Role of S&T Policy in National Innovation Systems

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Structure of Presentation

- Global Trends
- China, India, US in Perspective
- Innovation Defined Broadly
- National Innovation System
- National Innovation Systems of Three Countries Compared
- Key Policy Issues for NIS in Each Country
- Key Global Challenges
- Key Areas for International Cooperation

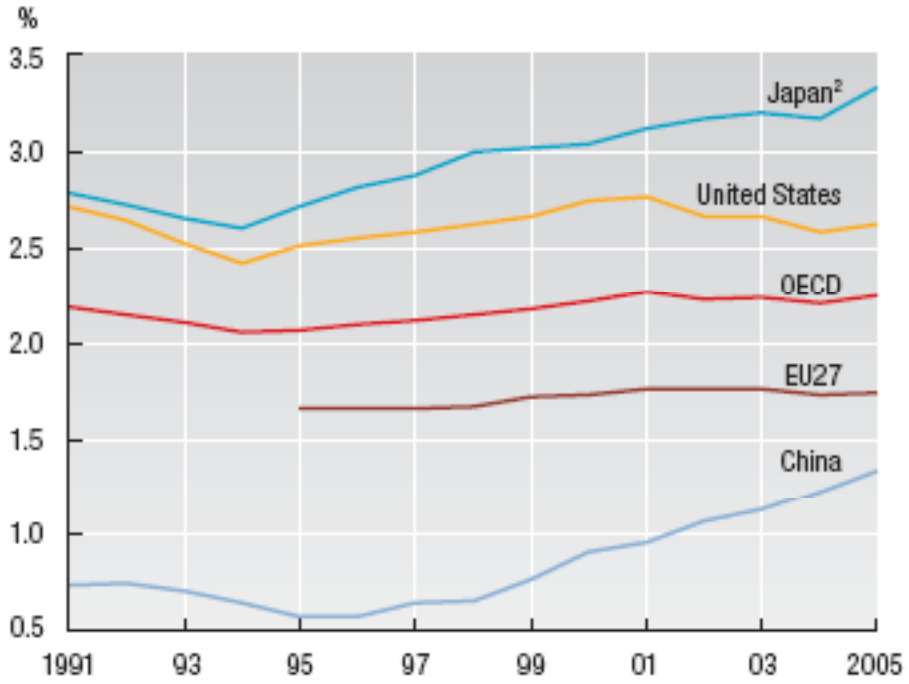
Global Trends

- Acceleration in rate of creation and dissemination of knowledge
- Increasing globalization as result of decreasing communication and transportation costs
- Knowledge increasingly global
- MNCs are main generators and disseminators of knowledge

Trends in R&D Spending

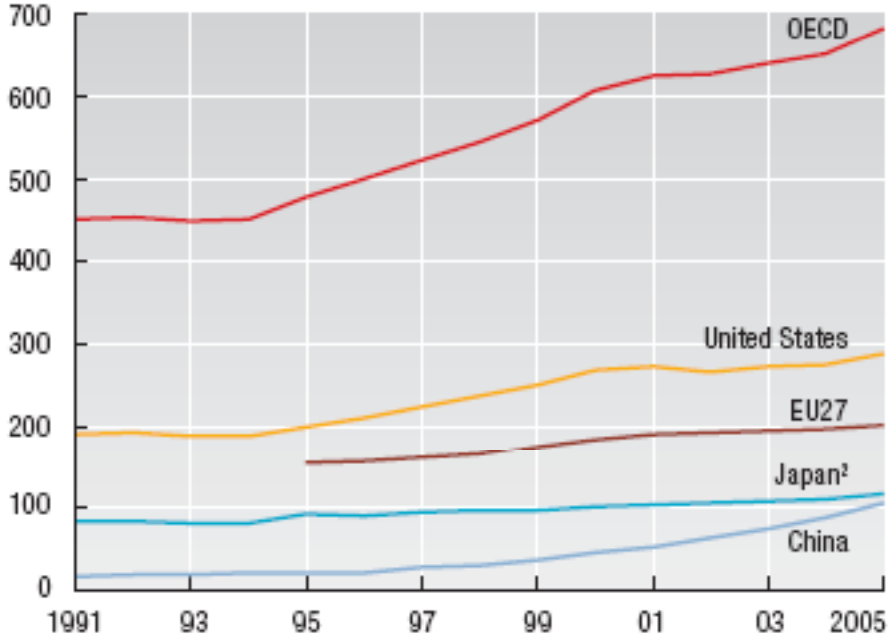
Trends in R&D intensity[1] by area, 1991-2005

As a percentage of GDP



Gross domestic expenditure on R&D by area, 1991-2005

Billions of USD PPP (2000)[3]

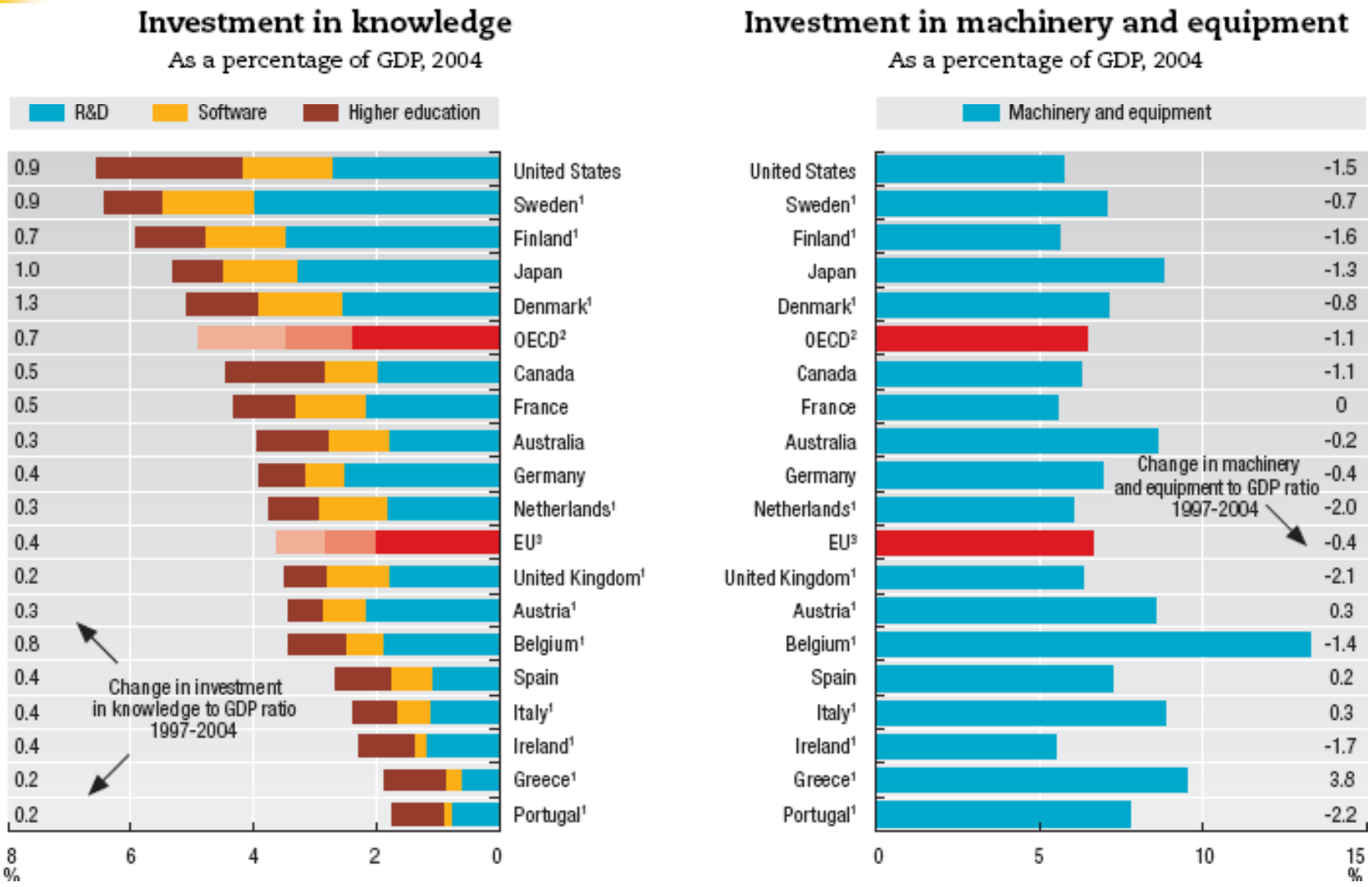


StatLink http://dx.doi.org/10.1787/116588372230

1. Gross domestic expenditure on R&D as a percentage of GDP.
2. Data are adjusted up to 1995.
3. USD of 2000 in purchasing power parity (PPP).

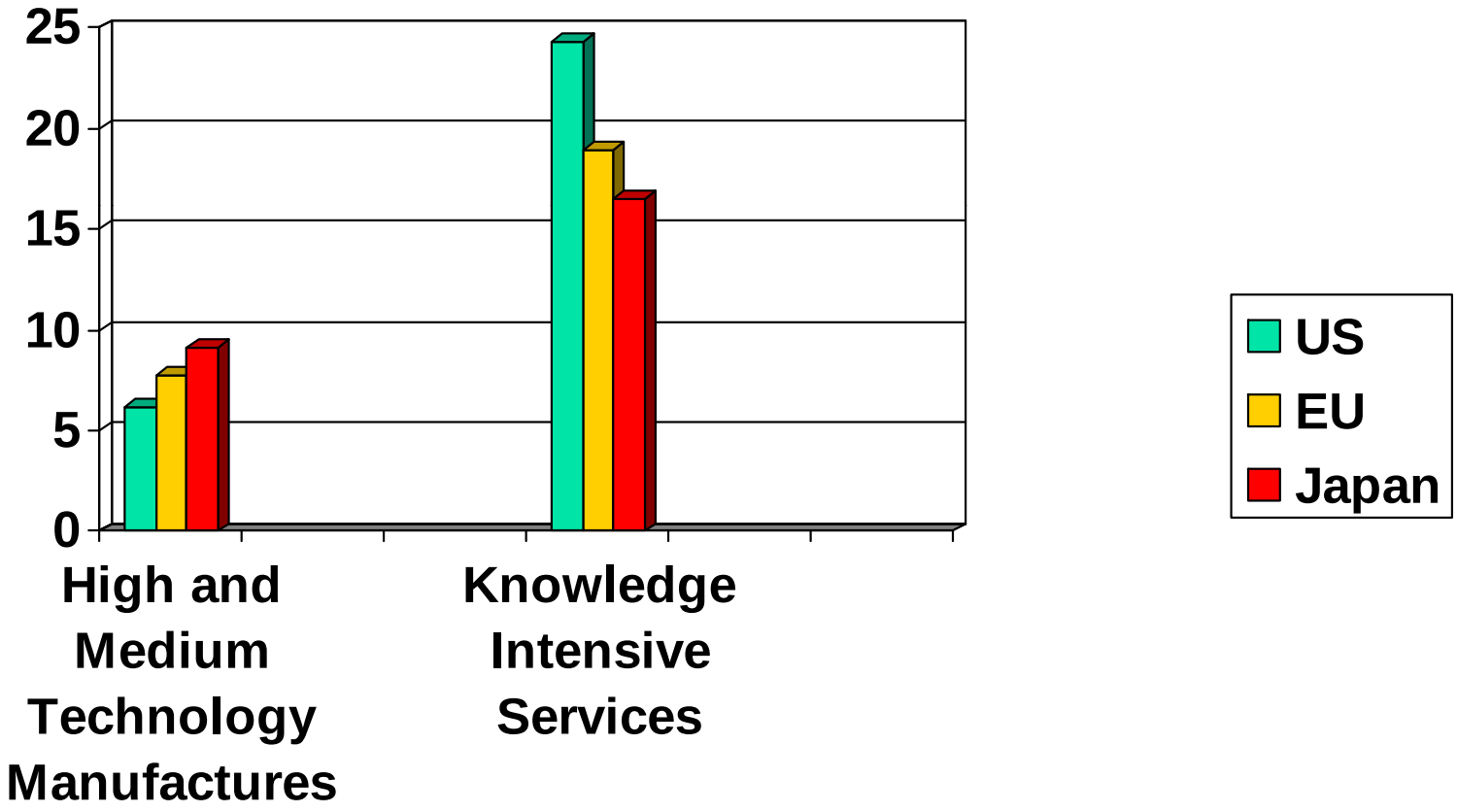
Source: OECD STI Scorecard 2007

Investments in Knowledge Now almost as Large as Investments in Machinery and Equipment



Source: OECD STI Scorecard 2007

Knowledge Intensive Services* Greater % of Gross GDP than Technology Intensive Manufactures in Advanced Countries (2002)



***Knowledge Intensive Market Services** exclude government and include following services: posts and telecommunications, finance & insurance, business services: Source OECD 2005

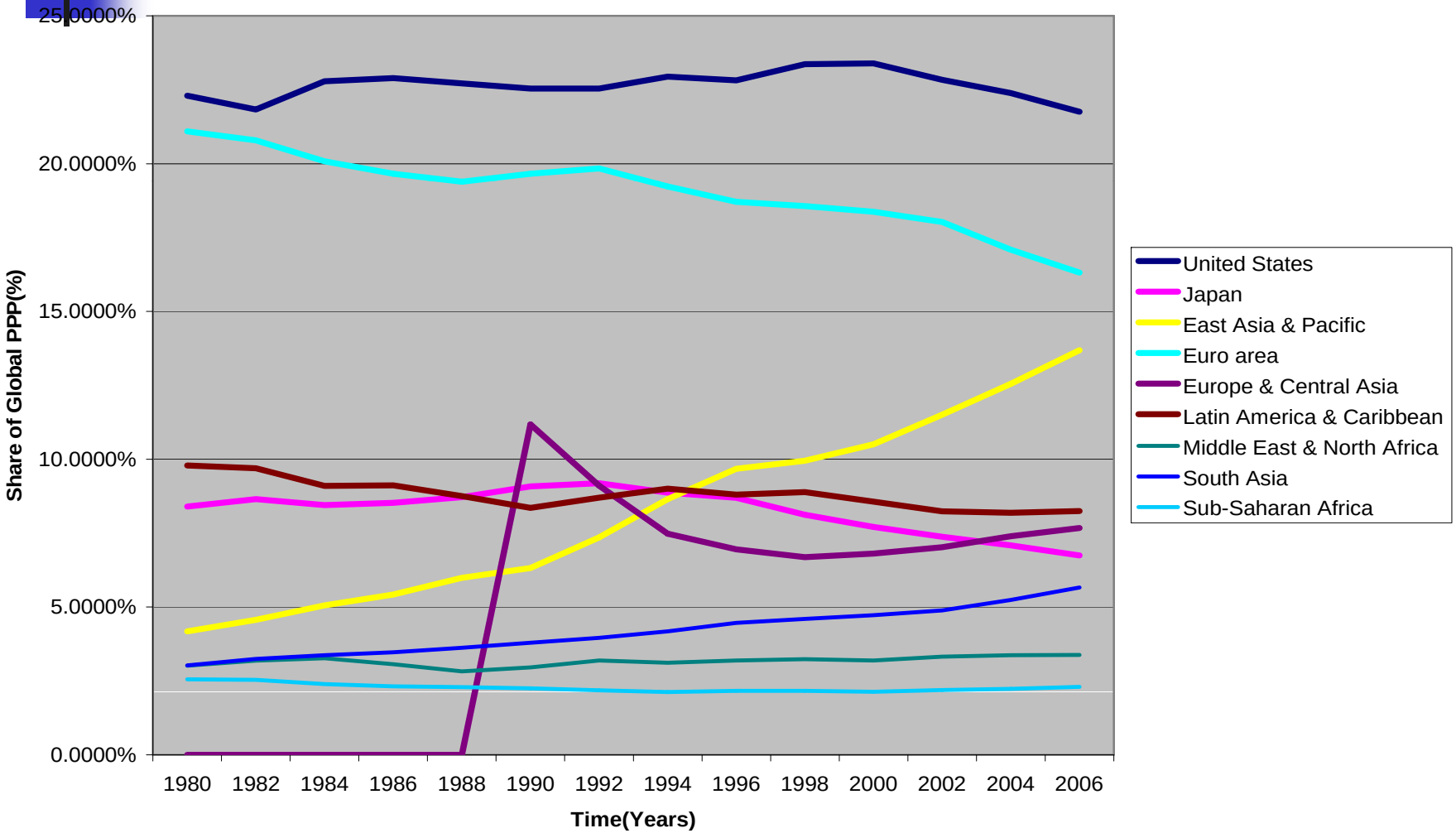
China, India, and US in Perspective

	China	India	US
Gross National Income (2006)			
GNI (2006 nominal billion)	**2,621**	**909**	**13,387**
GNI as share of Global GNI (%)	**5.38**	**1.87**	**27.5**
GNI/capita (2006 nominal)	**2,000**	**820**	**44,710**
GNI (2006 PPP)	**6,119**	**2,726**	**13,196**
GNI as share of global GDP(2006 PPP)	**10.16**	**4.53**	**21.4**
GNI/capita (2006 PPP)	**4,660**	**2,460**	**44,070**
Growth of GDP (1990-2006)			
1990-2000	**10.6**	**5.9**	**3.5**
2000-2006	**9.8**	**7.4**	**2.6**
Exports (2006)			
Merchandise Exports (millions)	**968,936**	**120,254**	**1,038,278**
Merchandise Exports(% of World Total)	**8.02**	**1.00**	**8.6**
Commercial Service Exports (millions)	**91,421**	**75,057**	**397,833**
Service Exports (% of World Total)	**3.30**	**2.71**	**14.4**
(Computer. information, comm, & other business services as % of Service Exports	**39.1**	**73.7**	**44.3**
People (2005)			
Population (millions, 2006)	**1,312**	**1,110**	**299**
Population as Share of Global Population	**20.07**	**16.98**	**4.6**
Life expectancy at birth(2006)	**72**	**64**	**78**
Poverty and Inequality			
% below $1/day poverty line (2004)	**9.9**	**33.3**	**Na**
% below $2/day poverty line (2004)	**34.9**	**80.0**	**na**
Gini Coefficient (2004)	**46.9**	**36.8**	**40.8**

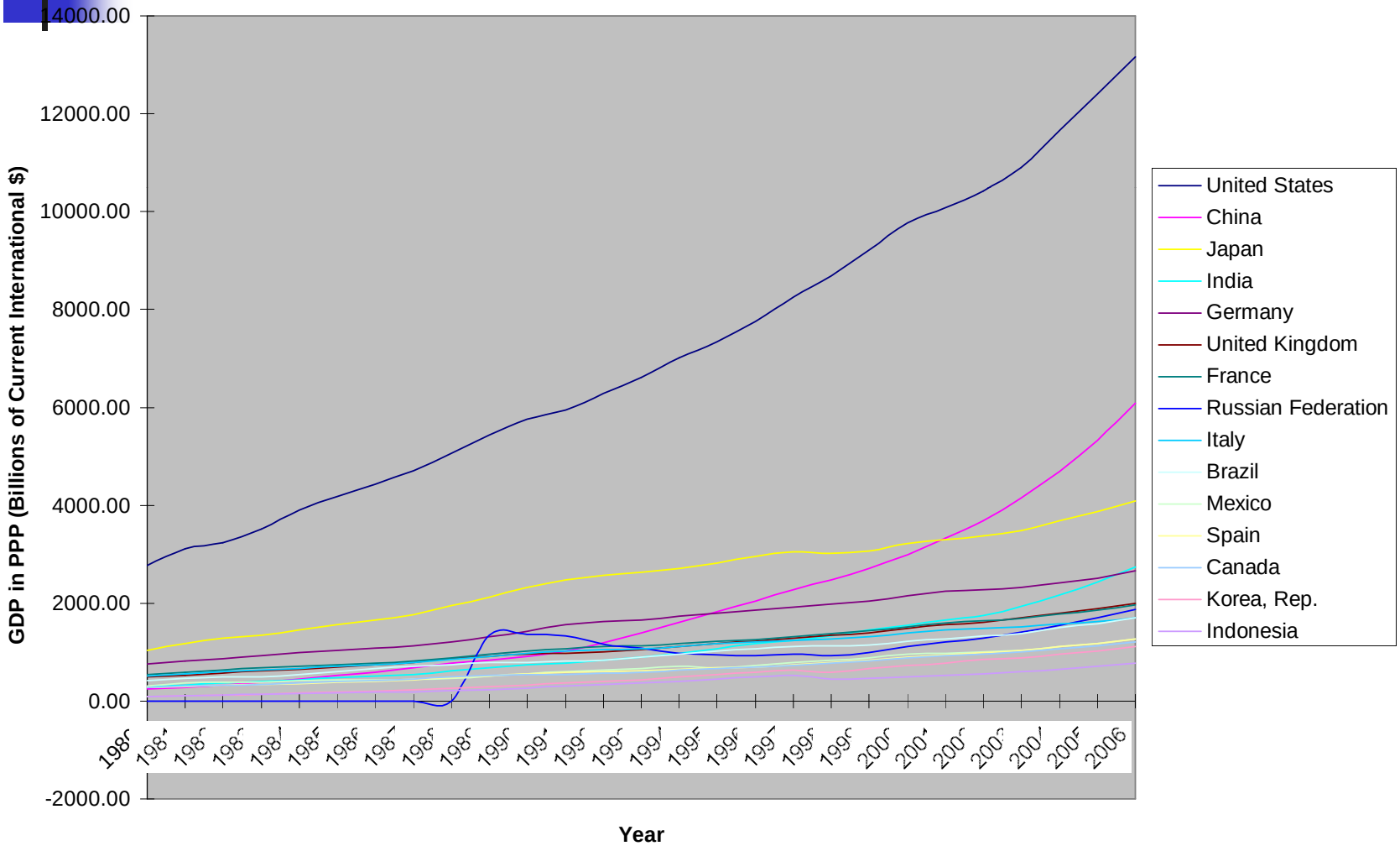
Rise of China and India

- Developing East Asia's share in Global GDP has shown fastest rise among all developing regions
- China and India are becoming major players on global stage
  - China already second largest economy in ppp terms
  - India already the fourth largest in ppp terms
- They reflect the two unbundlings
  - China: unbundling of production
  - India: unbundling of services
- They are on track to become even more important in global economic activity
  - Projecting at 2000-2006 rates of growth, they are set to be the largest and second largest economies in world by 2018
  - However, world is not linear, so this is just indicative
- They are both affecting and being affected by new global challenges that we will focus on with respect to countries participating in course

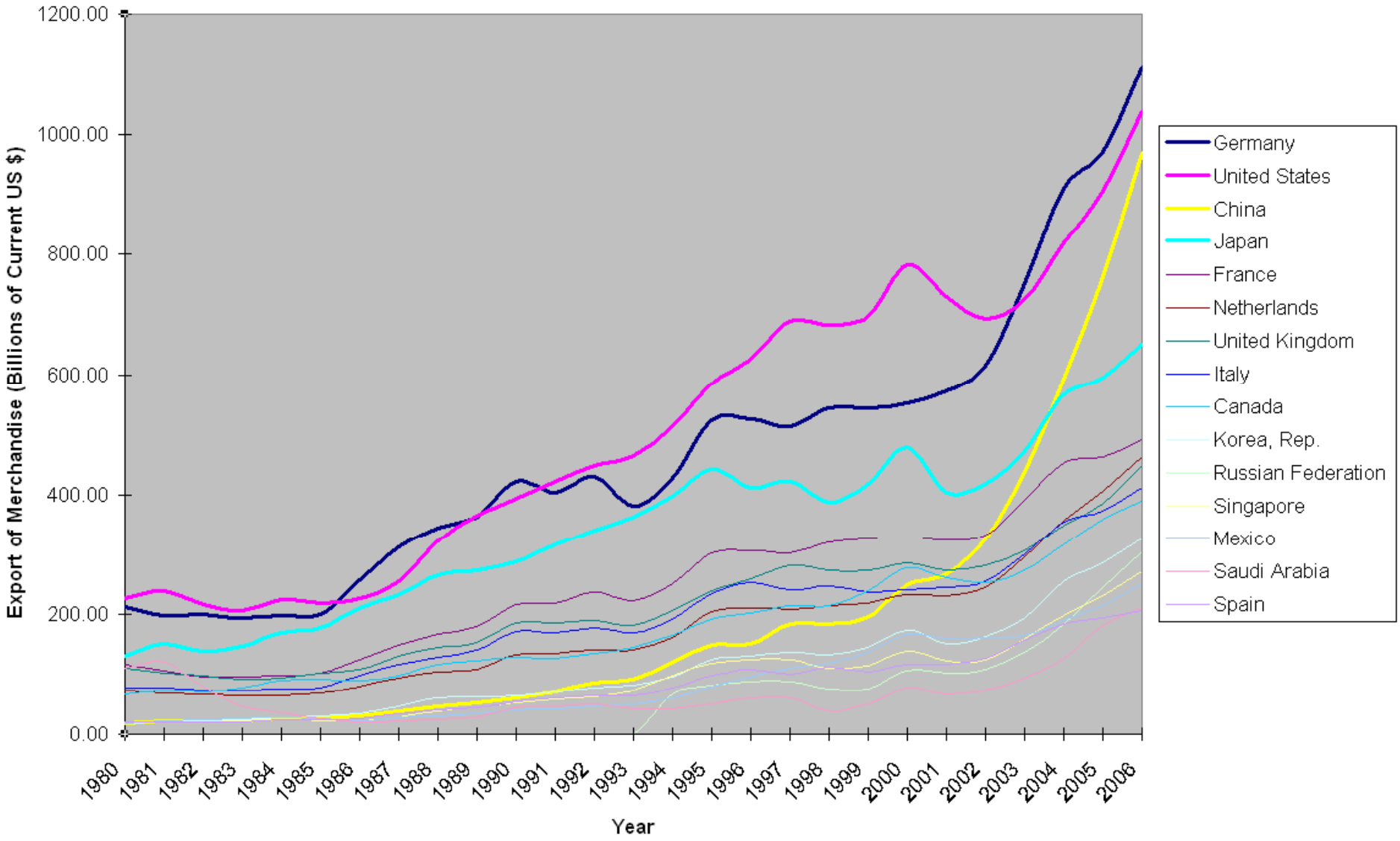
Changing Share of Different Regions in World GDP 1980-2006 (in PPP Terms)



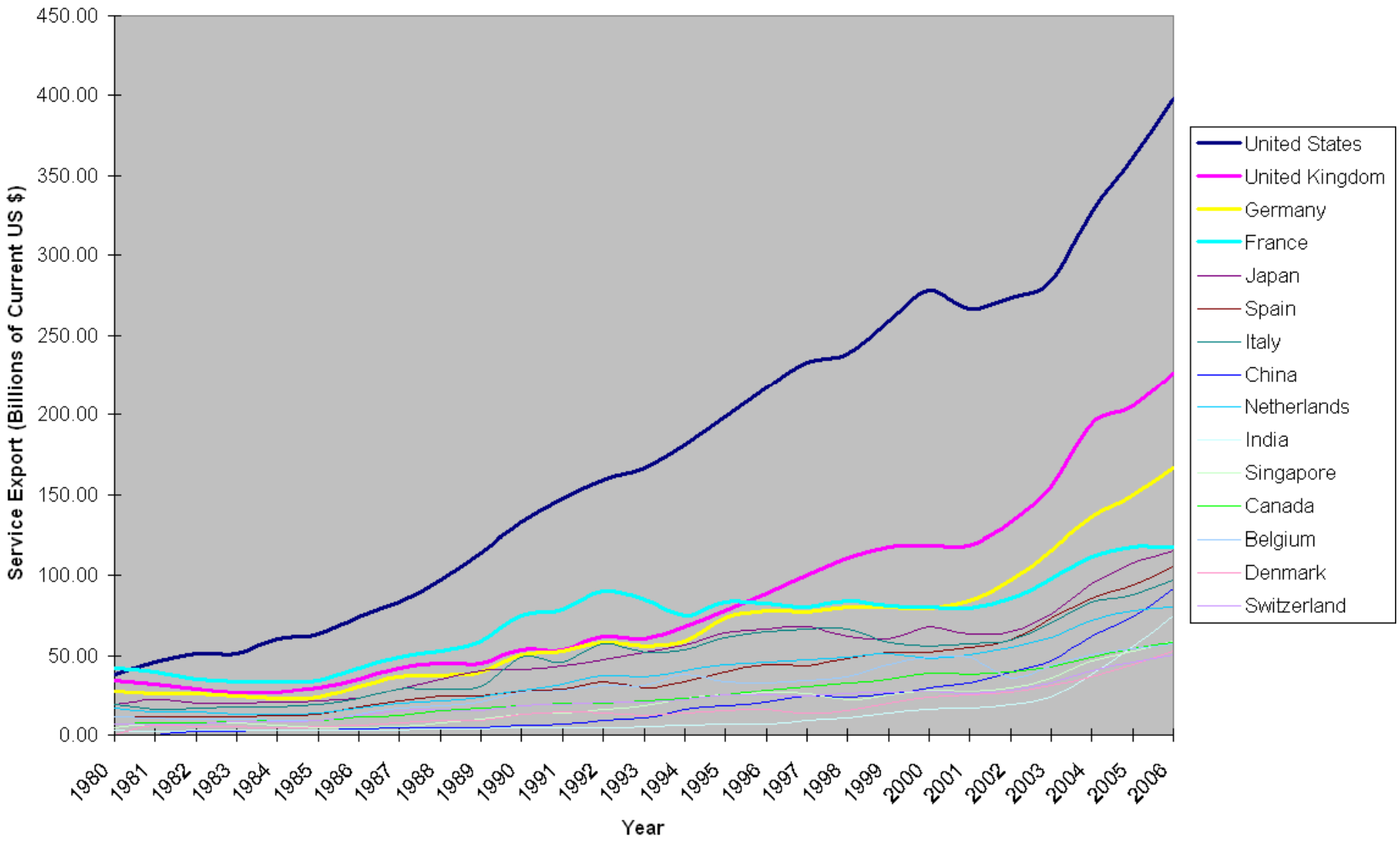
GDP Growth of 15 Largest Countries 1980-2006 (in PPP)



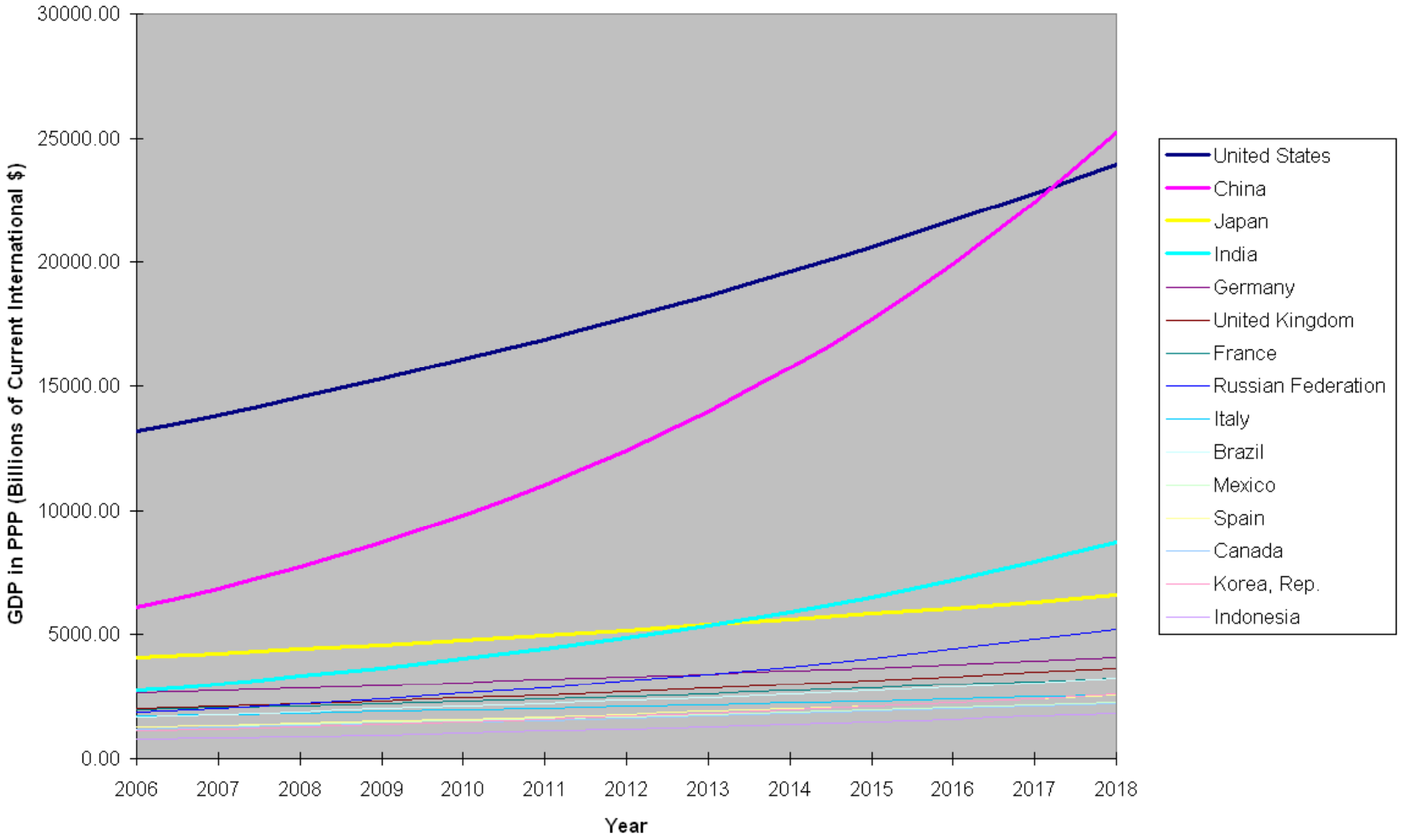
Top 15 Exporters Merchandise Trade



Top 15 Exporters Commercial Services



GDP Projections in PPP (based on 2000-2006 actual growth)



Innovation Defined Broadly

- Innovation is not just about R&D
  - Some comes from insight and experience
  - Lots come from copying or imitation or buying what has been done by others
- Innovation is not just narrow technology, but also about organization and business models
- Distinguish between innovation as
  - First in world development and application of new technology or organization (call it “cutting edge”)
  - First use in local context, which may not require R&D, although generally does require some technological capability (call it “adaptation”)

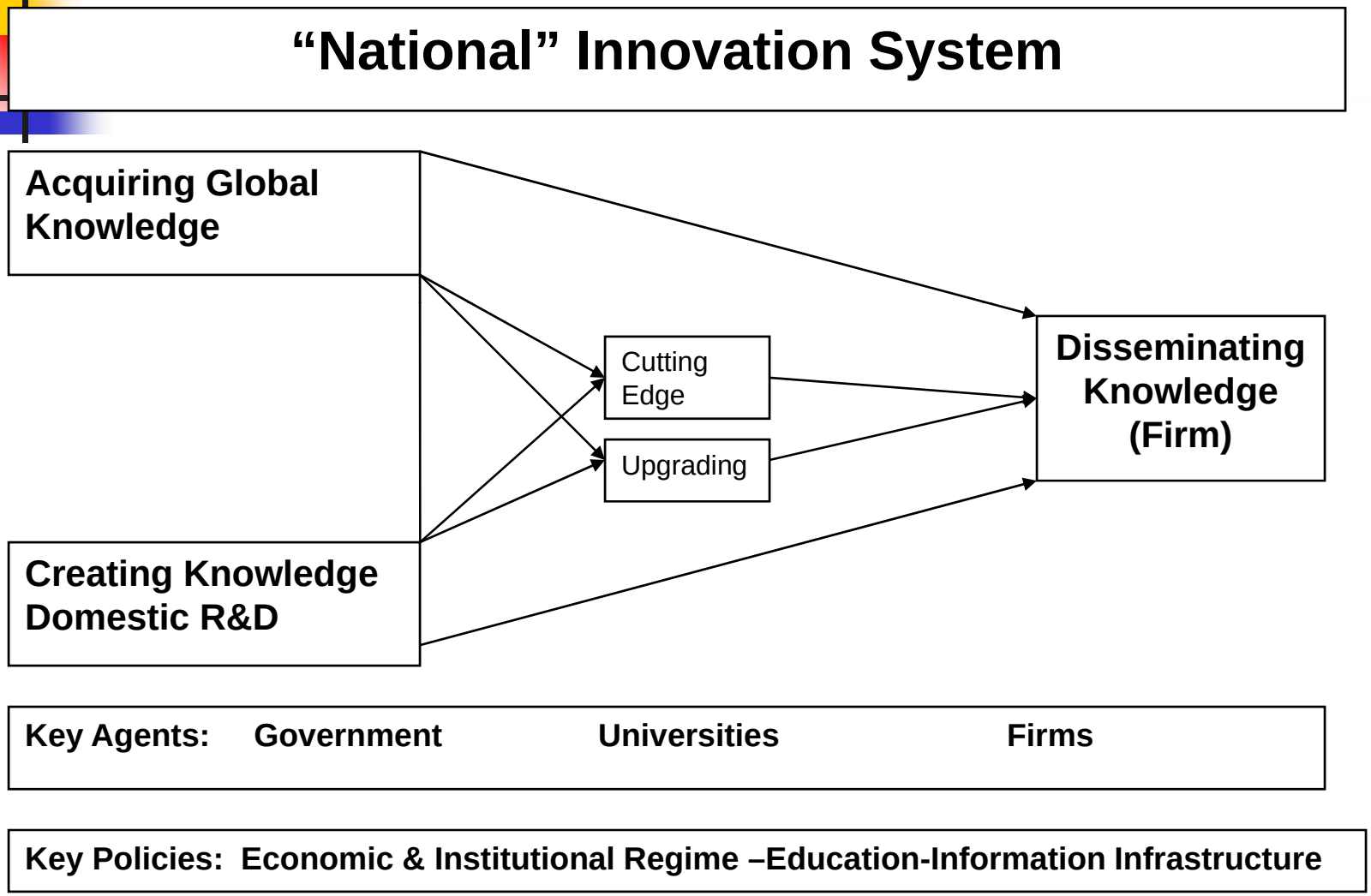
Innovation Defined Broadly (cont.)

- As stock of knowledge and global frontier are expanding very rapidly…
  - For countries or sectors not yet at global frontier it is most critical to access, acquire adapt and make effective use of already existing knowledge i.e “adaption”
  - As countries or firms get close to global frontier, then first in world “cutting edge” is more important
  - But all countries need to get better at creating, acquiring, and using knowledge effectively

National System of Innovation

- Not just R&D
- But also
  - Broader economic and institutional system,
  - Scientists, engineers, managers and professionals
  - Information infrastructure and networks
- National also somewhat of a misnomer because knowledge and innovation are increasingly global
- Propose a simple schematic diagram to conceptualize NIS

Schematic Diagram of NIS



NIS China, India, US Compared

- Acquiring Global Knowledge
- Creating Knowledge
  - R&D Inputs
  - R&D Outputs
- Using Knowledge (Proxied by)
  - Productivity per Worker
  - Dispersion in Productivity Levels within economy

Acquiring Global Knowledge

	China	India	US
Trade as Share of GDP (2006)	**73.9**	**47.6**	**28.3**
Merchandise exports % of GDP	**36.6**	**13.2**	**16**
Manufactured Exports % of merchandise exports	**92**	**70**	**79**
High tech exports % of Manufactured Exports	**30**	**5**	**30**
Commercial Service Exports % of GDP	**3.5**	**8.2**	**30**
Average Tariffs (in % - 2006)			
Average simple tariffs	**8.9**	**16.8**	**3.0**
Average weighted tariff	**4.3**	**14.5**	**1.6**
Average Gross FDI/GDP 1995-2004	**3.2**	**0.9**	**1.4**
Royalty and license fee payments ($ million 2006)	**5,321**	**421**	**26,523**
Royalty and license fee payments/million population (2006)	**4.08**	**0.38**	**88.75**
Tertiary Students Studying Abroad 2004	**381,330**	**129,627**	**46,547**

Formal R&D Inputs & Outputs

Indicator	China	India	US
Researchers in R&D, 2006	**926,252**	**117,528**	**1,334,628**
R&D researchers per million population,			
1995	**445**	**157**	
2006	**714**	**119**	**4,625**
Spending on R&D (US$ billions)			
US $ billion nominal 2006	**35.4**	**5.6**	**358**
US $ billion in PPP 2006	**82.0**	**16.6**	**353**
Spending on R&D (percentage of GDP)			
1995	**0.85**	**0.8**	
2006	**1.34**	**0.61**	**2.68**
Scientific and technical journal articles,			
1995	**9,261**	**9,591**	**202,887**
2005	**41,596**	**14,608**	**205,320**
Per million population			
1995	**7.69**	**10.29**	**762**
2005	**31.9**	**13.4**	**692**
Patents granted by U.S. Patent Of, (average 2002-2006)	**448**	**316**	**94,217**
per million population			
1991-1995 average	**0.05**	**0.04**	**247**
2002-2006 average	**0.35**	**0.30**	**324**

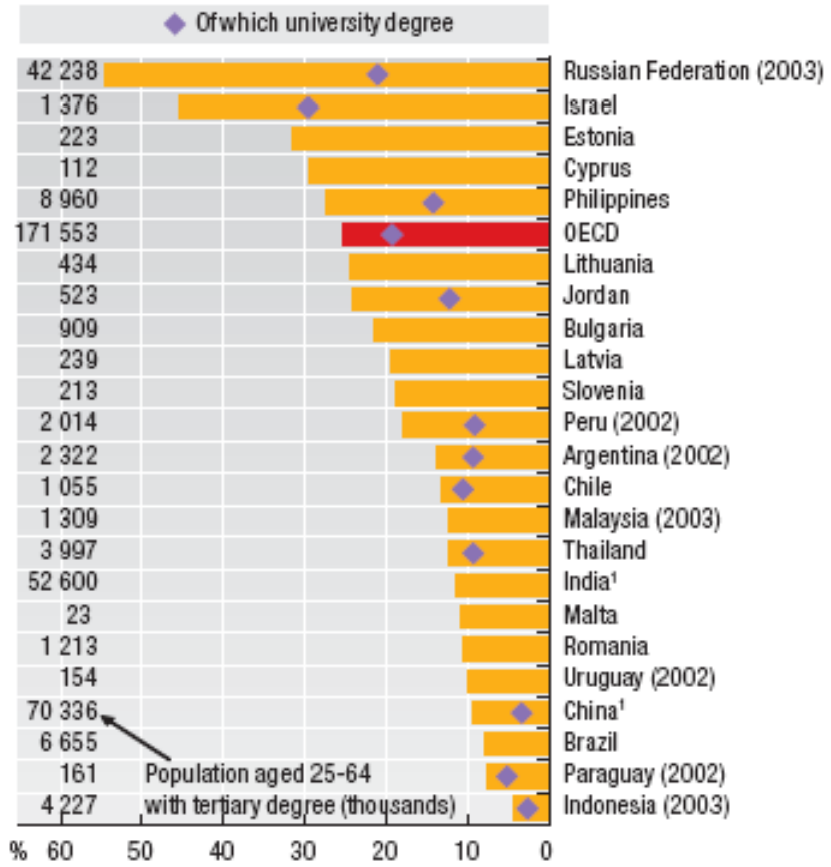
Proxy for Use: Productivity Levels

	China	India	US
Economy wide GNP/Capita	2,000	820	44,710
Agricultural Value Added/Worker (constant 2000$)			
1990-92	254	324	20,793
2003-05	401	392	41,797

Human Resources for S&T in Non OECD Countries

Educational attainment in non-OECD economies, 2004

Percentage of population aged 25-64 with tertiary degree



University entrants and graduates in non-OECD economies, 2004

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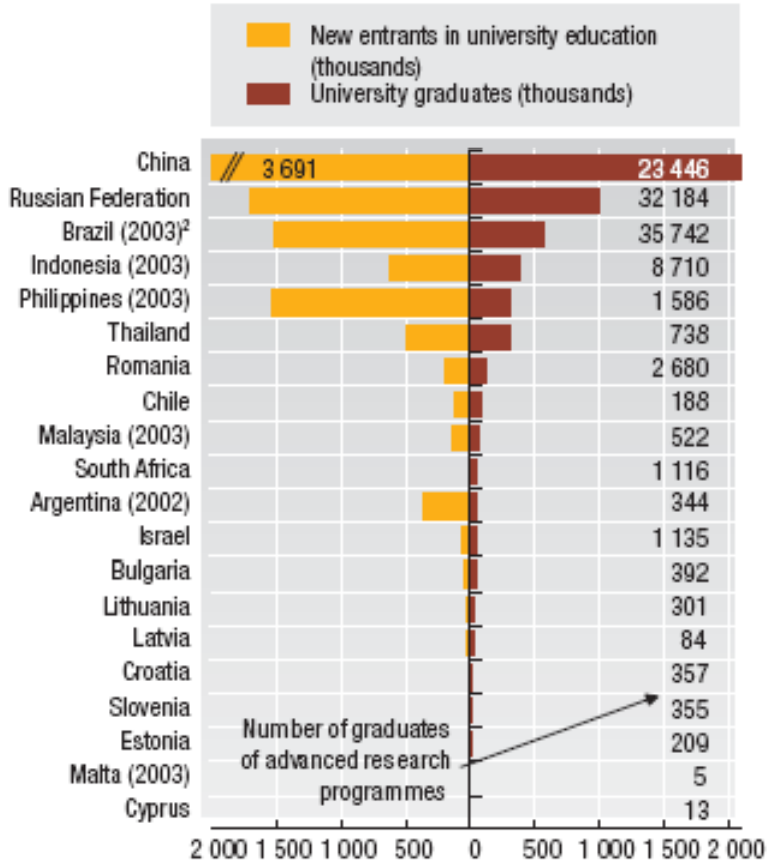

Source: OECD STI Scoreboard 2007

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cjd2 Carl Dahlman, 2/18/2008

Summary of Three NIS

	China	India	US
Acquiring	Extremely strong through trade, direct foreign investment technology transfer, foreign education, reverse engineering global supply networks	Still relatively weak compared to China due to lower global integration through trade, FDI, technology, others. Still not very globally integrated except in ICT	Strong because of global scope of its multinational companies which intermediate knowledge globally. Very strong global networks.
Creating	Becoming stronger, rapidly increasing R&D/GDP, second largest scientists and engineers in R&D in world, but still has way to go to improve institutional structure and productivity of R&D	Still relatively low R&D/GDP, has critical mass of scientists and engineers in R&D, but bulk of R&D still done by government labs rather than firms. Has to increase productivity of public R&D, and private R&D	Still world leader in absolute R&D effort, scientific and technical output, and innovation. Strong culture of risk taking innovation. However, rest of world is catching up, dominance diminishing. Also its companies are going global even in R&D
Using	Still dual economy with rapidly growing modern sector but still large traditional, low productivity sector. Domestic firms still mostly imitators and followers rather than global innovators. However are rapidly developing capability to acquire and adapt knowledge and innovate locally.	Extremely dual economy: with very small modern sector (only 11% of labor force and 2/3rds of that in government), very large traditional sector. Very large dispersion of productivity in any sector. Some strong domestic firms with innovation capability. Some becoming global innovators, and going abroad	Fully modern economy with most large multinational companies in world. Strong institutional Infrastructure for all dimensions of innovation, particularly development and commercialization of cutting edge innovation.

Key Policy Issues for Each Country

China	India	US
▪Strengthening the dissemination of innovation, whether local or foreign ▪Increasing efficiency of public R&D management and productivity ▪Strengthening cutting edge innovation ▪Strengthening global innovation capacity of domestic firms ▪Strengthening the enforcement of intellectual property rights ▪Strengthening the overall economic and institutional regime ▪Strengthening participation in global knowledge networks	▪Strengthening acquisition and use of global knowledge (liberalize trade and FDI policy) ▪Strengthening dissemination of innovation whether foreign or local ▪Strengthening efficiency of public R&D management and productivity ▪Increasing private R&D ▪Strengthening scientific and technical higher education ▪Strengthening the commercialization of domestic innovation ▪Strengthening the overall economic and institutional regime ▪Strengthening participation in global knowledge networks	▪Increasing stock of scientists and engineers ▪Increasing Basic R&D ▪Promote more R&D by firms ▪Strengthening acquisition and dissemination efforts ▪Move from complacent assumption that will continue to be world leader to more active innovation policy ▪More explicit coordination of Science, Technology and Innovation Policy ▪Strengthen the attractiveness for MNCs to do more R&D in the US ▪Strengthening cooperative research networks to deal with global problems

Key Global Challenges

- Environmental Constraints
  - Food Shortages
  - Rising commodity prices
  - Energy and Global Warming
- Poverty and Increasing Inequality
  - Global poverty has decreased, in part due to strong growth in China
  - But in China, India, and most countries of world inequality is increasing
- Increasing Global Systemic Risk
  - Financial
  - Disease Pandemics
  - Terrorism

Key International Issues

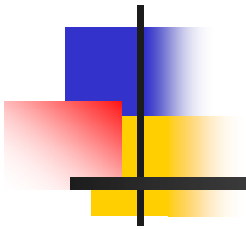
- Intellectual Property Rights
- Collaboration on environment related issues Global warming
  - Energy in general
  - Clean coal in particular
- Collaboration on “inclusive innovation to fight poverty and inequality

Finding Win Win Areas

- International collaboration on global public goods research
  - Raising agricultural productivity
  - Energy: energy efficiency, alternative energy, renewable energy,
  - Climate change: mitigation and adjustment policies
  - Improve preventive medicine
- International collaboration on pre competitive research
- Sharing of best practices on managing large research systems
- Strategic alliances among firms for private research

Conclusion

- There are many serious challenges
- Science and technology can play a key role
- Three countries here present are key players
- There is potential for greater cooperation and collaboration among governments, universities, research institutes, and firms
- Hopefully this conference will further strengthen awareness and collaboration



Thank You!

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