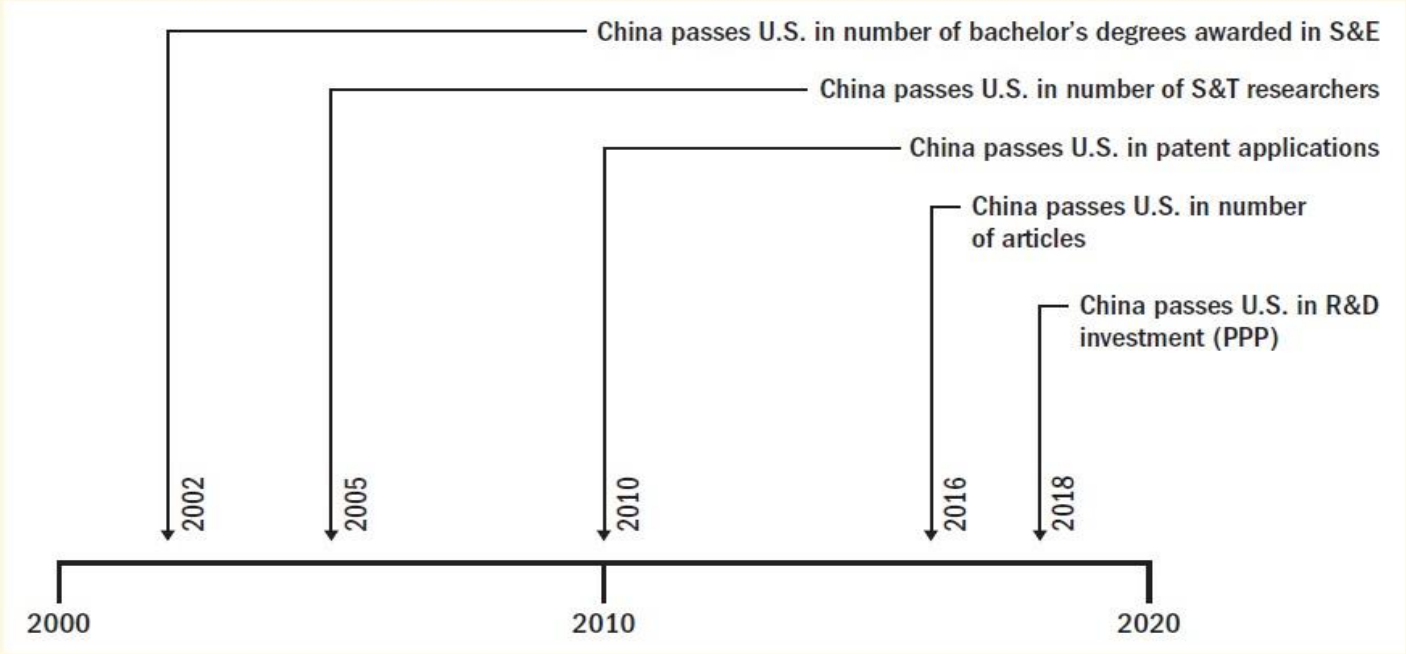

Doctoral Degrees in S&E by Awarding Country,
in Thousands
70
60
50
40
30
20
10
0


Global Patent Applications,
in millions
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Rest of world
China


Total Patent Grants,
in thousands
500
400
300
200
100
0
1988
1993
1998
2003
2008
2013
2018
China
Japan
United States
European Patent Office
Republic of Korea


Number of Companies
in Global Fortune 500
180
150
120
90
60
30
0
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
China
United States

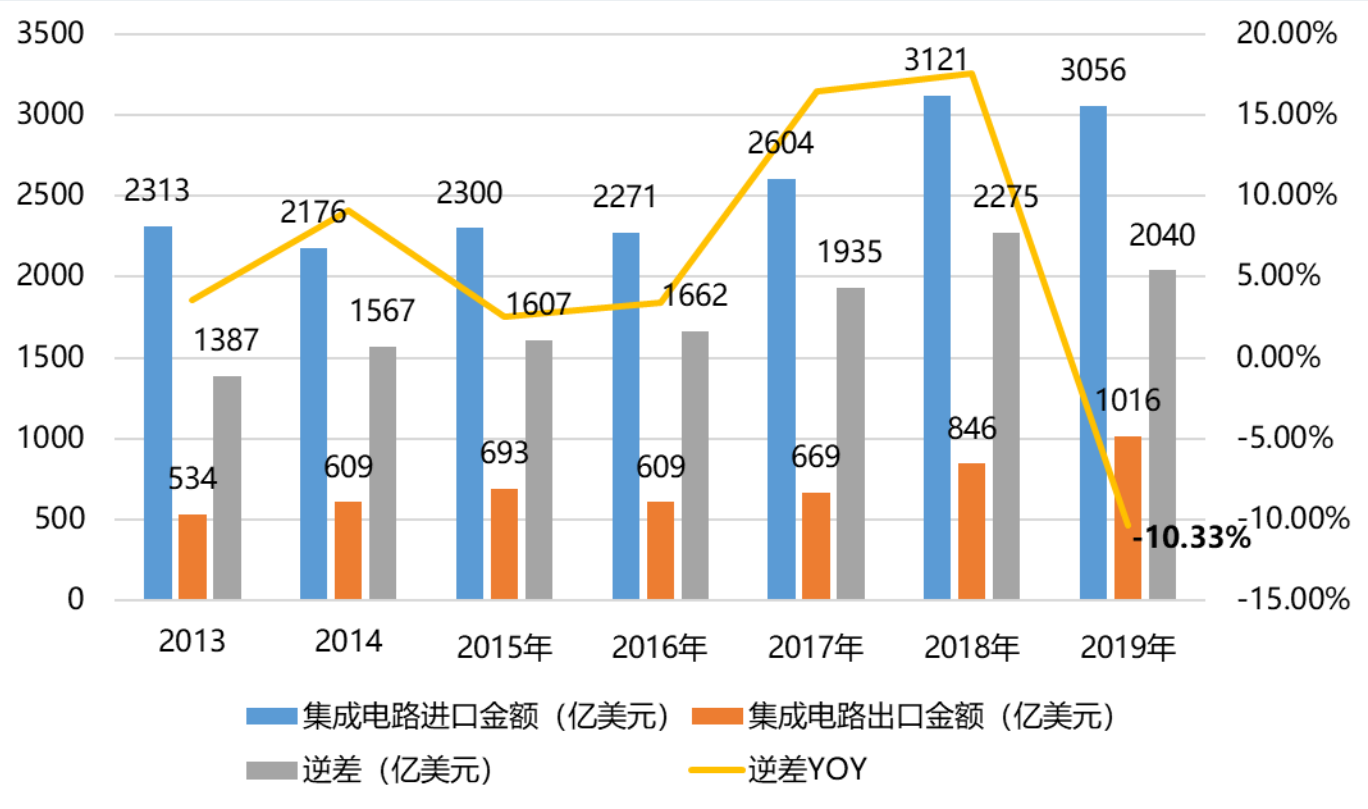
Timeline of China Surpassing the United States in Research and Development



Outcome of the reform--regrets

- There are still innovation gaps with global leaders in critical technological areas (see data on IC trade)
- China has accumulated strong manufacturing capabilities, but not strong brands;
- The overall productivity of Chinese economy is still relatively low;
  - 1/3 work in agriculture; regional/industrial diversity;
- There are still many institutional reforms to be completed if China wants to be an innovative country：
  - E.g. How to reform the management of Public Service Units (事业单位）?

China’s trade in IC industry (in $100 million)



III. New challenges

- COVID-19's impact on Chinese economy;
- Challenging geopolitical global environment
  - US-China conflict, from trade to STI
  - How to address "chocking" problems?
- The shifting of global value chain
  - Cost=>security
- Addressing institutional/system problems
  - HR policy differences in and outside public sectors

IV. A focus on US-China STI competition

- Despite the exaggeration of China's innovation power, China's innovation system has been and will continue to make great contribution to the global community:
  - China's contribution to global knowledge and global innovation;
  - China's contribution to address global challenges such as climate change;
- However, these potentials have been dampened by the systematic effort of the US government to decouple with China in innovation area since 2017:
  - Expansion on export control
  - Limitation on Chinese investment in the US
  - Restrictions on Chinese imports to the US
  - Targeting Chinese companies—ZTE and Huawei, and etc.;
    - Over 900 companies and many universities are now on the "entity list";
  - Investigation on American Chinese scientists
  - ……

The negative impact on global STI is tremendous

- On global knowledge production
  - US crackdown harms Chinese collaborations, *Nature*, July 16, 2021
- On global innovation
  - Delaying the diffusion of new product and services (such as 5G）
  - Increasing the cost of production and consumption
  - Damaging global value chain
- The decoupling process, when pushed to the extreme, will become a self-fulfilling prophesy, which will be a lose-lose situation for US, China, and the entire world!

V. How to manage US-China tech. rivalry?

		Enhancing Defense Capabilities	
		No	Yes
Enhancing Economic Prosperity	No	（QI) International Science Principles Basic research	(Q2) The Wassenaar Arrangement on Export Controls Defense-related technologies; Dual-use advanced technologies
	Yes	(Q4) WTO/TRIPS Commercial technologies	(Q3) Great Uncertainty Cutting-edge technologies

Valerie J. Karplus, M. Granger Morgan, David G. Victor, Finding safe zones for science, *Issues in Science and Technology*, Fall 2021

Table 1. **FRAMEWORK FOR ASSESSING TRADE-OFFS IN JOINT SOCIAL GAINS VERSUS POLITICAL RISKS IN US-CHINA COOPERATION**

RISK OF COOPERATIVE ACTIVITY MAGNIFYING ADVERSE POLITICAL RELATIONS

INCREASING	• Advanced weapons systems • Machine-augmented intelligence • Aerospace technology • Quantum encryption • High-voltage direct current electricity transmission • Small modular reactors and micro nuclear reactors	• Joint investigation of COVID-19 origins • Earth observation, e.g., greenhouse gas emissions, climate change, human trafficking, environmental degradation • Superconductivity • Geoengineering • Stem cell research
DECREASING	• Wind and solar energy technology development • Advanced battery chemistries • High-speed rail	• Radio and optical astronomy; astrophysics • Solid earth physics; plate tectonics; systems ecology • Advanced mathematics • Carbon capture and sequestration • Fundamental quantum physics • Technical standard-setting

INCREASING

ANTICIPATED JOINT SOCIAL GAINS FROM COOPERATING

What can be done?

- Re-open/establish channels of communication on multiple levels
  - Dialogues between governments, parliaments, and think-tanks;
  - (US-China Innovation Dialogue 2010-2016)
- Adopt a framework to manage tech rivalry between US-China:
  - Previous examples
- Establish boundaries for competition:
  - Try to minimize negative externalities to the global community
  - Try to minimize negative impact on global value chain
- Adopt measures to reduce distrust and regain confidence
  - Collaboration in research in climate change, public health, and etc.
  - preventing misuse of AI and other emerging technologies

Thanks !