U.S. – China Economic and Security Review Commission

The Impact of China's Five-Year Plans on Strategic Industries
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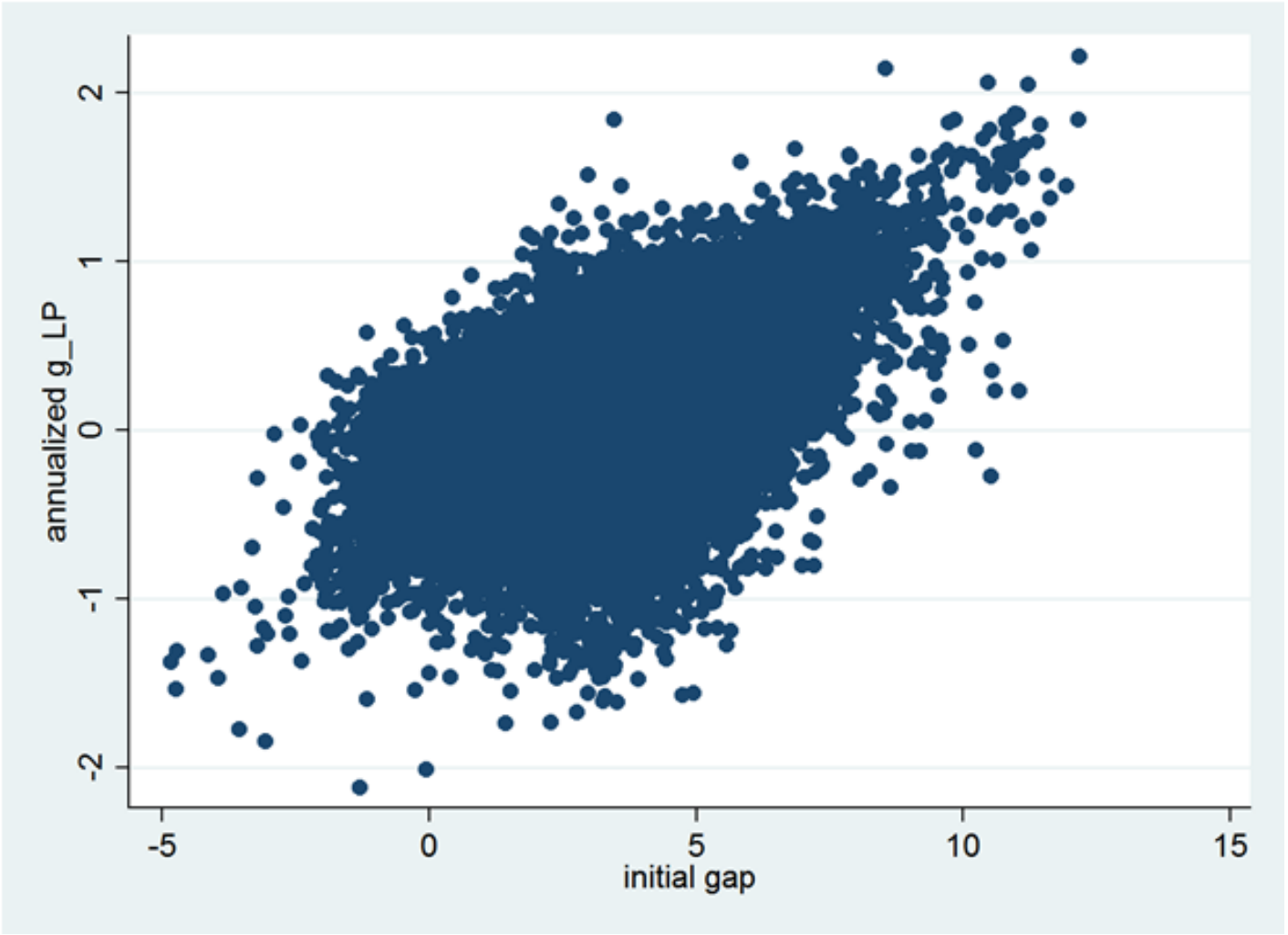
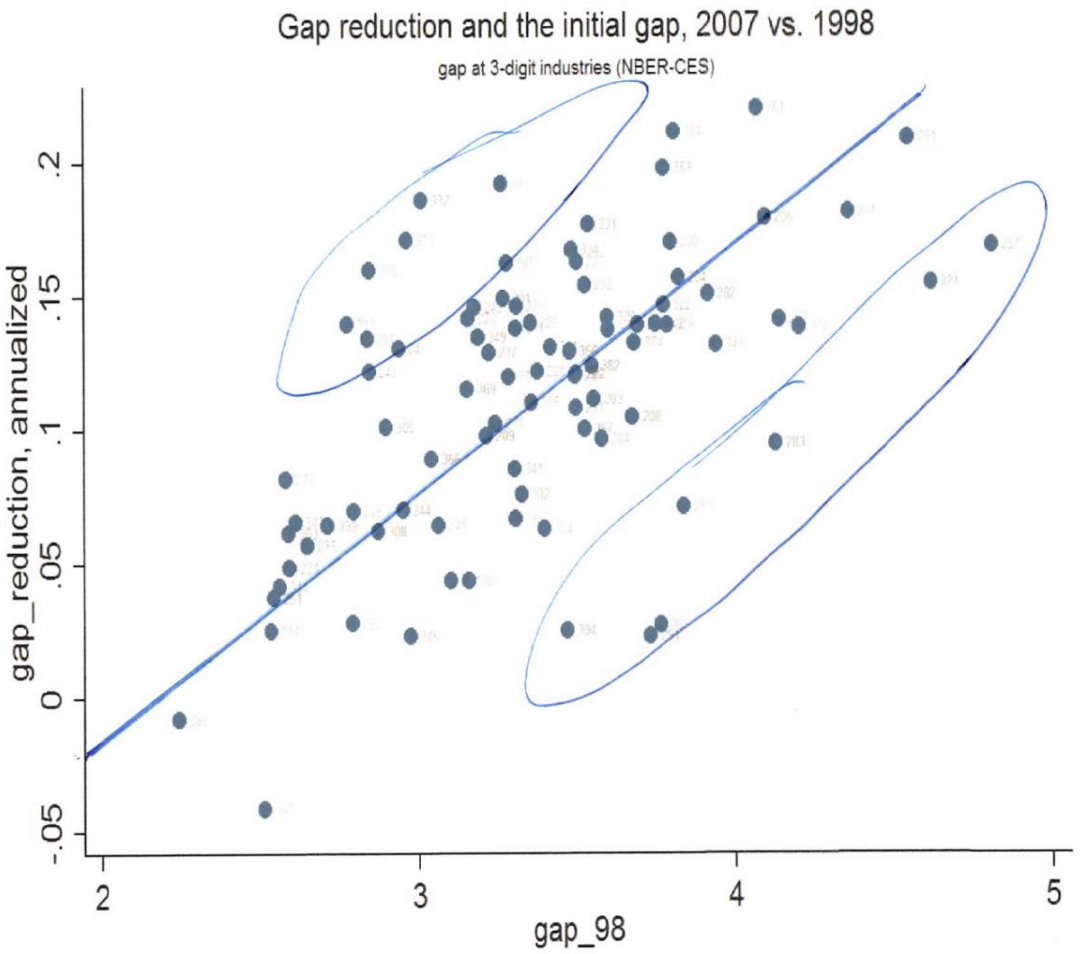
Shows how the labor productivity growth (gLP) of Chinese firms responds to the technology gap with the international frontier (i.e., the U.S.)…the larger the gap the greater gLP.

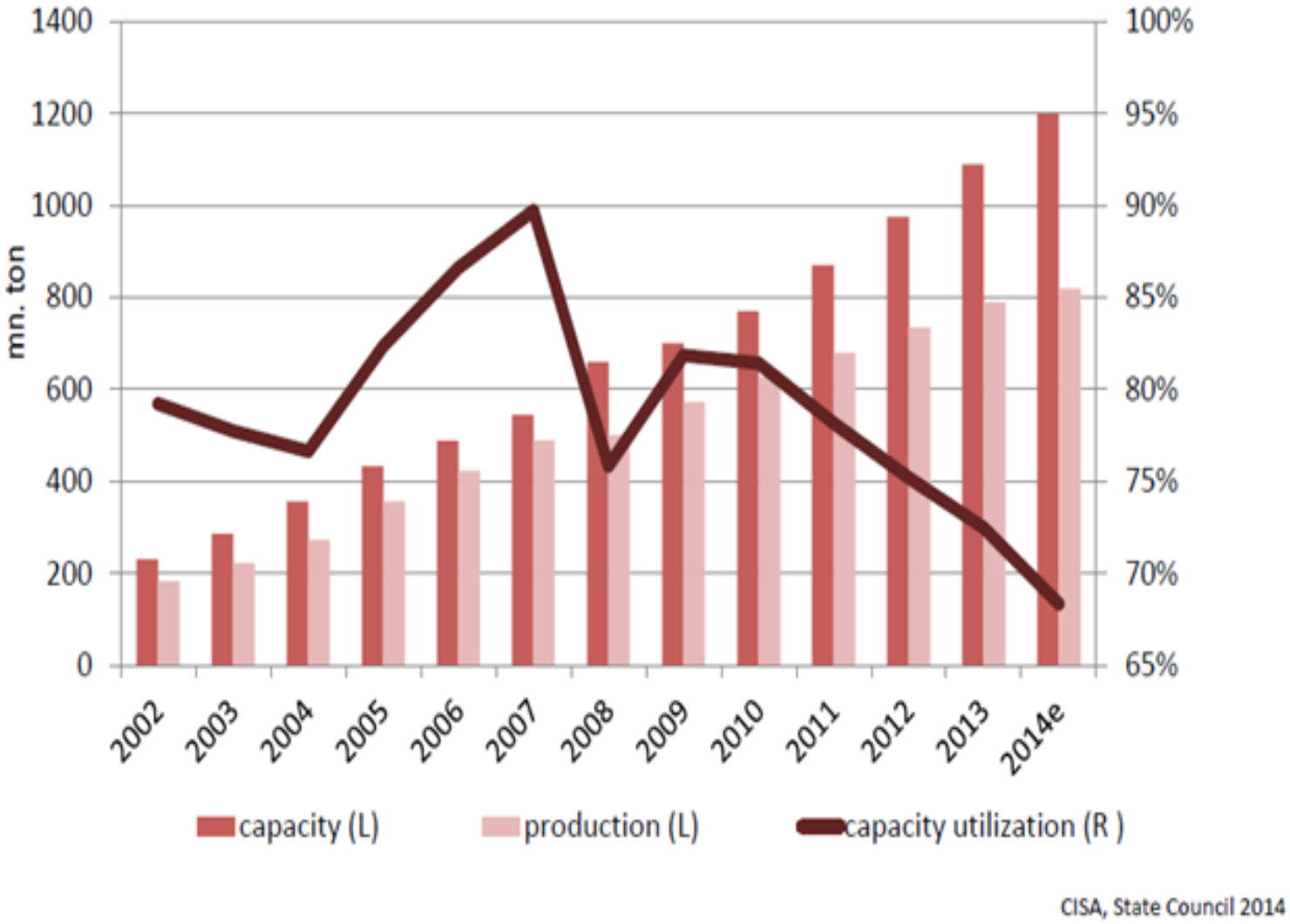


Shows a similar relationship for the rate of growth of catch-up (i.e., gap reduction) relative to the size of the U.S.-China productivity gap –

1. industries to the NW (mostly iron and steel due to relatively slow U.S. LP growth);
2. industries to the SE (petroleum and coal products, chemicals, apparel, computer and electronic products due to relatively high U.S. LP growth.



Reversals – 1998-2007 rising capacity utilization in the iron and steel industry; sharp post-2007 decline in capacity utilization…



CISA, State Council 2014

12th 5-year plan: Ch. 9 (sec. 4) "Drive advantaged enterprises to carry out alliance, x-regional merger and reorganization, and increase industry concentration with an emphasis on…iron and steel (and automobile, cement, machine building…). **The problem…**

(source: Dr. Markus Taube Univ. of Duisburg-Essen)

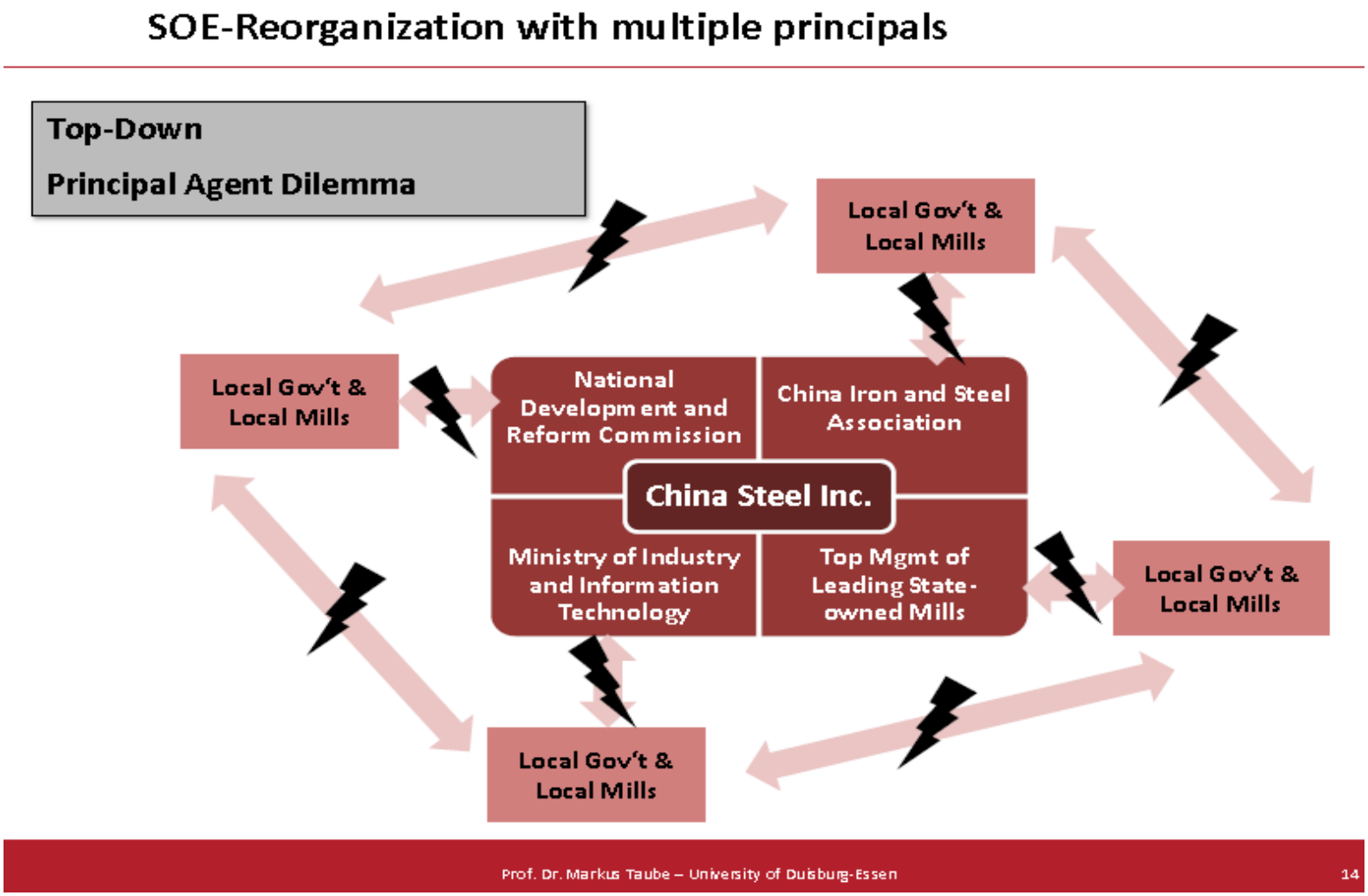


Table 3. Has China developed its own internal frontier?

1. Top decile Chinese firms > U.S. average (3/18) and
top 10 Chinese firms >> U.S. average (15/18)
2. 3-firm comparisons (publicly traded companies):
U.S./China sales/employee advantage = 2.28

Table G. Labor productivity by major industry sectors: Industry mean, top decile and top-10-firm average relative to US frontier*

mind2	industry	average LP to frontier ratio		top decile to US frontier ratio			top-10 firms to US frontier ratio			max	
		1998	2007	LP_98	LP_07	VA_share_2y_avg	LP_98	LP_07	VA_share_2y_avg	top1 firm vs US frontier ratio_98	top1 firm vs US frontier ratio_98
0	***Total Manufacturing***	**0.05**	**0.14**	**0.37**	**0.70**	**0.35**	**0.83**	**2.47**	**0.06**		
1	Food and beverage and tobacco products	0.09	0.25	0.55	1.45	0.50	2.20	6.15	0.14	5.24	8.64
2	Textile mills and textile product mills	0.05	0.16	0.37	0.67	0.23	0.84	1.76	0.01	1.51	2.40
3	Apparel and leather and allied products	0.10	0.12	0.66	0.58	0.27	0.99	1.54	0.02	1.67	2.81
4	Paper products	0.04	0.13	0.22	0.45	0.34	0.24	0.97	0.07	0.67	3.62
5	Printing and related support activities	0.08	0.20	0.34	0.77	0.41	0.74	1.20	0.07	2.12	1.86
6	Petroleum and coal products	0.02	0.04	0.07	0.19	0.32	0.07	0.35	0.16	0.10	1.02
7	Chemical products	0.03	0.09	0.19	0.51	0.33	0.60	2.08	0.04	1.07	3.50
8	Plastics and rubber products	0.06	0.14	0.37	0.68	0.28	0.43	1.67	0.03	0.67	8.04
9	Wood products	0.07	0.23	0.49	1.01	0.30	0.56	1.44	0.09	1.28	2.23
10	Nonmetallic mineral products	0.03	0.16	0.22	0.78	0.27	0.54	1.47	0.02	1.25	2.35
11	Primary metals	0.06	0.29	0.49	1.19	0.22	0.65	2.74	0.05	0.97	3.56
12	Fabricated metal products	0.06	0.17	0.41	0.84	0.34	0.60	2.22	0.04	1.27	4.17
13	Machinery	0.03	0.15	0.23	0.68	0.29	0.70	2.53	0.03	1.41	7.61
14	Computer and electronic products	0.08	0.11	0.45	0.52	0.51	1.87	2.17	0.05	3.56	3.64
15	Electrical equipment, appliances, and components	0.07	0.16	0.38	0.72	0.40	0.76	1.90	0.04	1.37	2.56
16	Motor vehicles, bodies and trailers, and parts	0.05	0.20	0.34	0.80	0.45	0.93	3.08	0.13	6.25	9.02
17	Furniture and related products	0.09	0.14	0.43	0.72	0.25	0.36	0.75	0.08	0.82	1.10
18	Miscellaneous manufacturing	0.05	0.07	0.44	0.44	0.27	0.43	0.67	0.04	0.99	1.07

*Note: The sample used in this calculation requires firms, which appeared in 1998, to appear again in 1999; and firms, which appeared in 2007, also existed in 2006. We further dropped firms with VA<=0, L<=1 and VA>=output. For the top 10 firms in each industry, we further limit our sample to LME (large and medium enterprises), and their LP can't exceed 10 times of US average in both 1998 and 2007.

What drives the catch-up?

1. Domestic firms with an edge benefit the most from FDI and import competition → separation effect with break out firms…
2. Five (5) of top 8 import sectors are also top 5 mfg. export sectors
3. The computer chips sector is on track…

China's Top 10 Exports

The following export product groups represent the highest dollar value in Chinese global shipments during 2014. Also shown is the percentage share each export category represe terms of China's overall exports.

1. Electronic equipment: US$571,045,520,000 (24.4% of total exports)
2. Machines, engines, pumps: $400,910,983,000 (17.1%)
3. Furniture, lighting, signs: $93,390,874,000 (4.0%)
4. Knit or crochet clothing: $92,002,609,000 (3.9%)
5. Clothing (not knit or crochet): $81,453,227,000 (3.5%)
6. Medical, technical equipment: $74,020,496,000 (3.2%)
7. Plastics: $66,816,299,000 (2.9%)
8. Vehicles: $64,243,754,000 (2.7%)
9. Gems, precious metals, coins: $63,212,400,000 (2.7%)
10. Iron or steel products: $60,685,405,000 (2.6%)

xx. Computer chips: (2%)

Source: http://www.worldstopexports.com/chinas-top-10-exports/1952

China's top 10 Imports

The following import product groups represent the highest dollar value in World global shipments to China during 2014. Also shown is the percentage share each import categor represents in terms of China's overall imports.

1. Electronic equipment (21.7% of total imports)
2. Oil
3. Machines, engines, pumps (9.2%)
4. Ores, slag, ash
5. Medical, technical equipment (5.4%)
6. Vehicles (4.6%)
7. Plastics (3.8%)
8. Organic chemicals
9. Copper
10. Oil seed

xx. Computer chips (90.5%, $163 billion)**

Source: http://www.worldsrichestcountries.com/top_china_imports.html

**Source International Business Strategies, 2015 estimates reported in the *Wall Street Journal*, http://www.wsj.com/articles/china-looks-to-prop-up-domestic-chip-makers-1422387551

Table 6. China's innovation system…achievements; challenges

numerical catch-up; quality lag

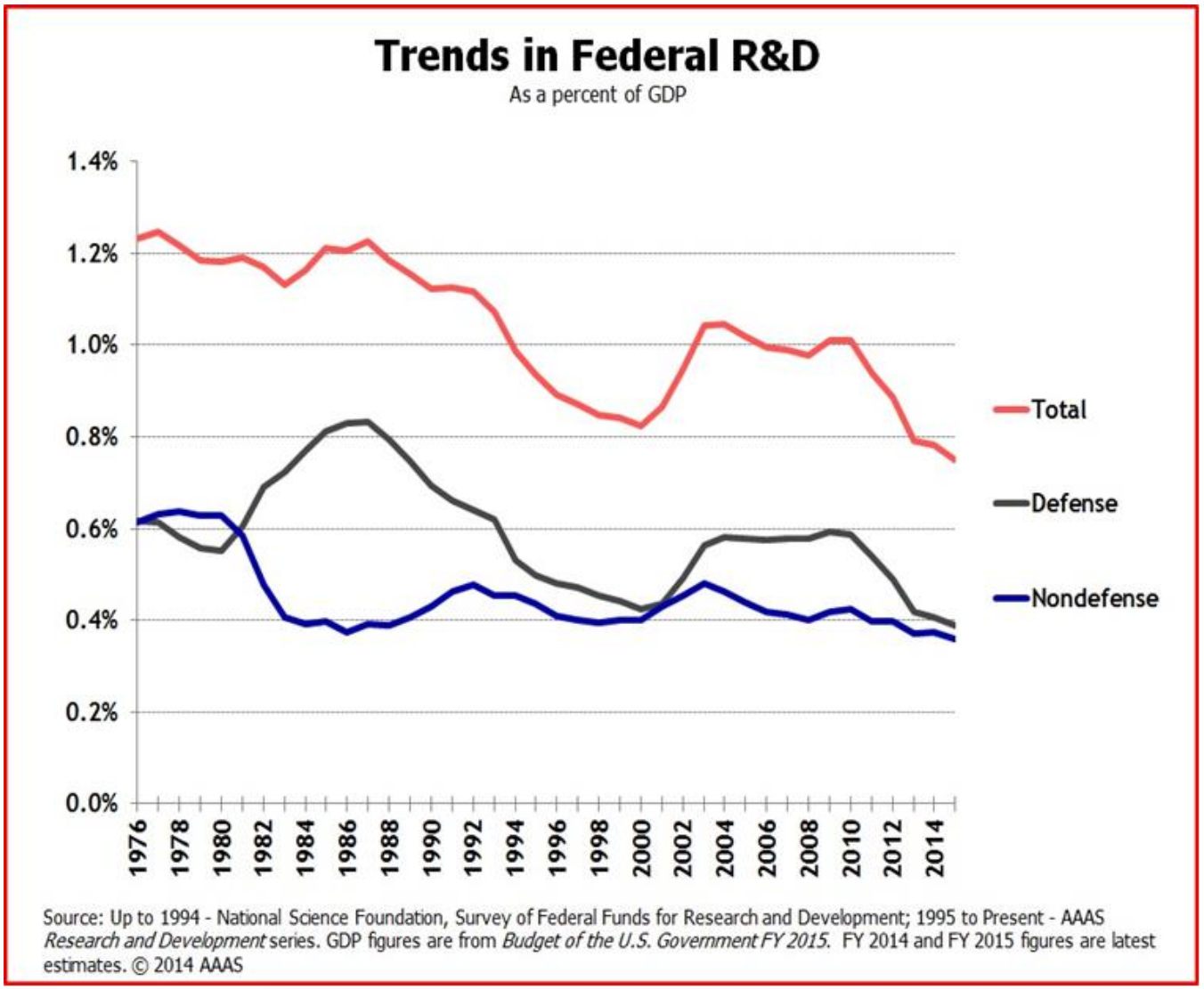
1. China as an "innovative society"…R&D/GDP = 2.0% vs. U.S. 2.8%

2. basic research share…5.0% vs. U.S. 18%

3. government share…21.6% vs. U.S. ~29%

Table 5. Intramural R&D Expenditure by Performing Sector (billion yuan)				
year	total	Basic (%)**	Applied (%)**	Experimental Development (%)**
1995 - Total	**34.87 (0.57%)***	**1.81 (5.2%)**	9.20	23.86
2007 – Total				
2012 - Total	**1029.84 (1.98)***	**49.88 (4.8%)**	**116.20 (11.3)**	**836.76 (83.9)**
Enterprises	**784.22 (76.2%)**	**0.71**	23.89	**759.63 (96.9%)**
Government sector (i.e., Research institutions)	**154.89 (15.0%)**	**19.79 (7.8%)**	**46.93 (30.3%)**	**88.17 (51.9%)**
Higher education	**78.06 (7.6%)**	**27.57 (35.3%)**	**40.27 (51.6%)**	**10.22 (13.1%)**
Private non-profit	**12.67 (1.2%)**	1.81	5.11	5.74
Intramural R&D by Source (billion yuan)				
year	Government	Self-raised by enterprises	Foreign funds	Other funds
2007 – 371.02				
2012 – 1029.84	**222.13 (21.6%)**	**762.50 (74.0%)**	**10.04 (1.0%)**	**35.16 (3.4%)**
Of which				
Beijing - 106.34	**56.60 (53.2%)**	36.86	4.79	8.08
Liaoning – 39.09	**9.00 (23.0%)**	29.64	0.08	0.36
Jiangsu – 128.79	**13.88 (10.8%)**	109.86	0.96	4.09
Zhejiang – 72.29	**6.04 (8.3%)**	64.44	0.31	1.47
*Share of GDP; **share of total R&D expenditure				

A matter of concern…



Key points re: patents and publications:

1. China has surpassed the U.S. in total patents filed and granted
2. China has surpassed the U.S. in invention patents granted to domestic filers
3. China has surpassed the U.K. in USPTO patents granted; lags S. Korea and Taiwan
4. China ranks 2nd in cited papers; 7th in total citations

Table 7. Comparisons of Patent Production

	Total	Domestic						Foreign
	All SIPO patents	Total	Enterprises	Universities	Research institutes	Government and other organiza-tions	Non-official	All
2012 – China: SPIO								
Invention								
applications	652,777	535,313 (82.0%)	316,414	75,688	29,518	6,807	106,886	117,464 (18.0%)
granted	217,105	143,847 (66.3%)	78,651	33,821	11,248	2,234	17,893	73,258 (33.7%)
In force, of which								
Invention	875,385 (24.9%)	473,187	274,038	96,707	37,639	3,086	61,717	402,198 (45.9%)
Utility model	1,501,044 (42.8%)	1,486,839	973,122	63,650	26,839	10,701	412,527	14,205 (0.9%)
Design	1,132,132 (32.3%)	1,044,997	564,716	17,161	2,671	5,072	455,377	87,135 (7.7%)
Total patents in force	3,508,561	3,005,023 (85.6%)	1,811,876	177,518	67,149	18,859	929,621	503,538 (14.4%)
USPTO, country of origin								
Utility (invention) patents granted	Total	U.S.	Foreign origin	Japan	U.K.	S. Korea	Taiwan	China
2007	157,282	79,526	77,756	33,354	3,291	6,295	6,128	772
2014	300,678	144,621	156,057	53,849	6,487	16,469	11,332	7,236
Citations (Essential Science Indicators, Thomson-Reuters) cumulative (2001-2011)								
Country	India	U.S.	Germany	Japan	U.K.	S. Korea	Taiwan	China
Most cited countries by papers (rank)	11	1	3	4	5	12	18	2
Most cited countries by citations (rank)	16	1	2	4	3	14	Below top 20	7

Comparisons/weaknesses

- All OECD countries dedicate substantially larger portions of R&D to basic research (3-5x)
- Enterprise sector:
  - Declining patent production returns to R&D …also, at the firm level weak correlation between patenting and productivity growth.
  - Local government patenting incentives may be unhelpful, e.g., incentives for patent grants appear to motivate filers to narrow the claims on their patent applications → lower quality
- Higher education sector:
  - All OECD countries dedicate larger portions of higher education which performs most of basic research (2-3x)
  - Limits to autonomy-creativity in higher-ed (hierarchical/muddled incentives).
- Research institute sector:
  - Strong on publications; surprisingly weak on patents
  - 15% of total R&D; 7.8% of basic research; 5.5% of total invention patents granted
- Notable Innovations:
  - Chinese version of Bayh-Dole Act – enables recipients (i.e. universities and research institutes to secure patents for government-funded research)
  - University-corporate collaborations (e.g., Tsinghua Unigroup with acquisitions-partnerships with Chip Makers, including Spreadtrum in which Intel has a 20% share)

U.S. - recommendations

- Increase spending on basic research – retain this comparative advantage as long as possible.
- Anticipate that it is very likely that China will catch-up…i.e.,
  - It is very unlikely that 25 years from now, the U.S. will be able to out-spend China on innovation and defense or…over the following 25 years be able to out-perform China in these areas.
  - To the extent possible seek to establish coordination and/or joint limits on such spending…

http://en.wikipedia.org/wiki/Frascati_Manual

- The (OECD) Frascati Manual classifies research into three categories:
- *Basic research* is experimental or theoretical work undertaken primarily to acquire new knowledge about observable phenomena and facts, not directed toward any particular use.
- *Applied research* is original investigation to acquire new knowledge directed primarily towards a specific practical aim or objective.
- *Experimental development* is systematic effort, based on existing knowledge from research or practical experience, directed toward creating novel or improved materials, products, devices, processes, systems, or services.