

Education, R&D and Convergence

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The Role of the State in Economic Growth in East Asia
Center on Global Economic Governance of Columbia University
Tsinghua University, Beijing, 18 March 2016

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Education

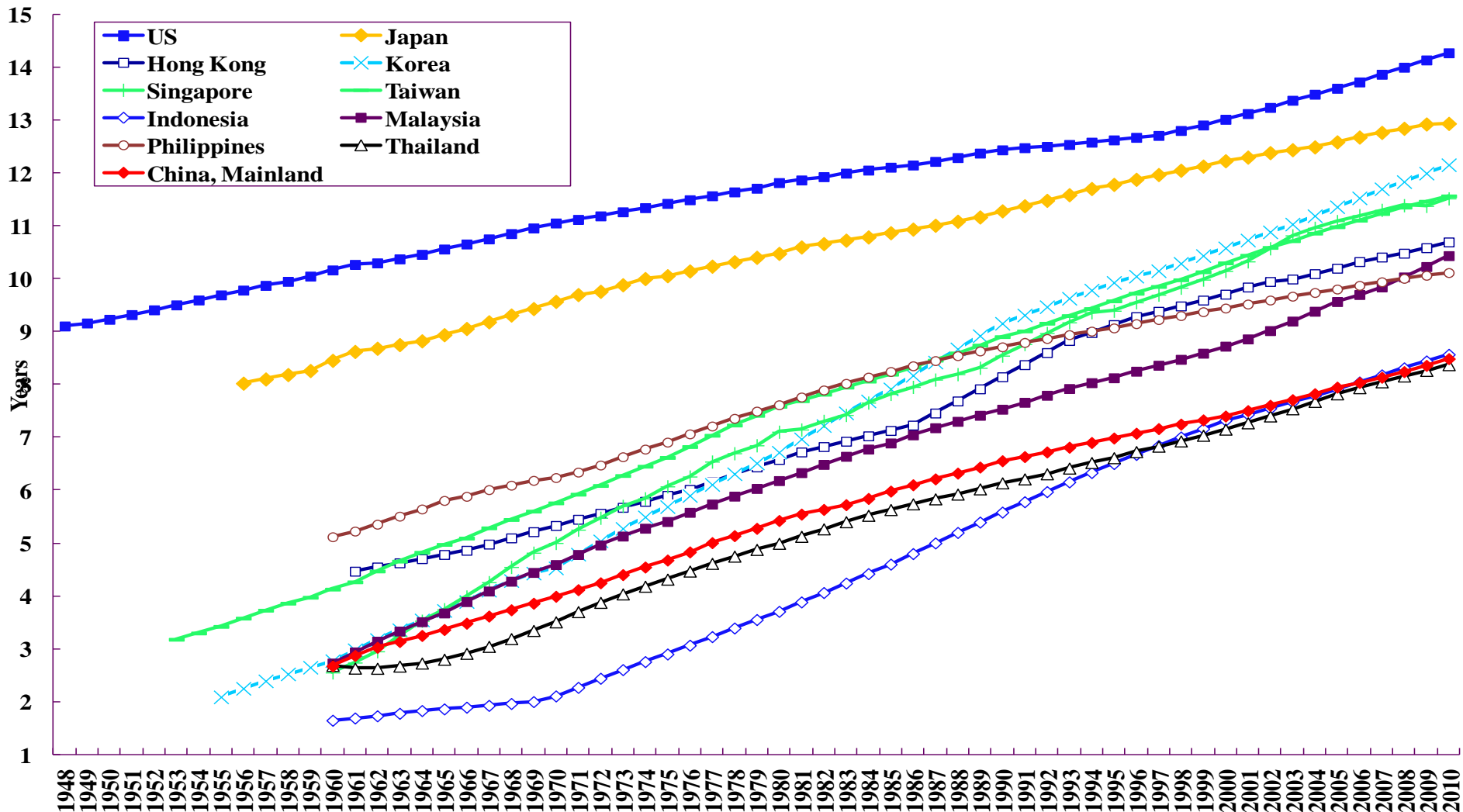
- ◆ China is trying to transition from input-driven economic growth to innovation driven economic growth.
- ◆ Innovation requires investment in both education and research and development (R&D). Both education and R&D have a substantial public goods element and the government needs to play an important role in their provision.
- ◆ China has a long tradition of emphasis on education and learning (human capital) and will continue to increase its investment in human capital.
- ◆ The Chinese enrollment rate of tertiary education has been rising rapidly during the past decade and stands at over 30 percent today. It is expected to rise further over the next decades as private tertiary educational institutions become more numerous in response to demand and facilitated by government policy. ²

Education

- ◆ One indicator of the level of human capital in an economy is the average number of years of schooling per person in the working-age population. In the following chart, the average number of years of schooling is compared across selected economies.
- ◆ By this measure, the United States and Japan are clearly the global leaders. South Korea has also been catching up fast. Most of the other East Asian economies also have quite rapidly increasing levels of human capital but it will take a while before they can catch up with the levels of human capital in the developed economies. China, Indonesia and Thailand have lagged behind in terms of investment in human capital.
- ◆ China has a different definition of working-age population—with a terminal age of 60--and so the number of school years per person in the customary working-age population, that is, up to 65, may well have been lower, given the lower enrolment rates at all levels of education 60 years ago.
- ◆ The average number of years of schooling of the working-age population³ (defined to be 18-60) may be estimated at between 10 and 11 in 2015.

Average Number of Years of Schooling of Selected Economies (1948-2010)

Average Number of Years of Schooling of Selected Economies (1945-present)

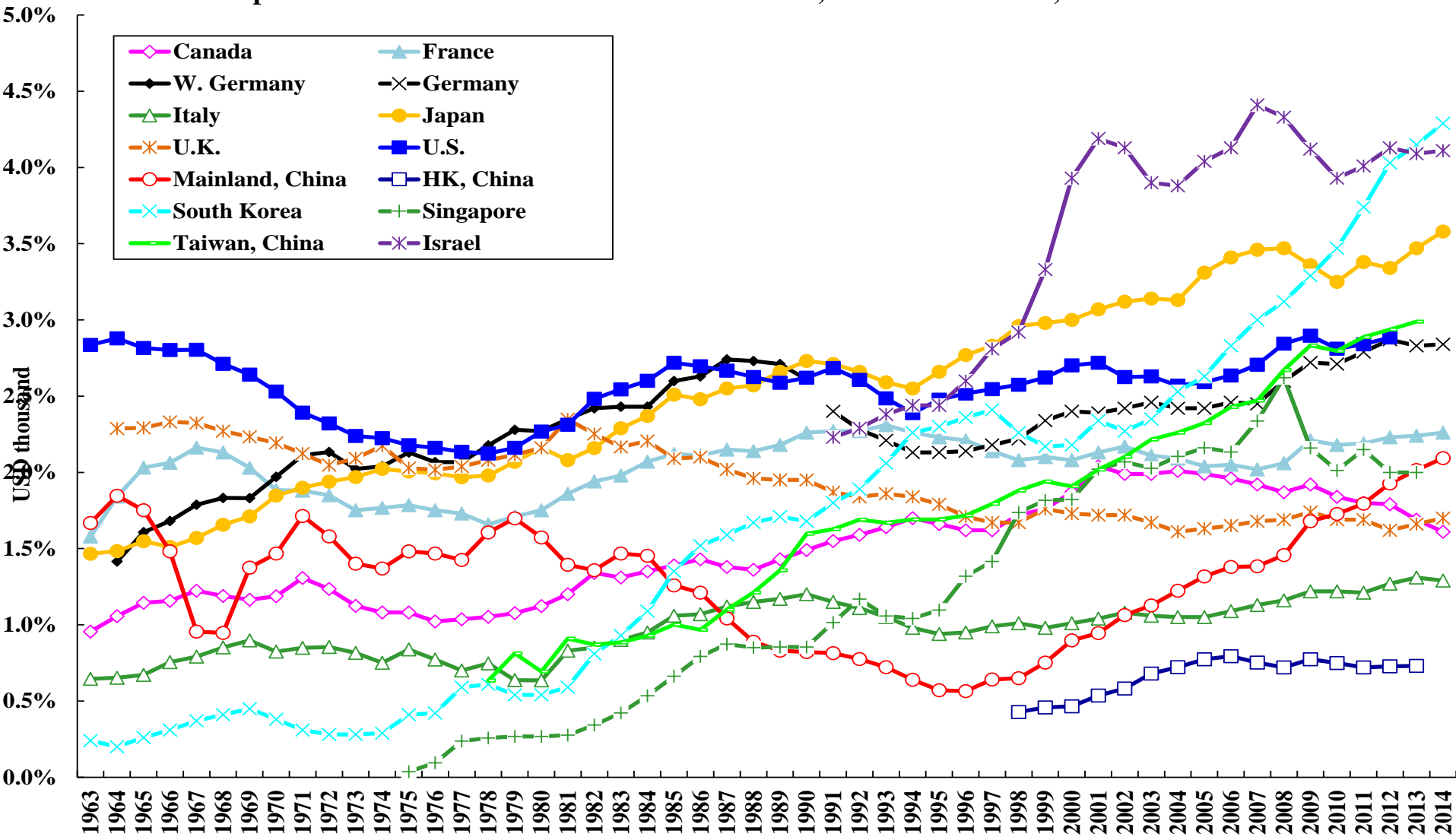


Research and Development

- ◆ China has also begun to increase its expenditure on Research and Development (R&D), which reached of 2.1 percent of GDP in 2015, short of its target of 2.2 percent. However, it still lags behind some of the other major economies.
- ◆ However, relative to many other economies, China lags behind on investment in both human capital and R&D capital, especially on a per capita basis.

R&D Expenditure as a Percent of GDP: G-7, 4 East Asian NIEs, China & Israel

R&D Expenditure as a Percent of GDP: G-7 Countries, 4 East Asian NIEs, China and Israel

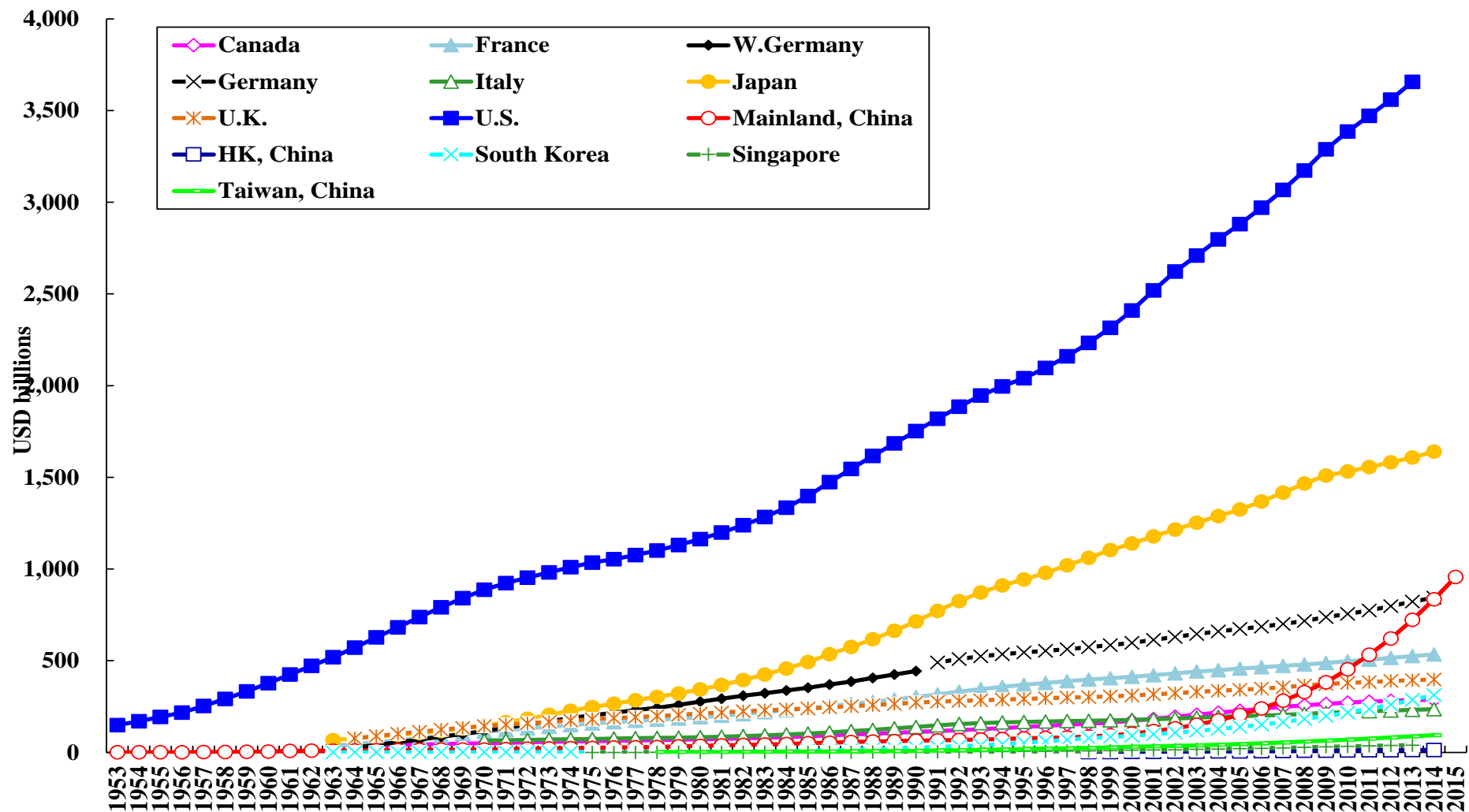


R&D Capital Stock

- ◆ The R&D capital stock, defined as the cumulative past real expenditure on R&D less the depreciation of 10% per year, is an useful indicator of innovative capacity. It should quite properly be treated as capital since R&D efforts generally take years to yield any results.
- ◆ Lawrence J. Lau and Yanyan Xiong (2015), in their Working Paper, “Are There Laws of Innovation? Part I: Introduction”, have constructed R&D capital stocks for the Group-of-Seven (G-7) countries, the East Asian Newly Industrialized Economies (NIEs) and China. The R&D capital stocks of selected economies are presented in the following charts.
- ◆ At US\$3.656 trillion in 2013 (in 2012 prices), the U.S. is the World leader in R&D capital stock. The Chinese R&D capital stock, at US\$722 billion in 2013, has caught up with those of most countries and regions with the exceptions of the U.S., Japan and Germany.

Real R&D Capital Stocks: G-7, 4 East Asian NIEs and China (Billion 2012 US\$)

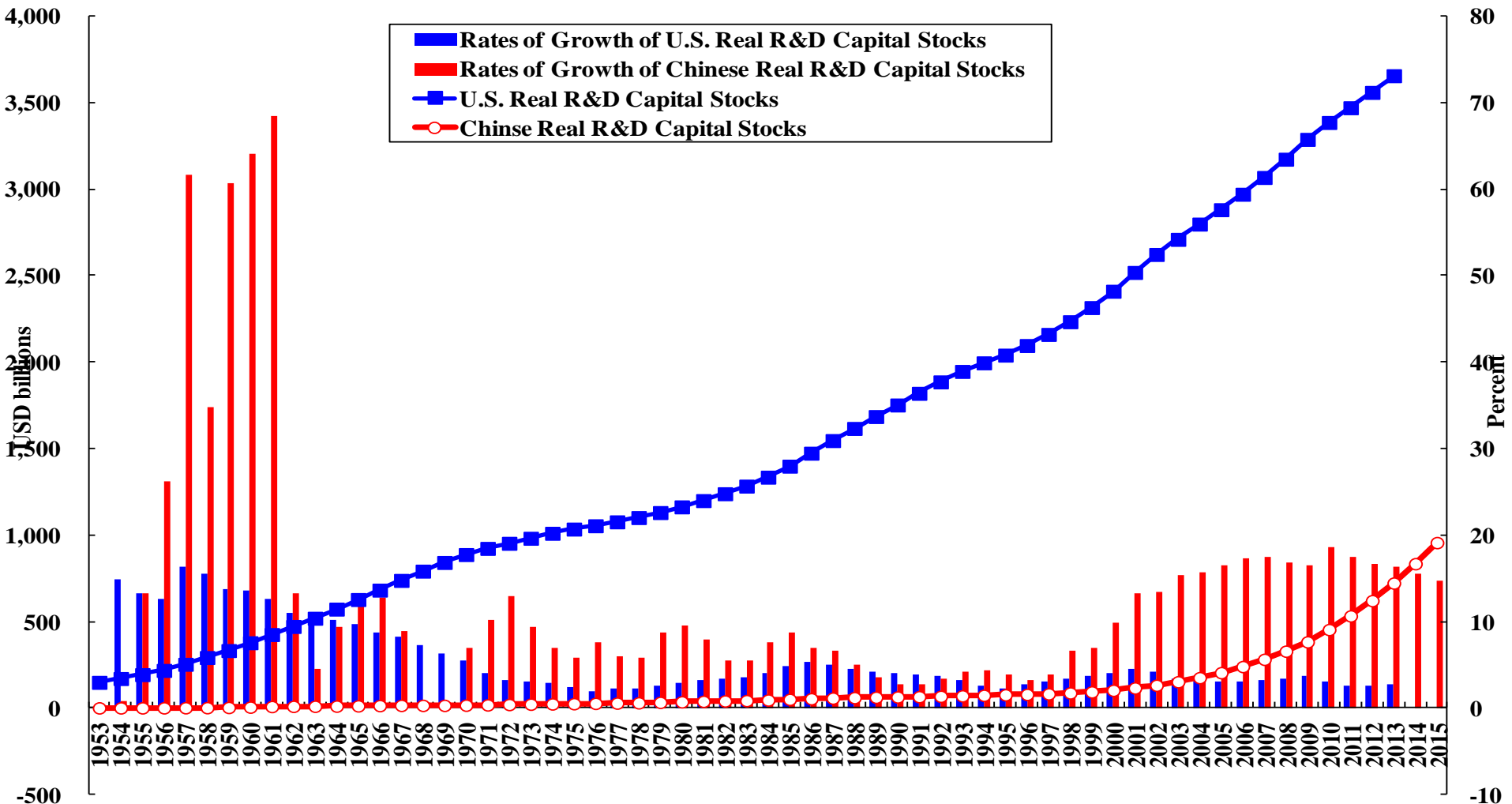
Real R&D Capital Stocks: G-7 Countries, 4 East Asian NIEs and China
(Billion US\$, 2012 Prices)



R&D Capital Stocks and their Growth Rates

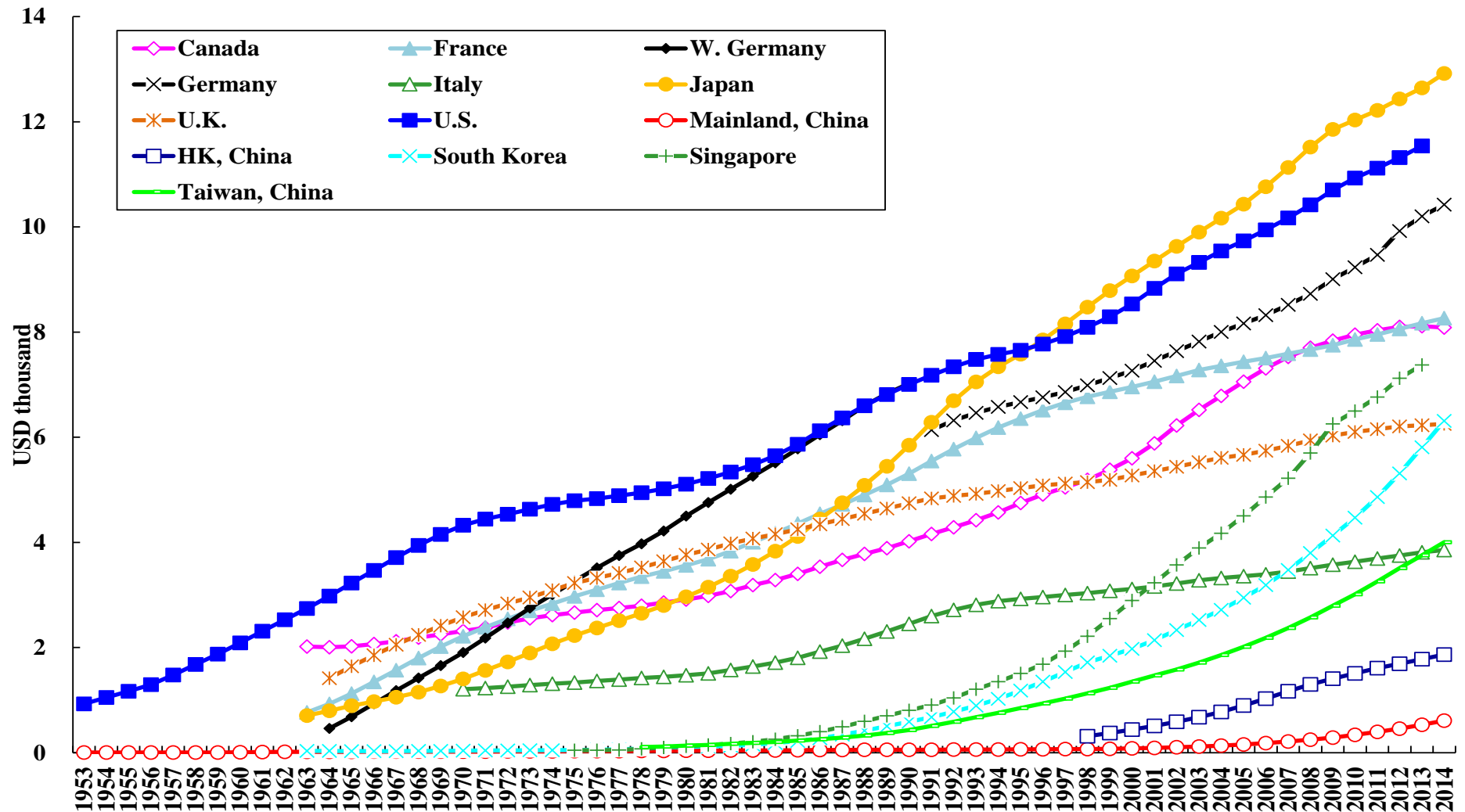
Rates: China and the U.S., 2012 US\$

Real R&D Capital Stocks and their Growth Rates: A Comparison of China and the U.S.
(Billion US\$, 2012 Prices)



Real R&D Capital per Capita: G-7, 4 East Asian NIEs and China (1,000 2012 US\$)

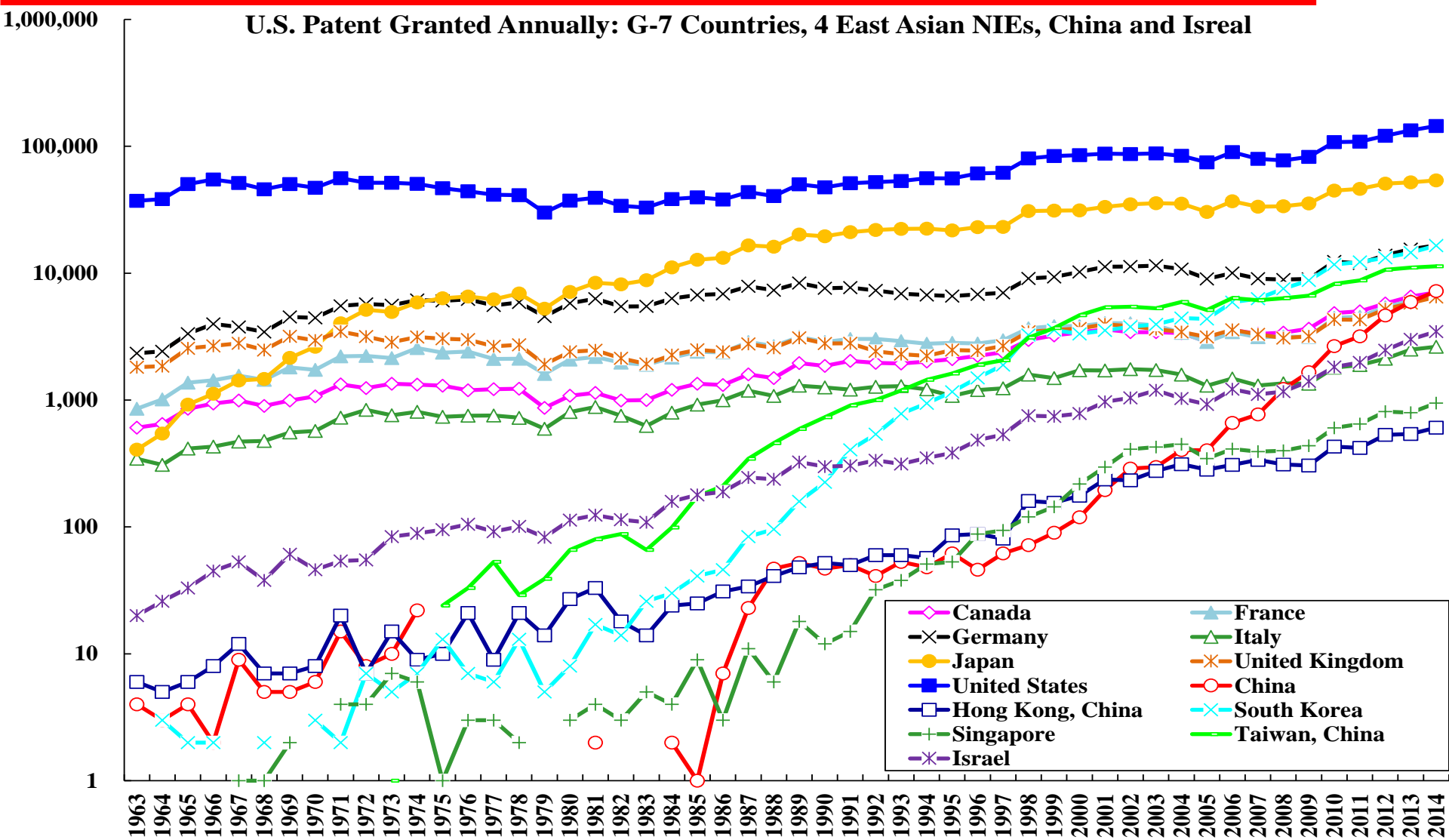
Real R&D Capital Stocks per Capita: G-7 Countries, 4 East Asian NIEs and China
(Thousand US\$, 2012 Prices)



Progress in R&D

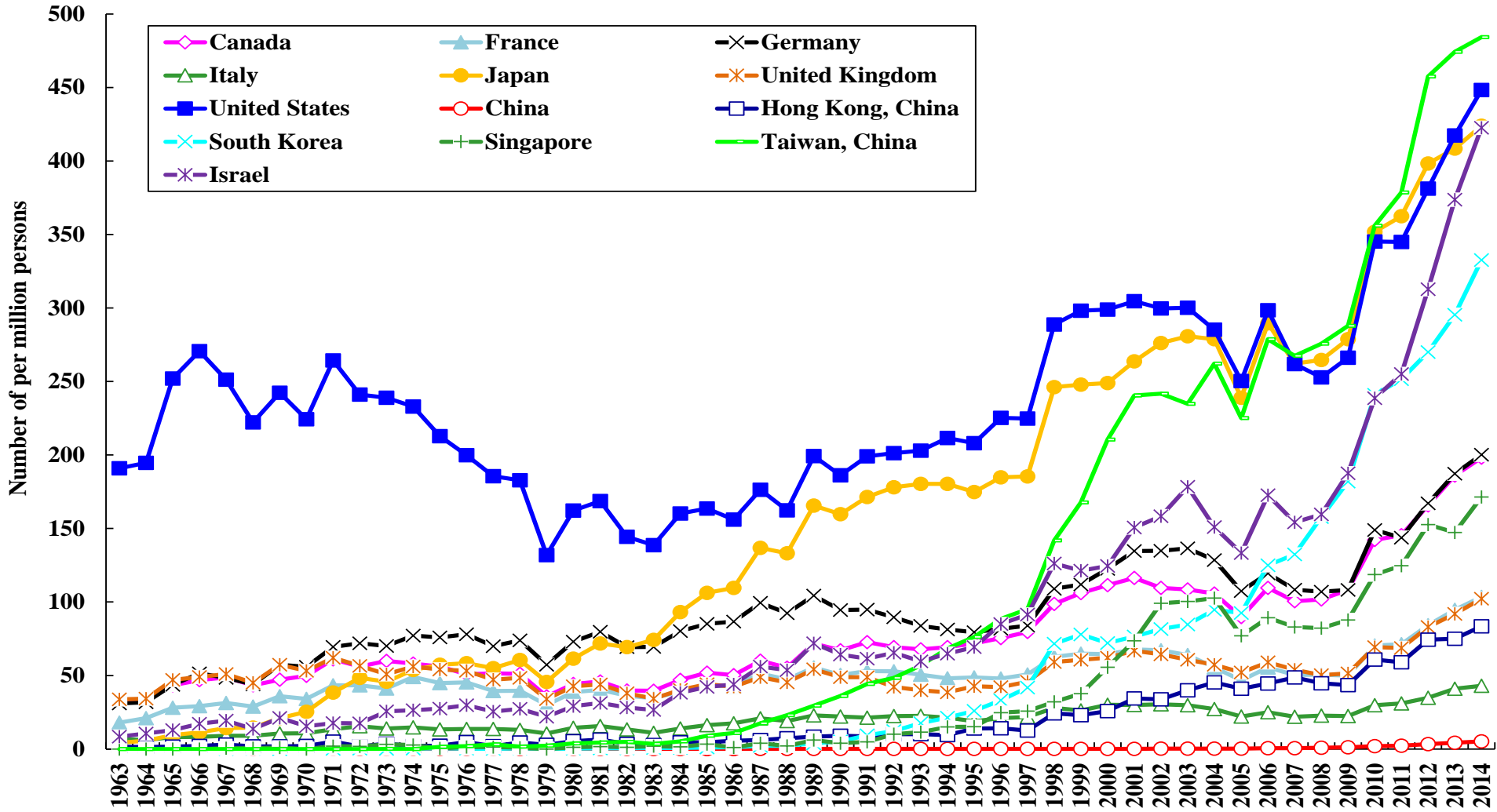
- ◆ In 2014, the Mainland granted 158,000 patents for invention to applicants within the Mainland, compared to the 144,621 domestic patents granted by the U.S. In 2015, the number of Mainland domestic patents increased by more than 60 percent to 256,000, the highest number of domestic patents granted in the World.
- ◆ China probably produces the highest number of published journal articles in the World today. However, it still has a long way to go in terms of citations.

Annual Number of U.S. Patents Granted: Selected Economies



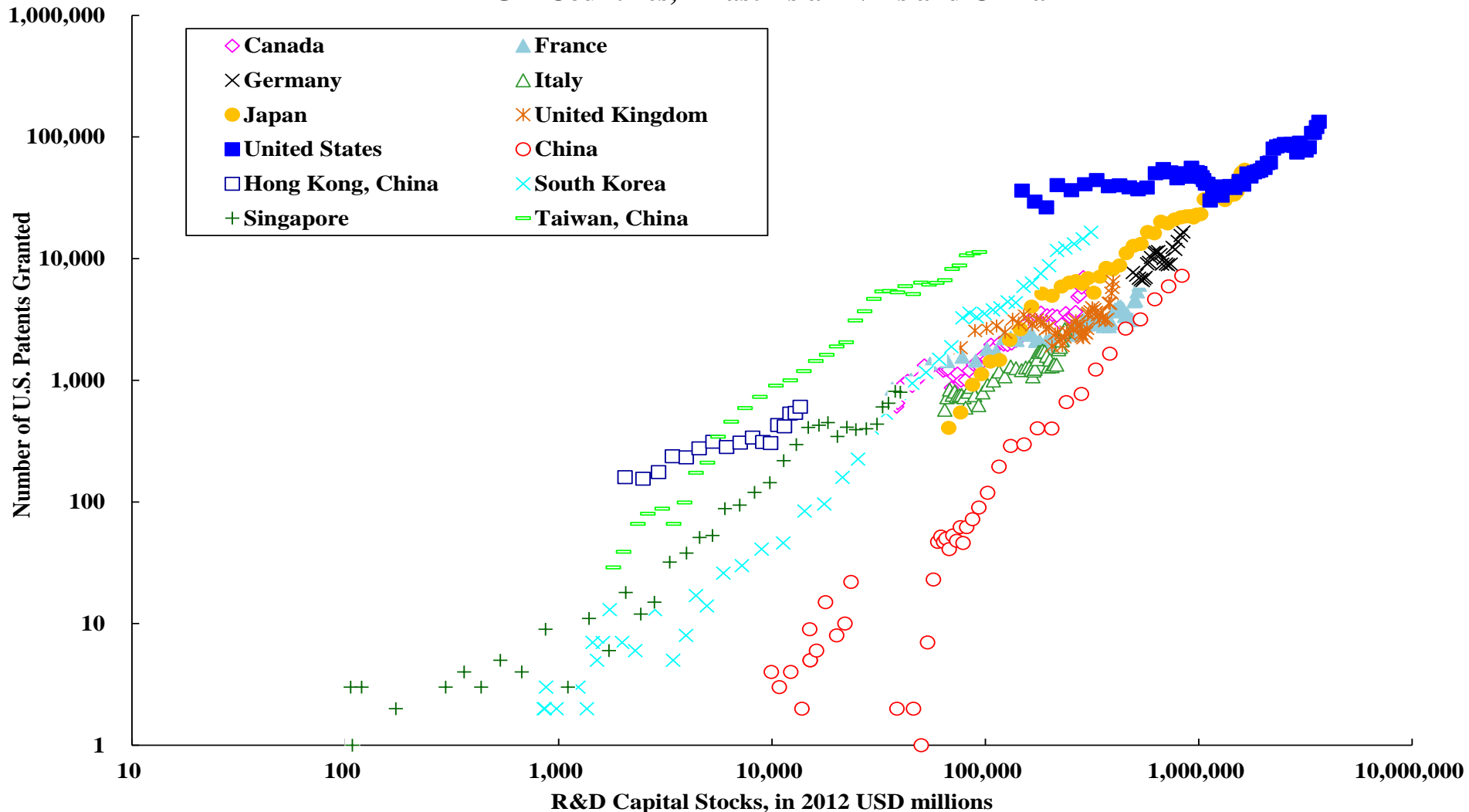
Annual Number of U.S. Patents Granted per Capita: Selected Economies

U.S. Patent Granted Annually Per Million Persons:
G-7 Countries, 4 East Asian NIEs, China and Isreal



U.S. Patents Granted and R&D Capital Stocks: Selected Economies

U.S. Patents Granted and R&D Capital Stocks:
G-7 Countries, 4 East Asian NIEs and China



Convergence

- ◆ China can exploit the economies of scale in innovation. The huge domestic market of 1.37 billion consumers in China greatly enhances the productivity of intangible capital (e.g., R&D capital and goodwill including brand building) by allowing the fixed costs of the R&D for a new product or process or advertising and promotion in brand building to be more easily amortized and recovered.
- ◆ Intellectual property protection has been receiving a great deal of attention from the Chinese Government. China has now established special national intellectual property courts in Beijing, Shanghai and Guangzhou to deal exclusively with such cases.
- ◆ Chinese investment in basic research has continued to be low. The Chinese are too practical to invest in activities that have only an uncertain return in the distant future. This reduces the possibility of break-through innovations originating in China.
- ◆ There may also be a cultural handicap. The Chinese scientists and engineers¹⁶ have too much respect for established scholarly authority to challenge it.

The Share of Basic Research in Total R&D Expenditure: Selected Economies

The Share of Basic Research Expenditure in Total R&D Expenditure:
G-7 Countries, 4 East Asian NIEs and China

