New Technology Indicator for Technological Progress

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Motivation

- Demand for international comparability of innovations is increasing; however, it is difficult to achieve (Hall and Jaffe, 2012).

- Three ways to measure technology (Keller, 2010):

1. R&D investments (inputs)
2. Patents (outputs)
3. Multifactor Productivity (MFP; impacts of technology)

- Empirical drawbacks of MFP: It is difficult to conduct cross-country comparisons and has tremendous data requirements (OECD, 2001).

Methodology

- The New Technology Indicator: R&D depreciation rate (Li, 2012 for detailed methodology)

- Drivers of R&D depreciation rate: Pace of technological progress and degree of market competition (Hall, 1997)

→ Appropriability condition:

U.S. technology leaders have smaller R&D depreciation rates than followers (Li, 2015).

Hypothesis: in a free trade environment, an industry in country A has a higher technological advantage than its counterpart in country B is expected to have a smaller R&D depreciation rate.

Data

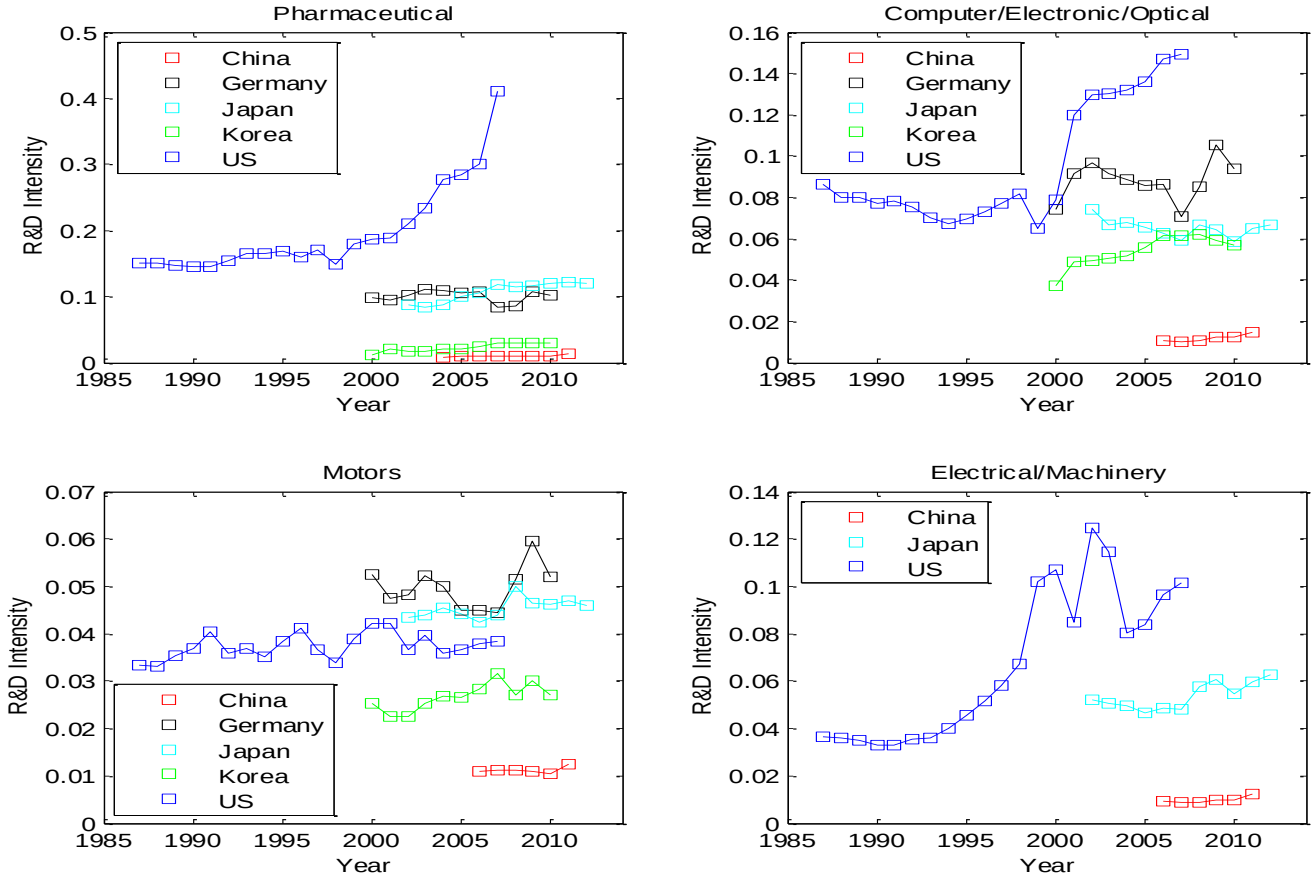
- Countries: the U.S., China, Germany, S. Korea, and Japan

- Industries: the motors, the pharmaceutical, the computer, electronic, and optical products, and the electrical equipment industries (cover all of Japan's high-tech industries)

- Period: The majority of the data cover the decade of the 2000s, but China's data is shorter because it started reporting R&D investments in 2006.

- Sources: BEA, Japan's Cabinet Office, OECD, and CEIC datasets.

Annual R&D Intensity for Each Industry across Countries



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Cross-Country Comparison I: the Pharmaceutical and Medical Device Industry

Country	δ_{RD}	δ_{RD} Ranking	Forbes' Ranking
United States	10%	1	1
Japan	13%	2	2
Germany	23%	3	3
China	46%	4	4
South Korea	76%	5	5

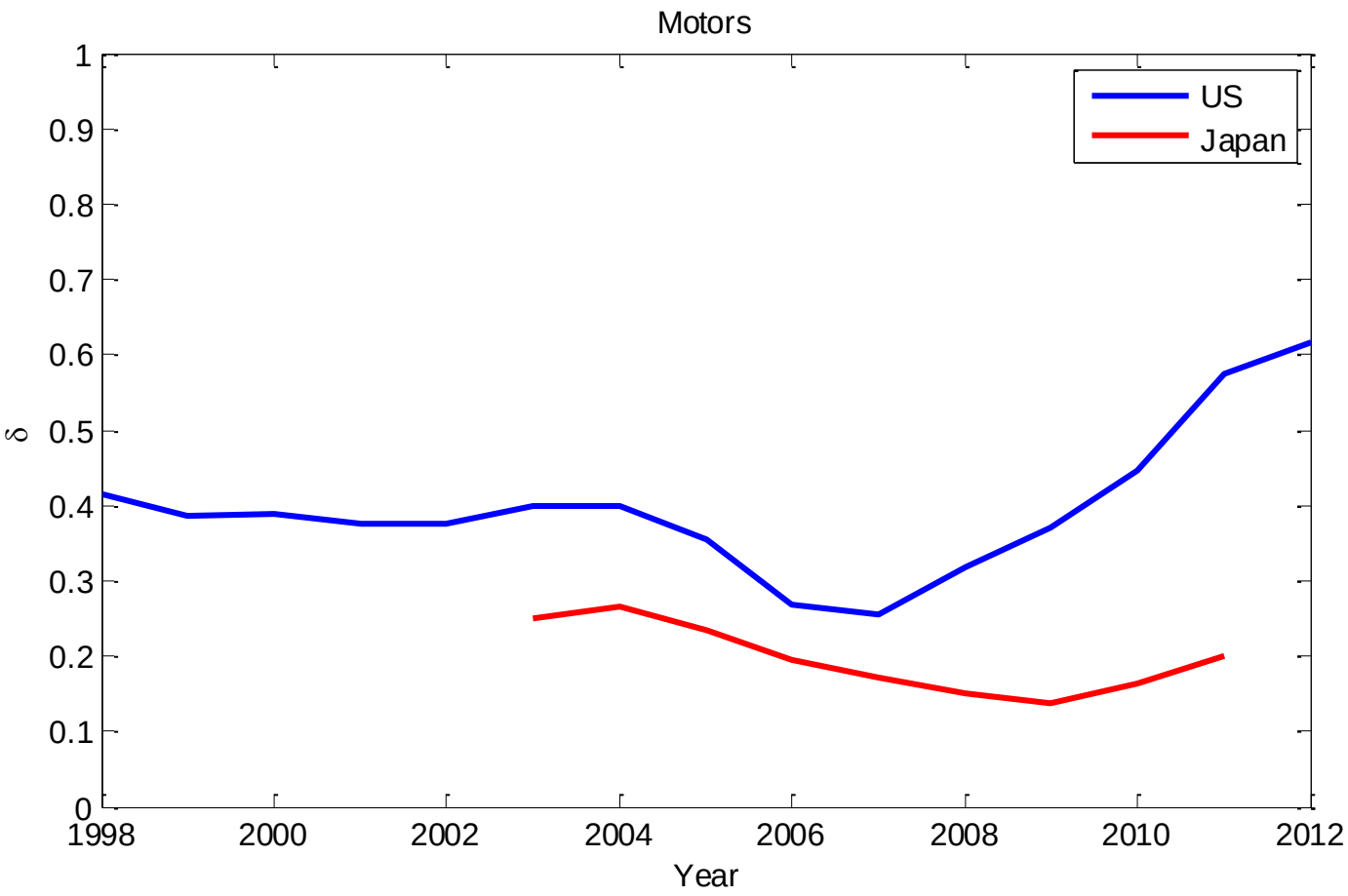
Cross-Country Comparison II: the Motor Industry

Country	δ_{RD}	δ_{RD} Ranking	Forbes' Ranking
Japan	22%	1	1
Germany	24%	2	2
United States	28%	3	3
South Korea	42%	4	4
China	61%	5	5

Comparison on R&D Depreciation Rate and MFP Level between the U.S. and Japan

Industry	$\delta_{RD, US}$	$\delta_{RD, Japan}$	MFP_{US}	MFP_{Japan}
Electrical equipment Industry	26%	33%	1.3	1.1
Computer, electronic, and optical products industry	32%	30%	19.5	15
Pharmaceutical industry	10%	13%	1.05	0.9
Motors industry	28%	22%	1.1	1.3

Time-Varying R&D Depreciation Pattern vs. Jorgenson et al. (2014)'s MFP



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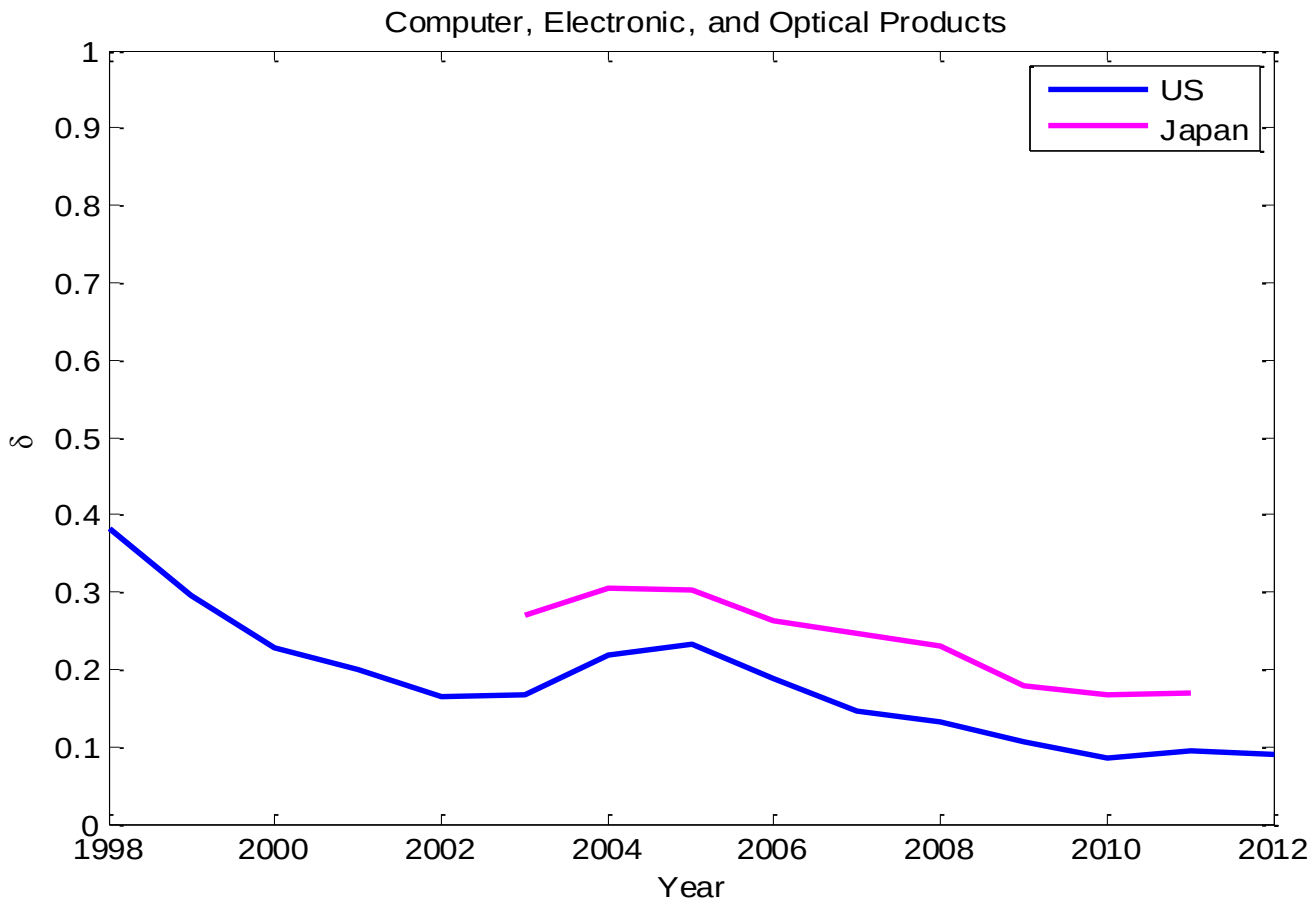

Conclusion

- Countries are different in technology.
- Based on data for four high-tech industries over five countries, the new indicator shows promising results.
- The new indicator is faster and cheaper to deliver cross-country comparisons in technology.