

The Quality and Quantity of Chinese Economic Growth

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*All opinions expressed herein are the author's own and do not necessarily reflect the views of any of the organisations with which the author is affiliated.

Introduction

- ◆ We begin with a historical overview of the Chinese economy from the early 19th Century to the present.
- ◆ We then examine the absolute quantity of Chinese economic growth as well as the relative quantity of growth compared to other major economies of the world.
- ◆ We continue with an assessment of the absolute quality of Chinese economic growth, followed by an assessment of the relative quality of growth compared to other major economies.
- ◆ Finally, we conclude with long-term projections of the Chinese economy to 2050.

Introduction

- ◆ The Chinese Government has declared that it will put more emphasis on the quality rather than the quantity of economic growth. It is clear what quantity means and how it can be measured. What do we mean by quality, and how do we measure it?
- ◆ The quality of economic growth can be reflected in socio-economic indicators such as the average educational attainments, the state of public health, the conditions of the environment, the equitability of the distribution of income, and the incidence of poverty.
- ◆ The quality of economic growth can be enhanced through the increased provision of public goods such as education, public health, healthcare, elderly care, environmental preservation, protection and restoration, basic research, infrastructure, social safety net, and alleviation of poverty. The provision of these public goods has been vastly expanded in China over the past seventy plus years, with significant positive results.
- ◆ The objective of this lecture is to review the progress that has been made in both the quality and the quantity of Chinese economic growth over the past several decades in both absolute terms and relative to other major economies of the world.

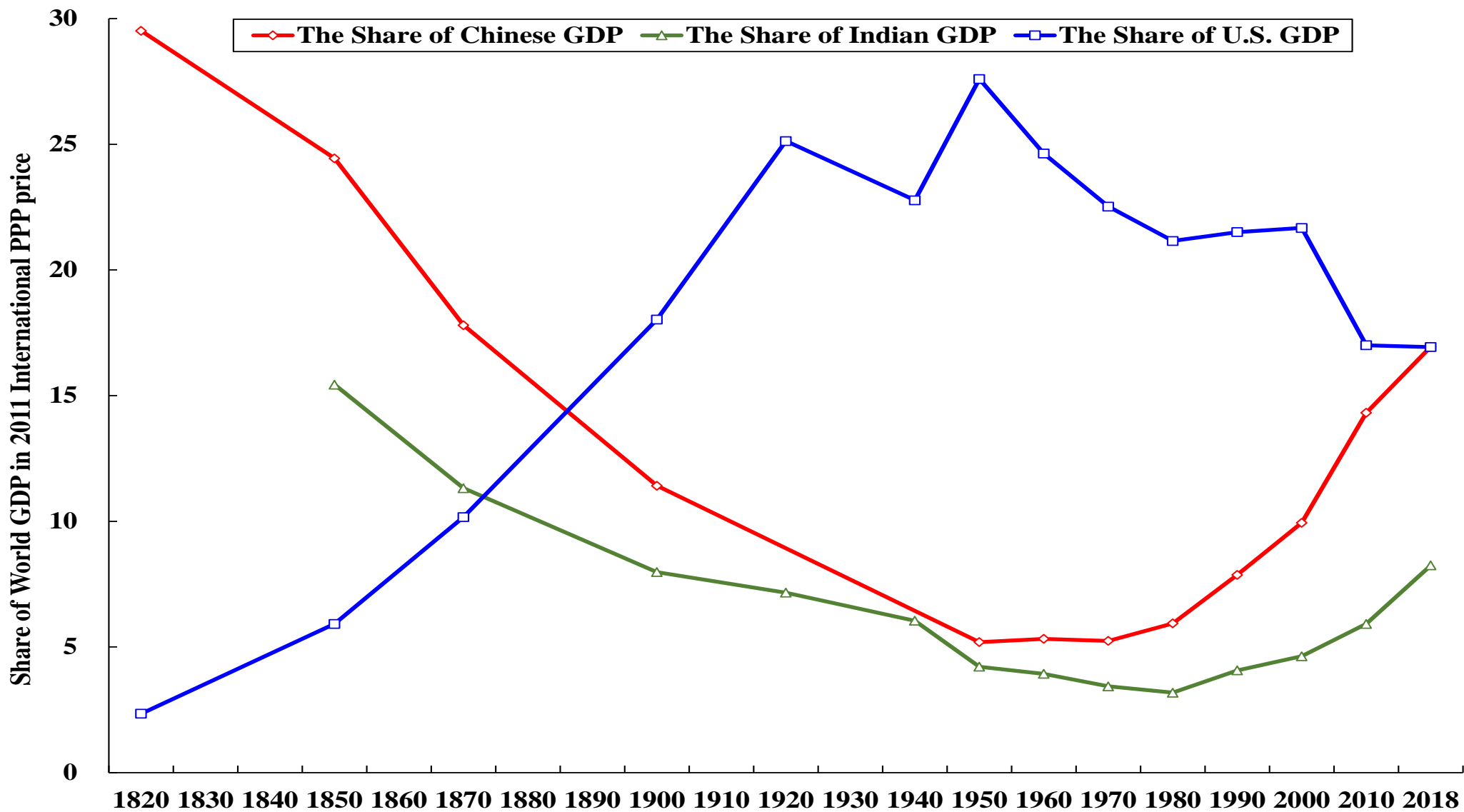
Introduction

- ◆ However, the improvement in the quality of economic growth is not necessarily reflected in a higher level of measured GDP. For example, the increase in leisure (the reduction in work hours); the blue skies, green mountains and turquoise waters (unless a green GDP is measured); improvements in educational attainments and public health, etc., are all costly but generate negative value-added at market prices and will therefore reduce rather than enhance the rate of growth of conventionally measured GDP.
- ◆ The provision of public goods also constitutes a form of re-distribution in kind, for example, clean air and water can be freely enjoyed by everyone, and hence also directly advances the goal of “common prosperity”.
- ◆ Finally, increasing the provision of public goods can be a significant source of growth of the domestic aggregate demand of both consumption and investment, over and above what increases in household consumption alone are able to provide. Maintaining an adequate growth of aggregate demand is essential for continued Chinese economic prosperity.

The Fall and the Rise of Economies from 1820 to the Present

- ◆ We begin with a chart showing the shares of China, India and the U.S. of world GDP since 1820, using data from the (Angus) Maddison Project Database. The database was constructed on the basis of “Purchasing Power Parity (PPP)” international prices, and hence generates slightly different results from those studies that use market prices at market exchange rates, including this one.
- ◆ In 1820, China supposedly accounted for more than 30% of the then world GDP, India somewhere between 20 and 25%, and the U.S. less than 3%. China and India (and hence Asia) together accounted for more than half of the then world GDP.
- ◆ The Chinese and Indian shares then declined continuously to below 5% until 1950 for China and 1980 for India, whereas the U.S. share rose steadily to reach a peak of over 30% in 1960. The Chinese and Indian shares respectively then began to recover.

The Shares of World GDP of China, India and the U.S. since 1820 (Maddison Project Database) PPP



The Fall and the Rise of Economies from 1820 to the Present

- ◆ In 2015, in Purchasing-Power-Parity (PPP) terms, Chinese GDP reached parity with U.S. GDP, with each accounting for approximately 18% of world GDP. This finding was supported by both the International Monetary Fund and the World Bank.
- ◆ Around 1800, Chinese population may be estimated at 330 million (compared to 1.41 billion today), or approximately 37 percent of the then world population. The Chinese share of world population has since fallen to a little more than 17 percent.
- ◆ For various reasons, the Chinese real GDP per capita started to fall continuously in the 19th Century until the middle of the 20th Century, to less than US\$100 in today's prices in 1949.

The Absolute Quantity of Chinese Economic Growth

- ◆ The Aggregate and per Capita Real Gross Domestic Product (GDP)
- ◆ The Secondary (Manufacturing, Mining and Construction) and Tertiary (Service) Sectors
- ◆ The International Trade
- ◆ The Renminbi Exchange Rate and Chinese Foreign Exchange Reserves
- ◆ Science and Technology

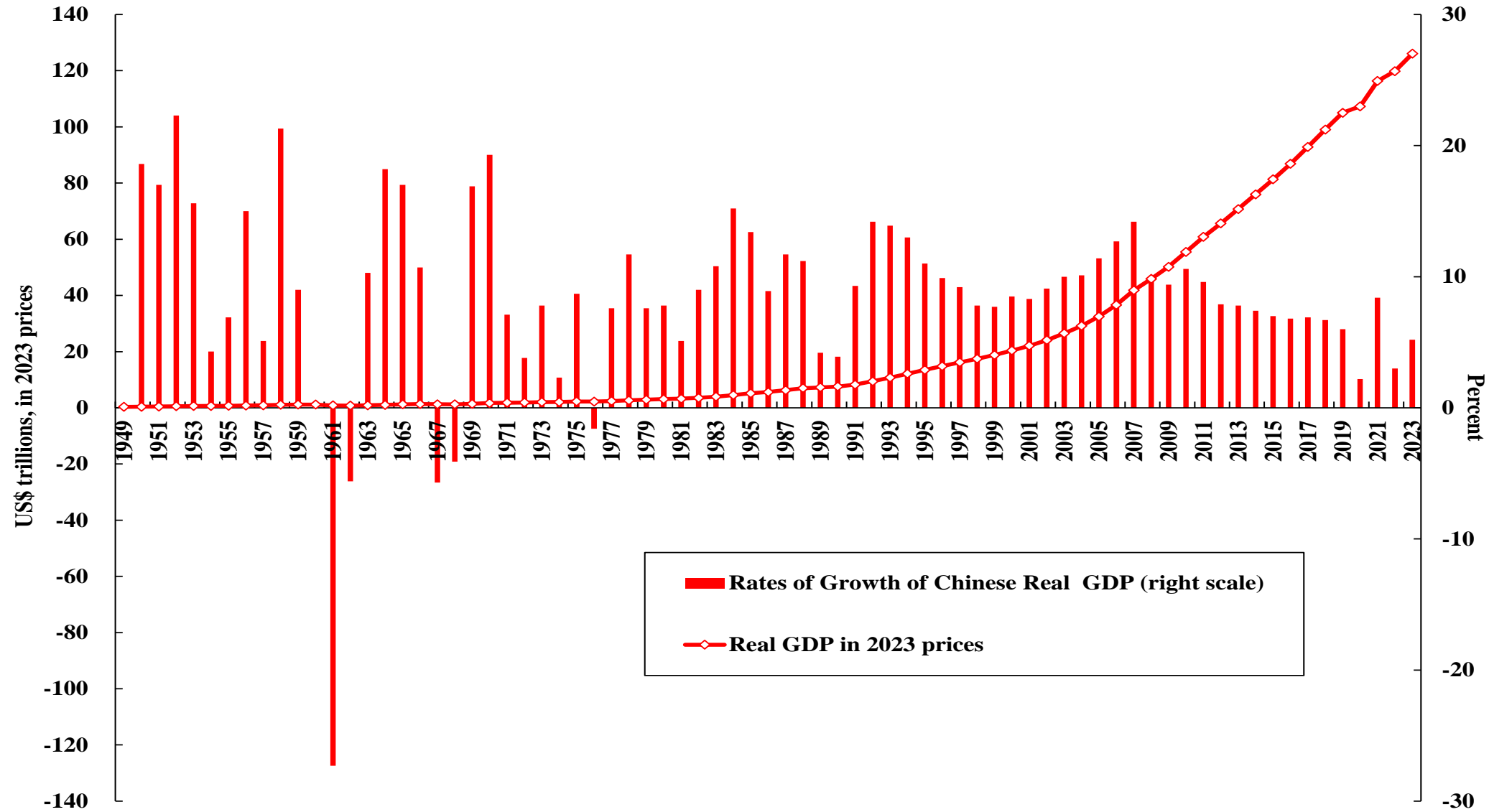
The Aggregate and per Capita Real Gross Domestic Product (GDP)

- ◆ The performance of the Chinese economy since the establishment of the People's Republic of China in 1949 has been most impressive. Chinese real GDP has grown at an average annual rate of more than 8 percent over this long period of three-quarters of a century, which is historically unprecedented. Moreover, many qualitative indicators, such as educational attainments and life expectancies, have also improved significantly over the same period. The purpose of this lecture is to examine both the quality and the quantity of Chinese economic growth over the past seven and a half decades.
- ◆ We shall assess the quantity and quality of Chinese economic growth in both absolute terms, that is, on its own, and also in relative terms, that is, in comparison with the performance of other major economies. We shall show that both absolutely and relatively, China has come out very well in the growth of not only quantity but also quality.

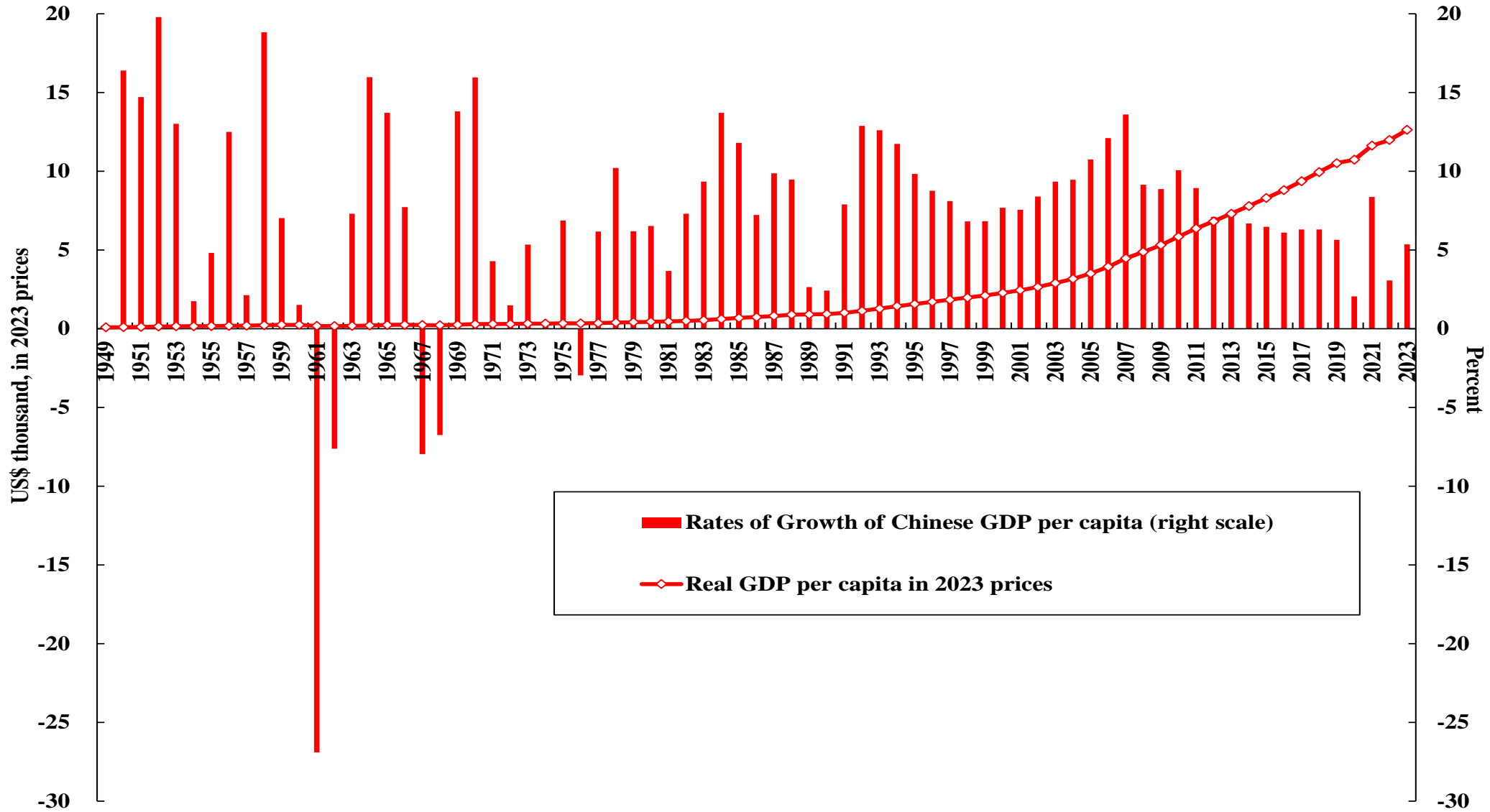
The Aggregate and per Capita Real Gross Domestic Product (GDP)

- ◆ Between 1949 and 2023, Chinese real GDP has grown from 333.4 billion Yuan to 126.1 trillion Yuan (in 2023 prices) (and from US\$47.1 billion to US\$17.80 trillion, converted at the Yuan/US\$ exchange rate at year-end 2023), an almost 380-fold increase (see Chart).
- ◆ We note that while the real GDP grew 5.2% in 2023, there is some deflation, with the GDP deflator declining by 0.5% from 2022.
- ◆ Between 1949 and 2023, Chinese real GDP per capita has grown more than 140-fold, from 616 Yuan to 89,424 Yuan in 2023 prices (and from US\$86.9 to US\$12,626) (see Chart). Even then, the Chinese real GDP per capita was only one-sixth of that of the U.S. and ranked below 70th among all economies in the world.
- ◆ Despite the significant fluctuations and volatility of the rates of growth during the 20 years from the late 1950s to the late 1970s, the average annual rates of growth of real GDP and real GDP per capita for the entire period of 74 years from 1949 to 2023 were respectively **8.35%** and **6.96%**, a truly remarkable achievement over such a long period of time. It is historically unprecedented.

Chinese Real GDP and Its Annual Rate of Growth: 1949-2023



Chinese Real GDP per Capita and Its Annual Rate of Growth: 1949-2023



The Growth of Chinese Real GDP and Real GDP per Capita, 1949-2023

- ◆ We can attribute this success largely to the economic reform and opening undertaken by China in 1978, as well as to the long time-horizon of the Chinese economic policy makers and their single-minded focus on economic growth. With a long enough planning horizon, one can afford to undertake investment in development-leading infrastructure, that is, infrastructure the demand for which has not yet materialised but can be created by the supply itself, infrastructure that may take a long time to pay off or pay off only through externalities. But very often “supply creates its own demand”! Such investment can stimulate demand and further development, but because of its typically long payback periods and inability to internalise the benefits, is unlikely to be undertaken privately.
- ◆ Chinese accession to the World Trade Organization (WTO) in 2001 was also pivotal because it enabled the export promotion strategy and the movement of the surplus labour in the agricultural sector to the industrial and service sectors.
- ◆ The Chinese GDP of US\$17.80 trillion in 2023 was **65.06%** of the U.S. GDP of US\$27.36 trillion, but Chinese GDP per capita of US\$12,626 remained far behind, at only **15.5%** of the U.S. GDP per capita of US\$81,610.

The Growth of Real GDP and Real GDP per Capita since Economic Reform, 1978-2023

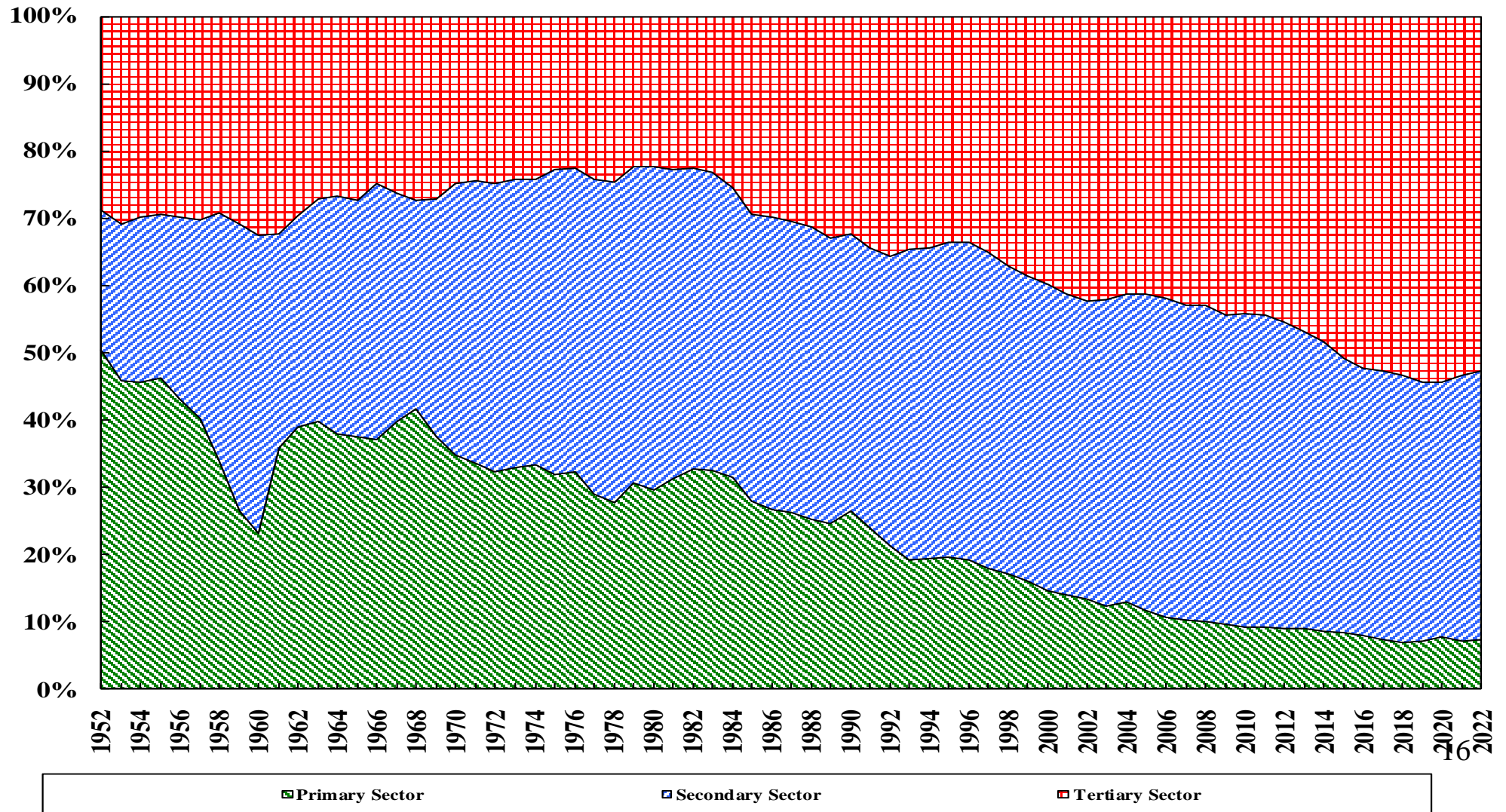
- ◆ Between 1978, the beginning of the Chinese economic reform and opening to the world, and 2023, real GDP has grown more than 40-fold, from 2.68 trillion Yuan to 126.1 trillion Yuan (in 2023 prices) (and from US\$379 billion to US\$17.80 trillion). During the same period, real GDP per capita has grown more than 30-fold, from 2,789 Yuan to 89,424 Yuan (and from US\$393.8 to US\$12,626).
- ◆ During this period of four and a half decades, there was not one single year in which the rate of growth of real GDP or real GDP per capita turned negative.
- ◆ The average annual rates of growth of real GDP and real GDP per capita for the post-reform period from 1978 to 2023 were respectively **8.93%** and **8.01%**, even higher than the average annual rates of growth achieved since 1949.

The Secondary (Manufacturing, Mining and Construction) and Tertiary (Service) Sectors

- ◆ In 1952, the primary (agriculture) sector accounted for 50.5% of Chinese GDP; the secondary (manufacturing, mining and construction) sector accounted for 20.8%; and the tertiary (service) sector accounted for 28.7%. In 2023, the primary sector accounted for 7.1%, the secondary sector 38.3%, and the tertiary sector 54.6%.
- ◆ In 1952, the primary sector accounted for 83.5% of Chinese employment; the secondary sector 7.4%; and the tertiary sector 9.1%. In 2022, the primary sector accounted for 24.1%; the secondary sector 28.8%; and the tertiary sector 47.1%.
- ◆ The primary sector went from the largest sector in terms of GDP and employment in 1952 to the smallest sector in 2023.
- ◆ After the beginning of economic reform and opening to the world in 1978, Chinese international trade increased by leaps and bounds, especially after the accession to the World Trade Organization (WTO) in 2001.

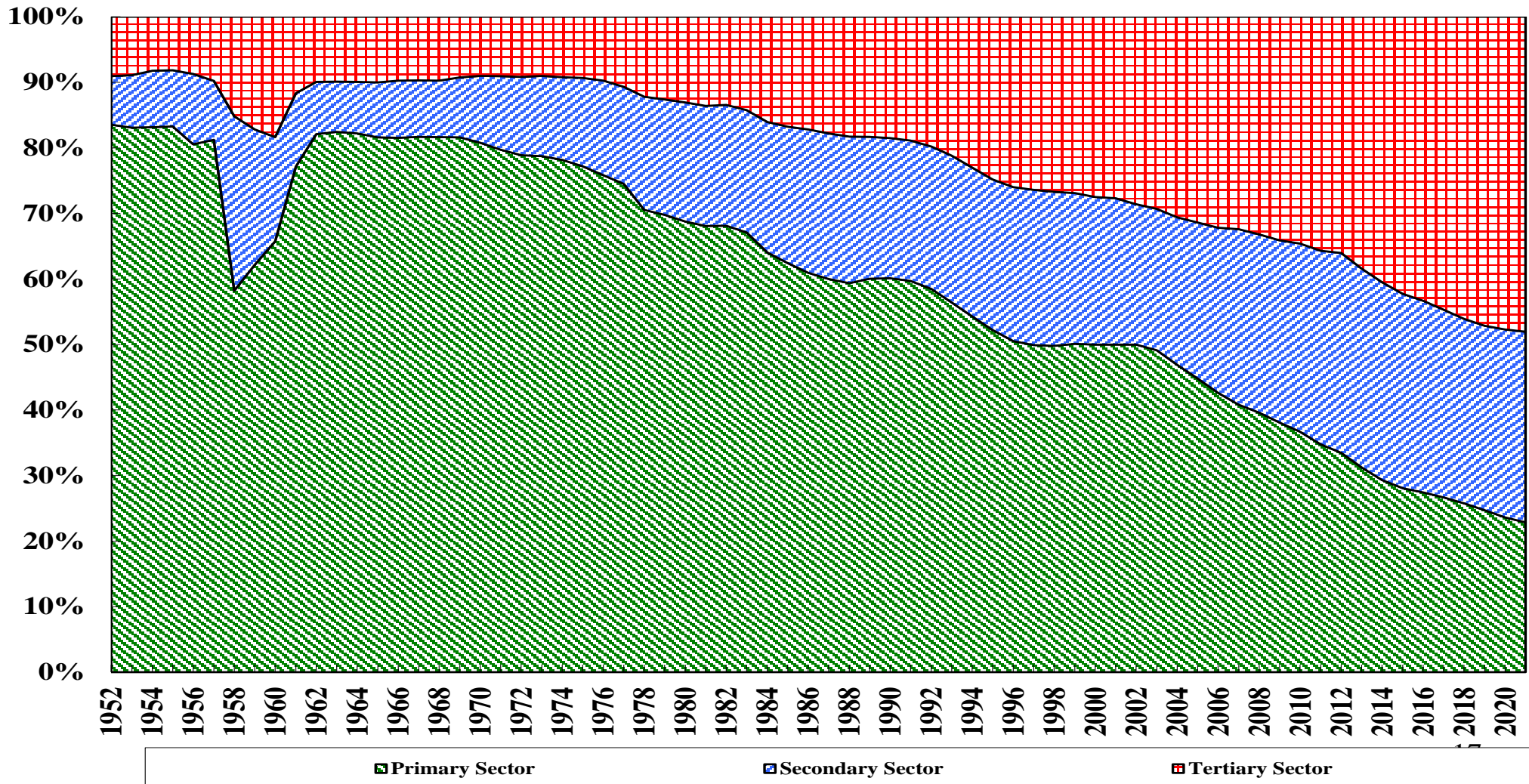
The Distribution of Chinese GDP by Sector Since 1952

The Distribution of Chinese GDP by Originating Sector Since 1952



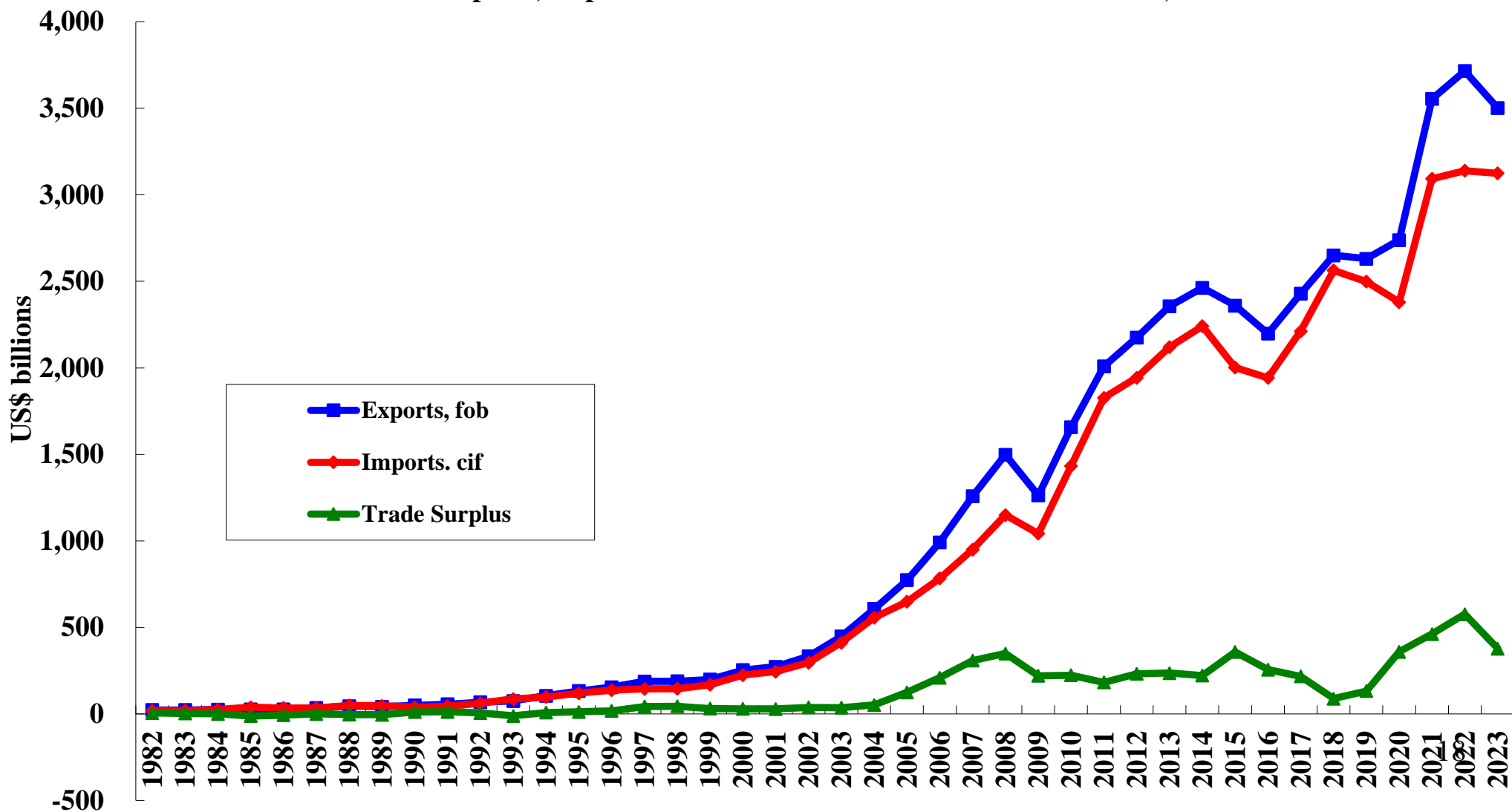
The Distribution of Chinese Employment by Sector Since 1952

The Distribution of Employment by Sector since 1952



Annual Chinese Exports, Imports and Trade Balance of Goods and Services

Annual Chinese Exports, Imports and Trade Balance of Goods and Services, in US\$ Billion

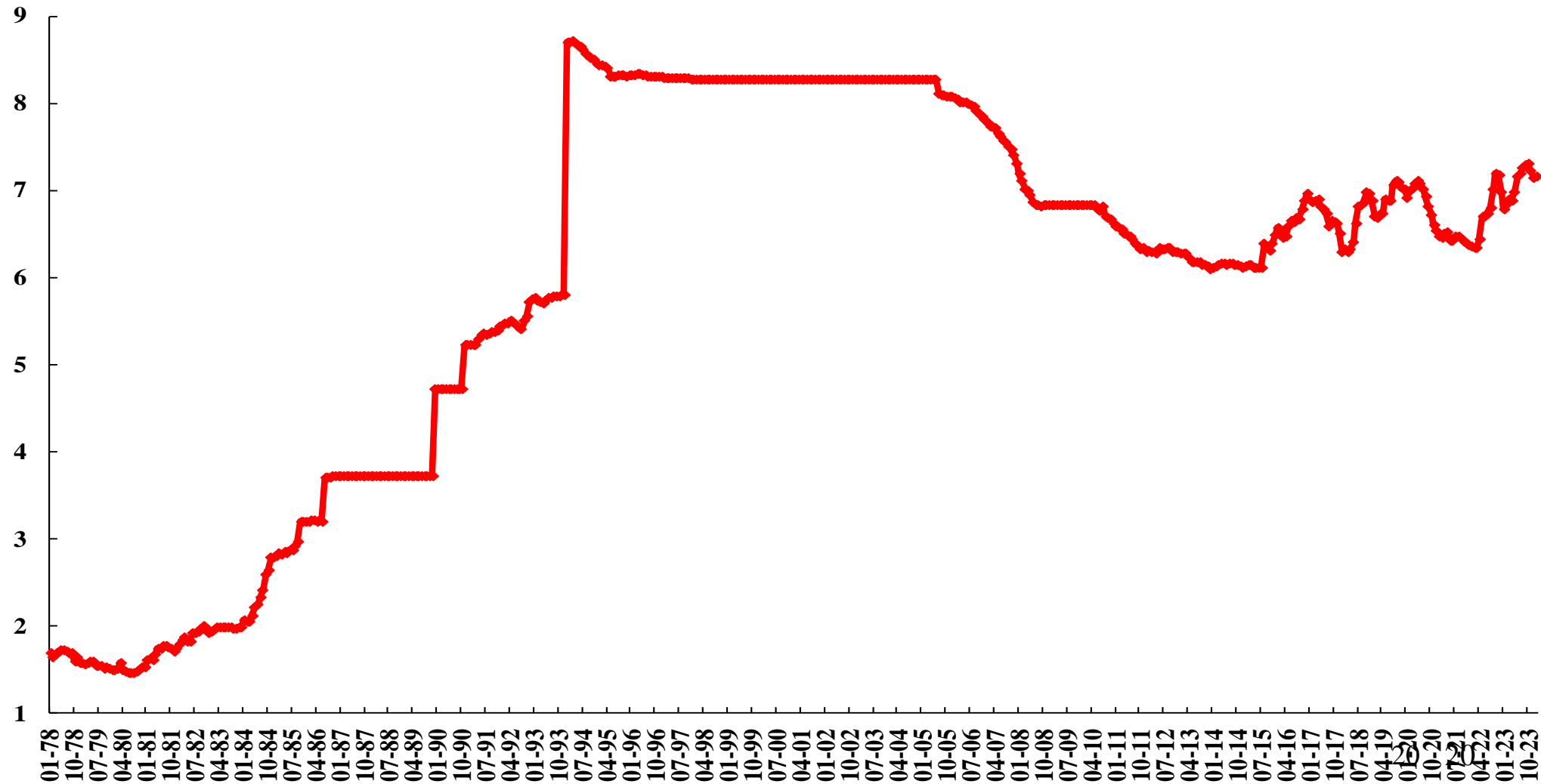


The Absolute Quantity of Chinese Economic Growth: The Internationalisation of the RMB

- ◆ One notable development is the gradual internationalisation of the Renminbi. The Renminbi has been a current-account convertible currency since 1994. Its value comes from the Renminbi's purchasing power over Chinese goods, services and assets. In fact, offshore Renminbi is fully convertible in Hong Kong. China's capital controls only apply to certain capital flows into and out of Mainland China.
- ◆ If bilateral cross-border transactions between two countries can be settled in their own national currencies rather than in a third-country currency like the U.S. Dollar, the transaction costs and the exchange rate risks are both reduced, because only one currency exchange is required and hence there is only one exchange rate risk. If the settlement is made in a third-country currency, two currency conversions are required, doubling the transaction costs, and exchange rate risks are incurred by both the exporting and the importing countries. Thus, own-currency settlement benefits both the exporting and the importing country.

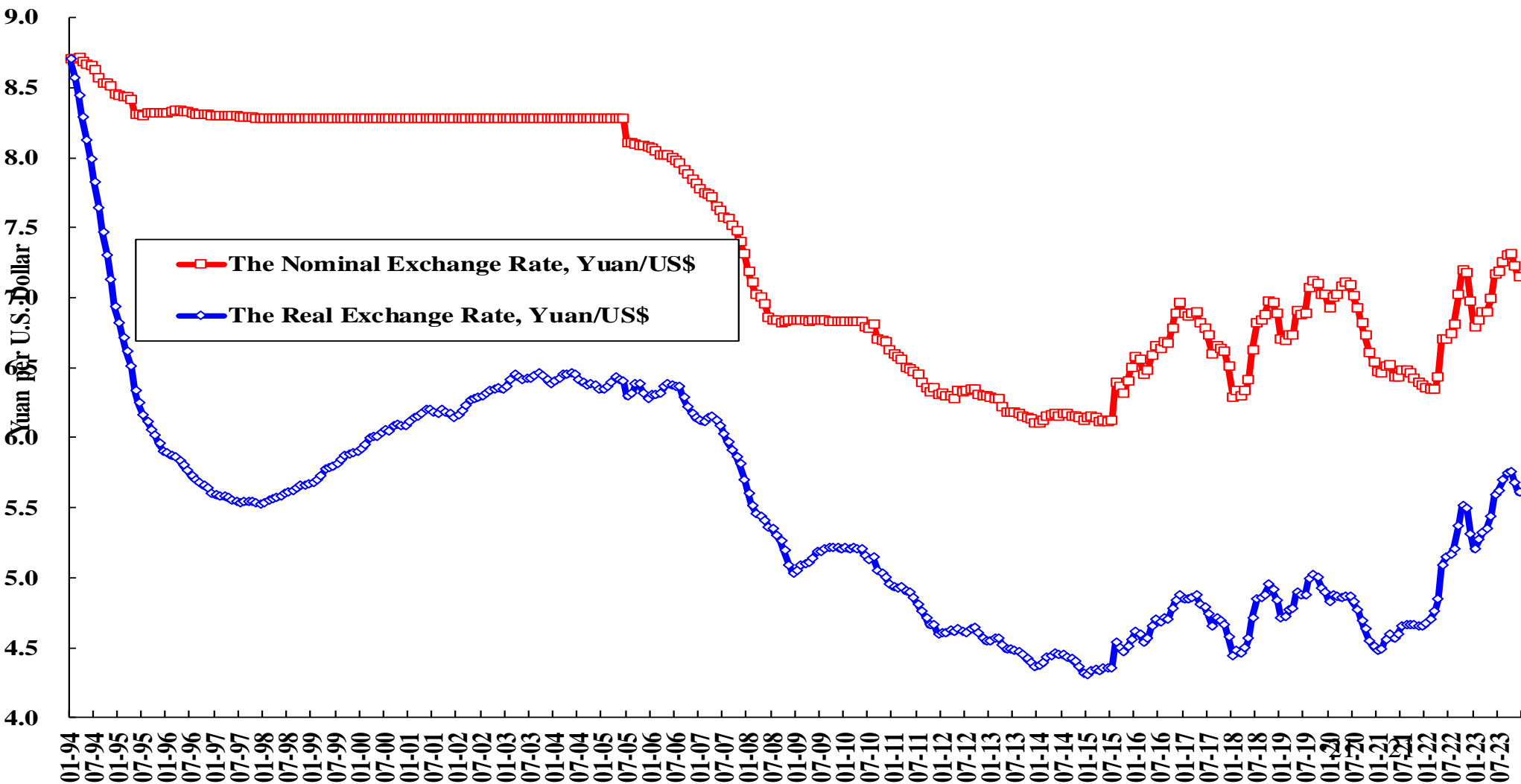
The Nominal Exchange Rate of the Renminbi, Yuan/US\$, 1978-present

Nominal Exchange Rate of the Renminbi, Yuan/US\$, 1978-present



The Nominal and Real Yuan/US\$ Exchange Rates, 1994-the Present

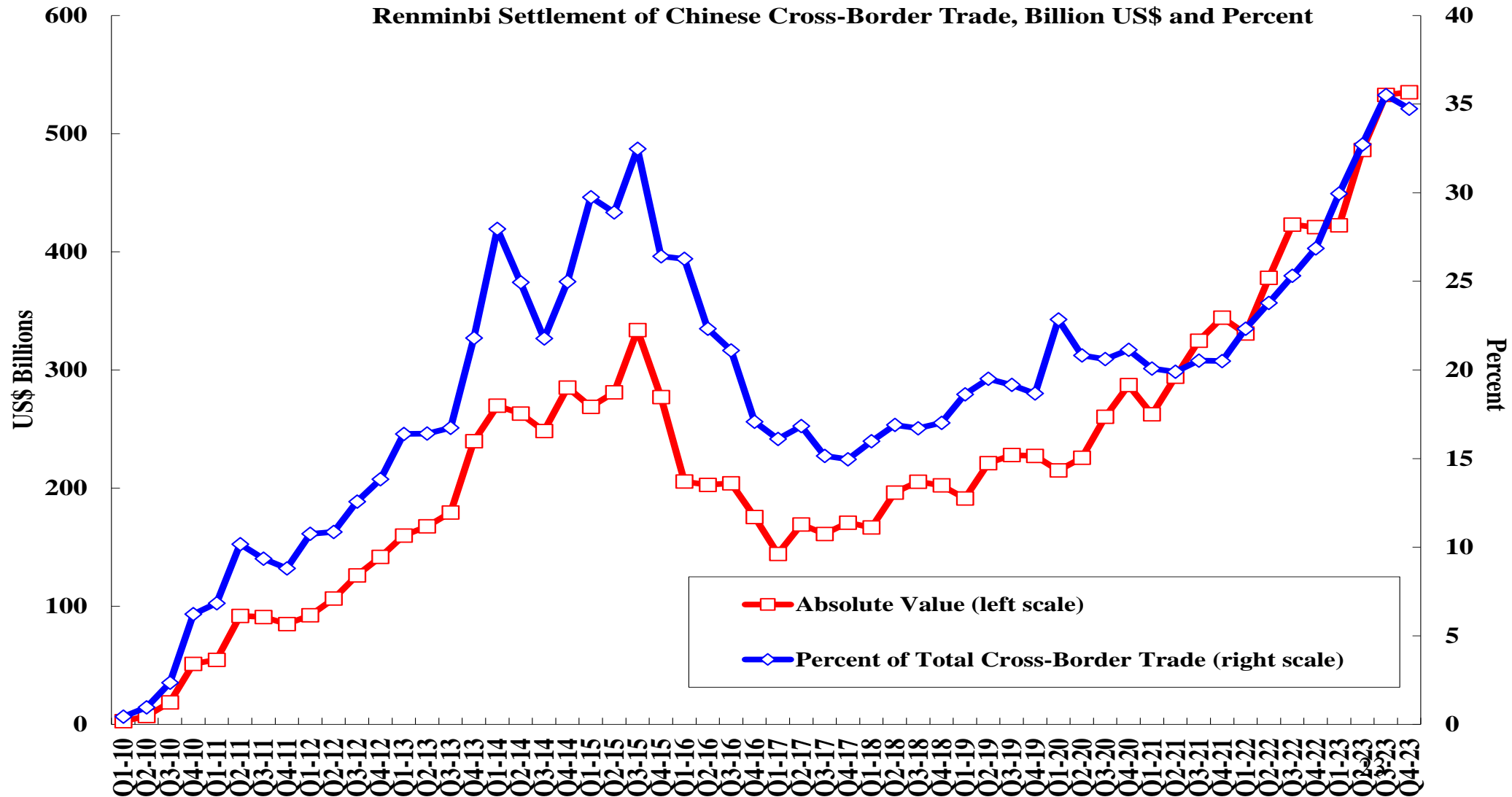
The Nominal and Real Yuan/US\$ Exchange Rates (1994 prices)



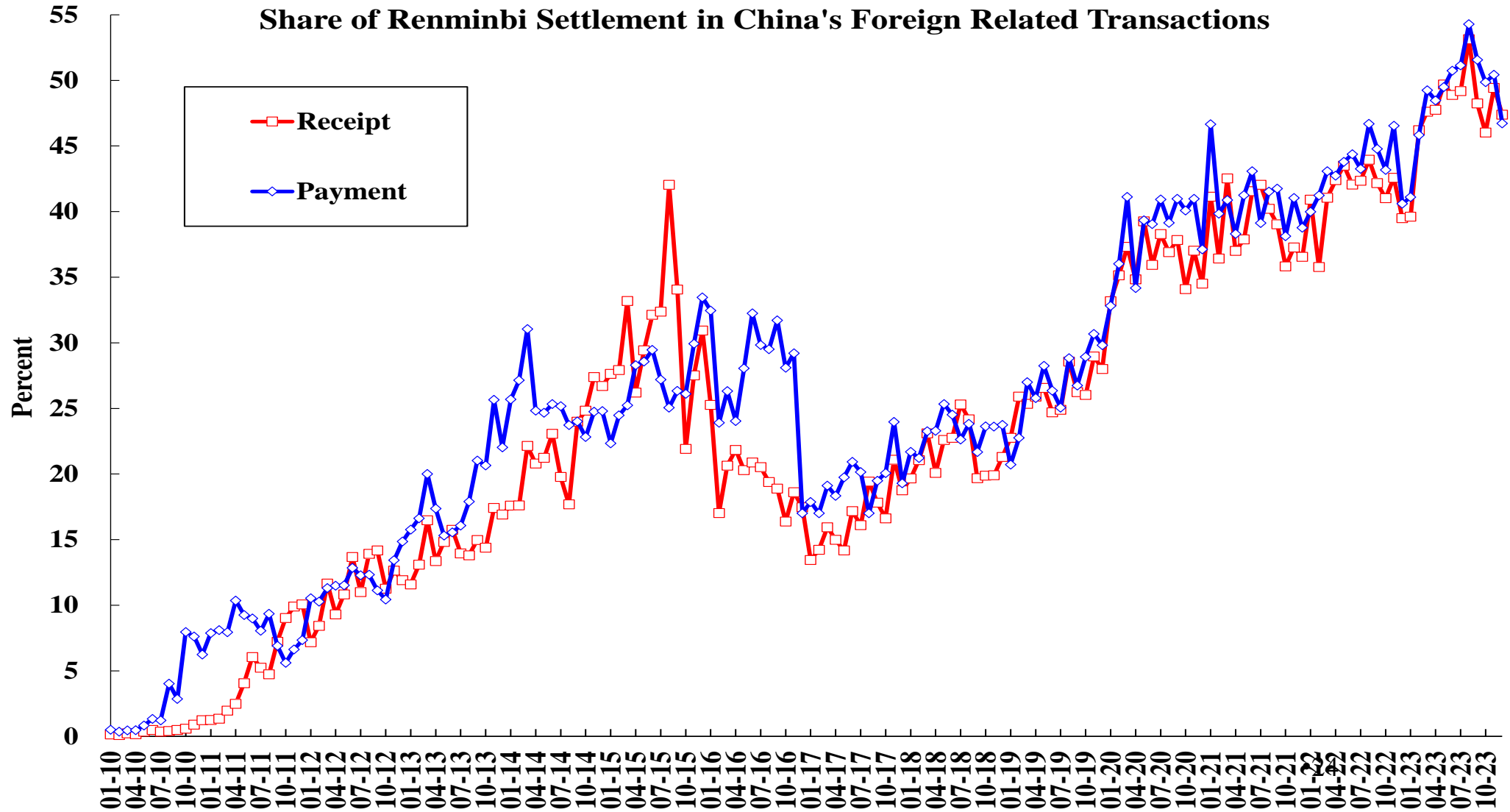
The Internationalisation of the Renminbi: The Settlement of Chinese Cross-Border Trade

- ◆ Before 2010, almost all Chinese cross-border trade was settled in U.S. Dollar. The percentage of Chinese cross-border trade settled in Renminbi was zero in 2010. It rose to over 30% in mid-2015, only to fall because of a sudden and unexpected devaluation, to below 20% in 2017. It has since recovered gradually to reach 35% again in 2023.
- ◆ In terms of foreign-related transactions, which include foreign direct investment and portfolio investment flows, the percentage of settlement in Renminbi also started at zero in 2010. It followed the same temporal pattern as Chinese cross-border trade, with a substantial drop between 2015 and 2017. It has recently risen to approximately 50%.
- ◆ The main impetus for the wider use of the Renminbi in world settlement comes from the fact that international trade between China and many of its trading partners is increasingly settled in each other's own national currencies.

Renminbi Settlement of Chinese Cross-Border Trade, Billion US\$ and Percent



The Share of Renminbi Settlement in Mainland China's Foreign-Related Transactions



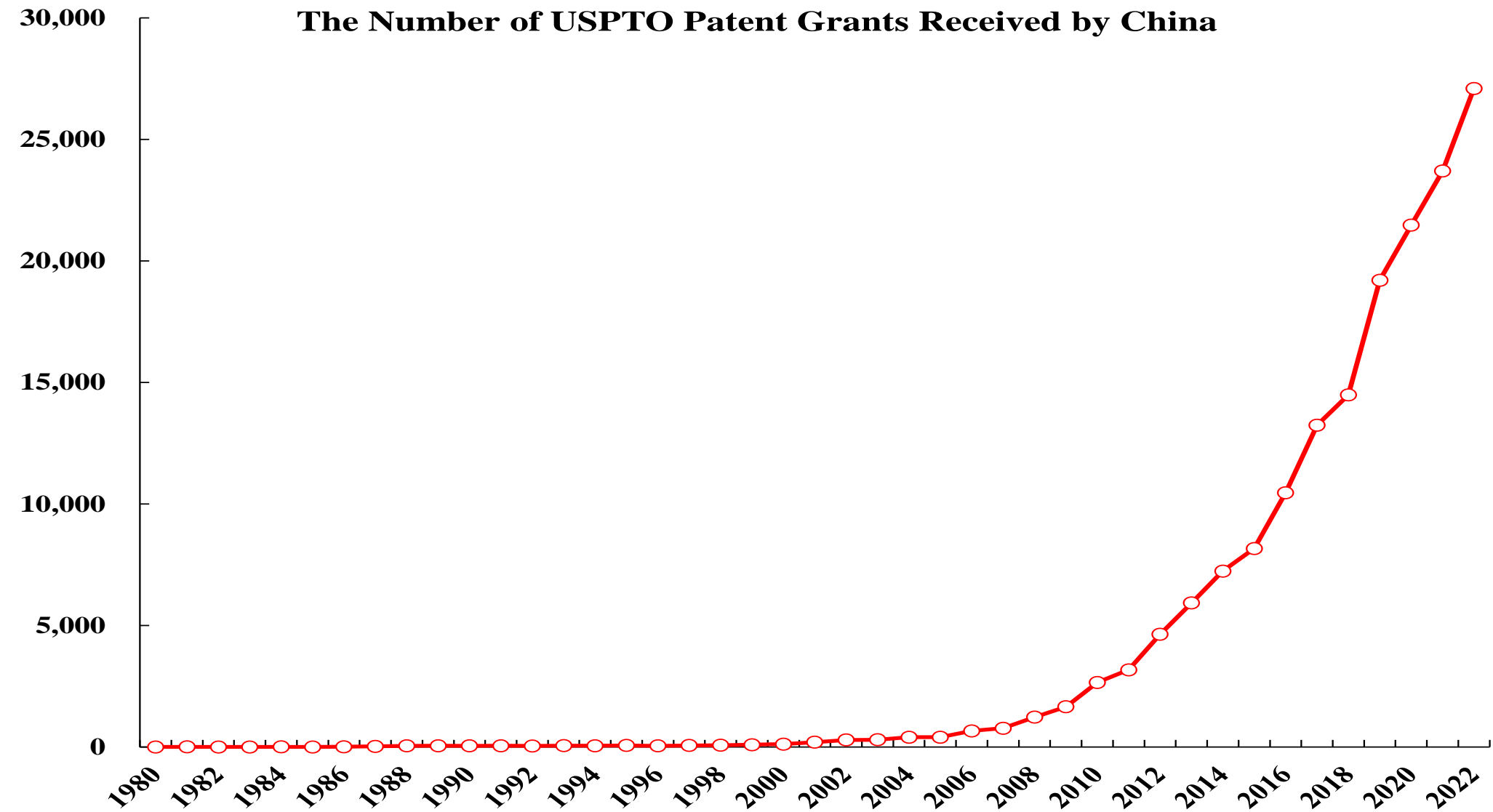
The Internationalisation of the Renminbi

- ◆ More and more countries have signed own-currency settlement agreements with China. For example, in trade with China, both Indonesia and Russia use their own respective national currencies, the rupiah or the ruble, together with the Chinese yuan, to settle. More recently, countries such as Argentina, Brazil and Saudi Arabia have also agreed to settle their bilateral trade with China in their own respective currencies and the Yuan.
- ◆ With more and more settlement done in own currencies, the need for the maintenance of a large foreign exchange reserves, especially U.S. Dollar-denominated assets, is reduced.
- ◆ The Society for Worldwide Interbank Financial Telecommunication (SWIFT) international payment system for the U.S. Dollar is increasingly weaponised under U.S. pressure, forcing many countries, such as Iran and Russia, to look for alternatives. The use of the United States dollar as an international medium of exchange or store of value by third countries is likely to decline gradually over time.

The Absolute Quantity of Economic Growth: Science and Technology

- ◆ China has been increasing its expenditure on research and development (R&D), which reached 2.56% and 2.64% of Chinese GDP respectively in 2022 and 2023.
- ◆ Since 2014, it has also strengthened intellectual property right protection significantly by establishing special intellectual property courts with sole nationwide jurisdiction on such matters.
- ◆ The numbers of patents awarded to Chinese discoverers and inventors by respectively the United States Patent and Trademark Office (USPTO), the European Patent Office (EPO), and the China National Intellectual Property Administration (CNIPA) have all been increasing by leaps and bounds in recent years.
- ◆ China has also made indigenous innovations in many areas: for example, 5G and 6G communication, the Beidou Navigation Satellite System, electric vehicles, high-speed trains, quantum communication, solar panels, super-computers and ultra-high-voltage transmission of electricity.

The Number of USPTO Patent Grants Received by China



The Relative Quantity of Growth

- ◆ The Shifting Centres of Gravity of the World Economy
- ◆ The Diversification of the International Media of Exchange
- ◆ Science and Technology

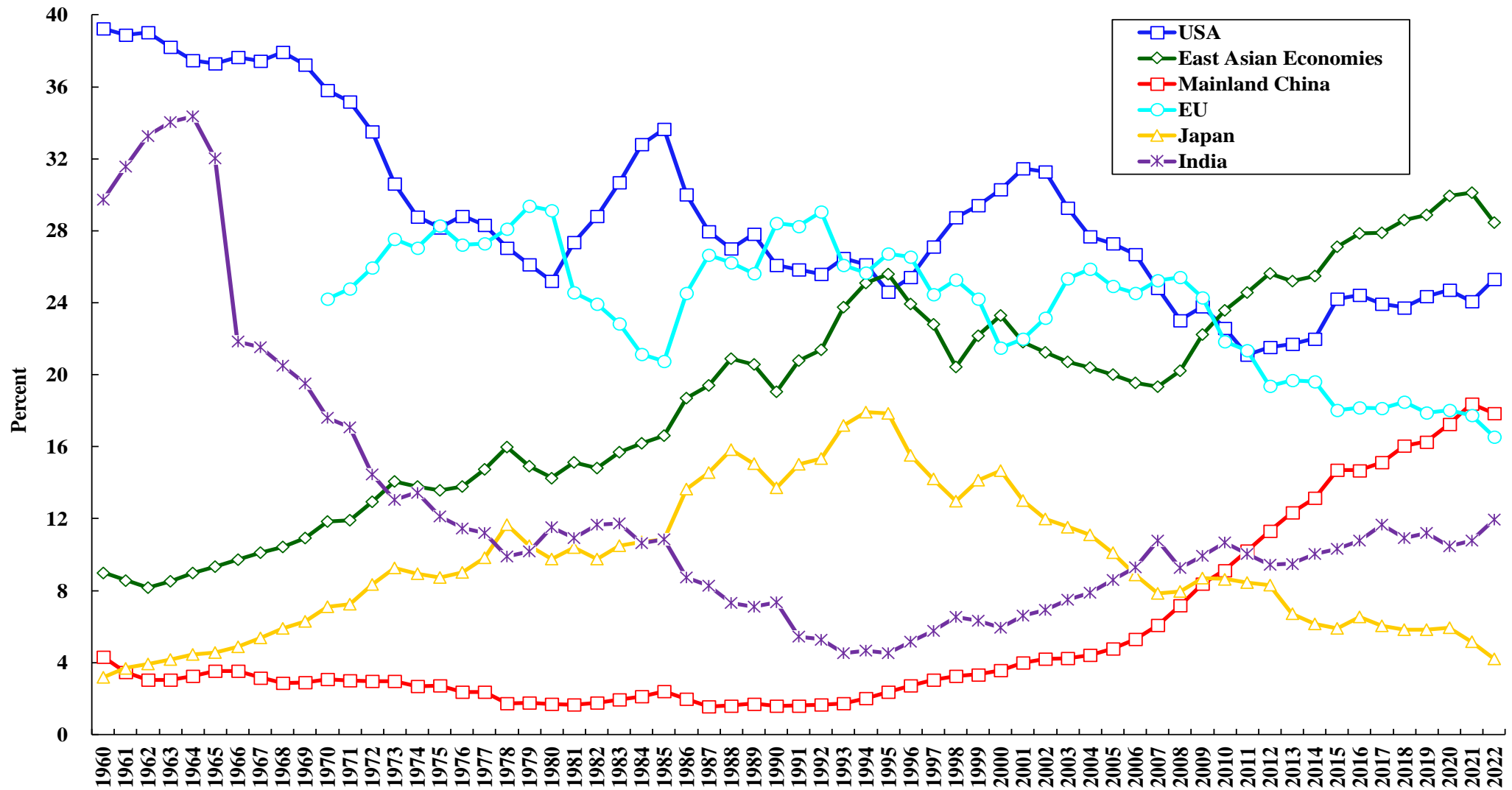
The Shifting Centres of Gravity of the World Economy

- ◆ The developing economies have been driving world economic growth in the past three decades. As a group, they have been growing faster than the developed economies as a group.
- ◆ Since 1960, the centres of gravity of the world economy have been shifting from North America and Europe to East Asia. And within East Asia, they have been shifting from Japan to China since the mid-1990s.
- ◆ With the rise of the Indian and South Asian economies, such as Bangladesh, it appears that the centres of gravity of the world economy will be shifted to Asia in another decade or so, with Asia accounting for more than half of the world's GDP as it once did in the early 1800s.
- ◆ The shifts can be seen in real GDP, international trade, manufacturing value-added, wealth, and the choice of currency for the settlement of international transactions.

The Shifting Centres of Gravity of the World Economy: Real GDP

- ◆ Based on market prices and exchange rates, between 1960 and 2022, the share of the U.S. in world GDP declined from 40% to 25%; and the share of Mainland China rose from 4% to approximately 18%. During the same period, the share of East Asia as a whole rose from 9% to almost 30%; Japan's share went from 3.2% to 4.2%, although at its peak, Japan accounted for 18%; and India's share went from almost 35% in 1965 to a low of 4.5% in 1995 and then recovered to almost 12% in 2022.
- ◆ If East Asia and India continue on the same trajectory, Asia's share of world GDP will exceed one half of the world's GDP in another decade or so, similar to the situation in the early 1800s.

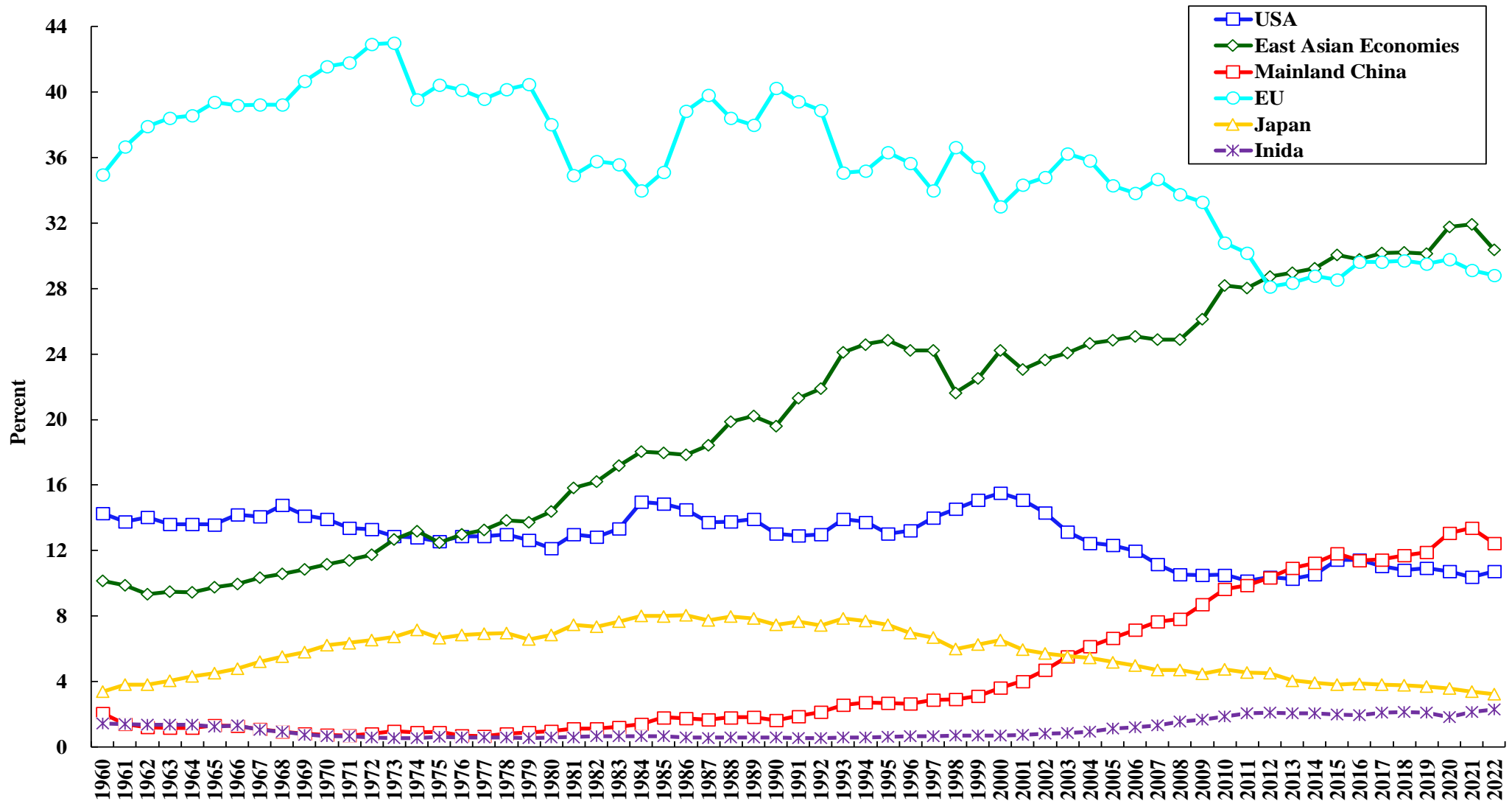
The Shares of East Asia, EU, China, India, Japan and the U.S. in World GDP, 1960-2022



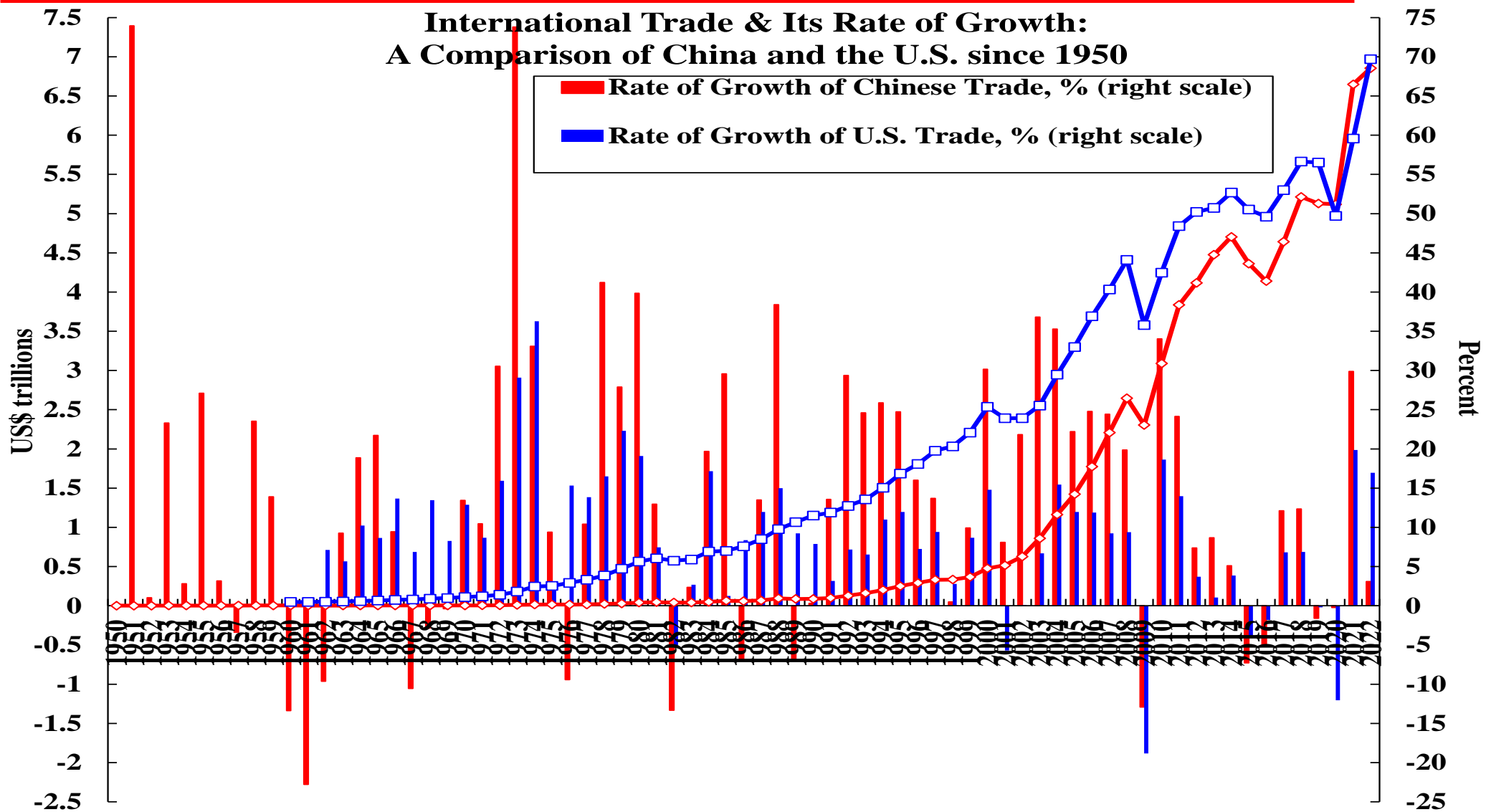
The Shifting Centres of Gravity of the World Economy: International Trade

- ◆ Between 1960 and 2022, the share of the U.S. in international trade in goods declined from 14.3% to 10.7%; and the share of Mainland China rose from 2% to 12.4%. During the same period, the share of East Asia as a whole rose from just over 10% to over 30%, surpassing the European Union; Japan's share declined from 3.4% to 3.2%; and India's share rose moderately to 2.3%.
- ◆ With the inclusion of India and other Asian economies such as Bangladesh and the oil and gas producers of the Middle East, Asia's share of world trade already approaches one half of the total.

The Shares of East Asia, EU, China, India, Japan and the U.S. in World Trade, 1960-2022



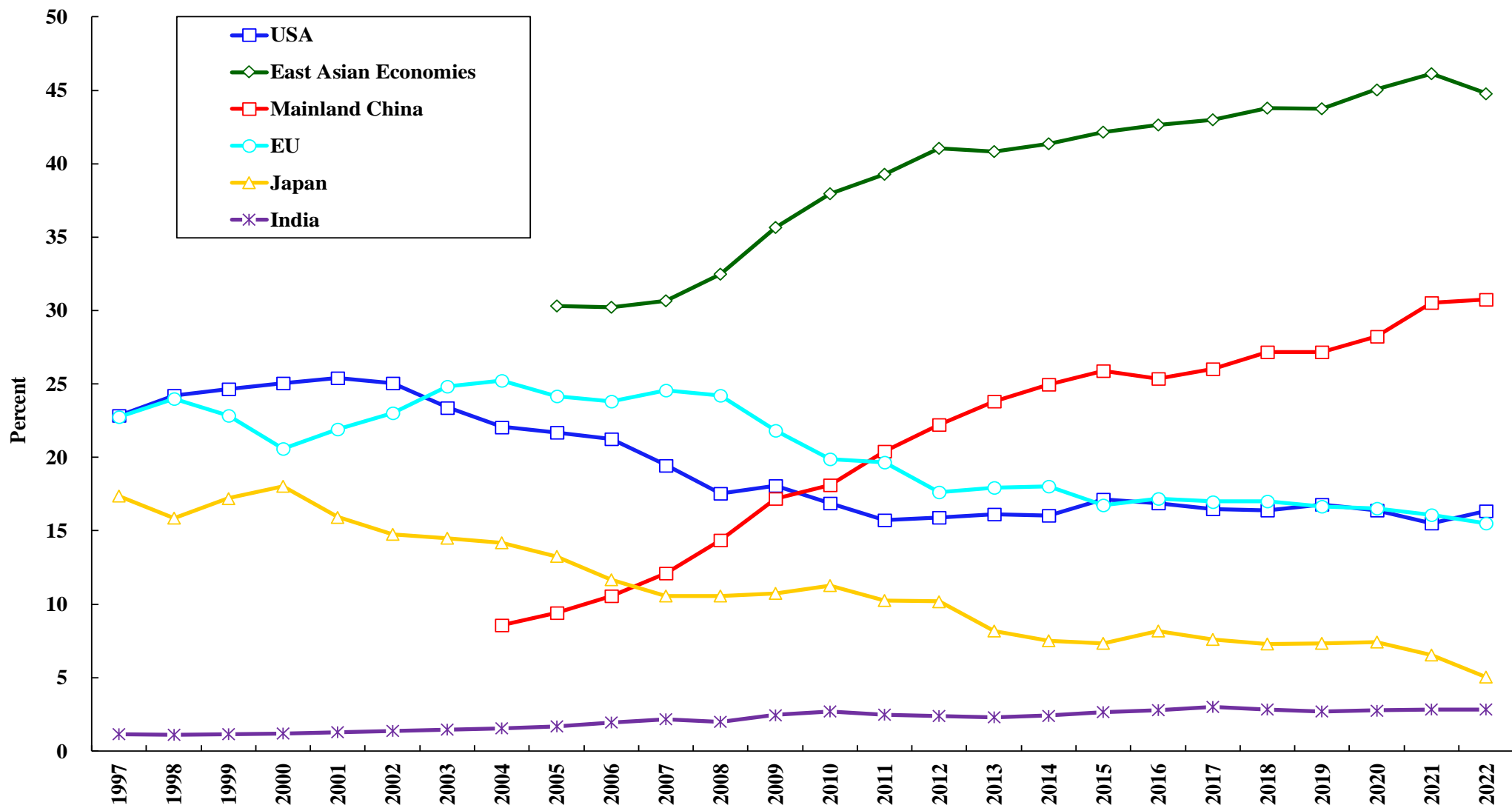
The Growth of Mainland Chinese and U.S. International Trade in Goods and Services



The Shifting Centres of Gravity of the World Economy: Value-Added in Manufacturing

- ◆ In 2022, the share of East Asia in manufacturing value-added was just under 45%; the share of Mainland China was over 30%; and the shares of the European Union and the U.S. had declined to 15.5% and 16.4% respectively. Japan's share declined from over 17% in 1997 to just above 5% in 2022. Between 1997 and 2022, India's share rose from 1.1% to 2.8%.
- ◆ The share of Asia is also likely to be more than half of the world total.

The Shares of East Asia, EU, China, India, Japan & the U.S. in World Manufacturing Value-Added

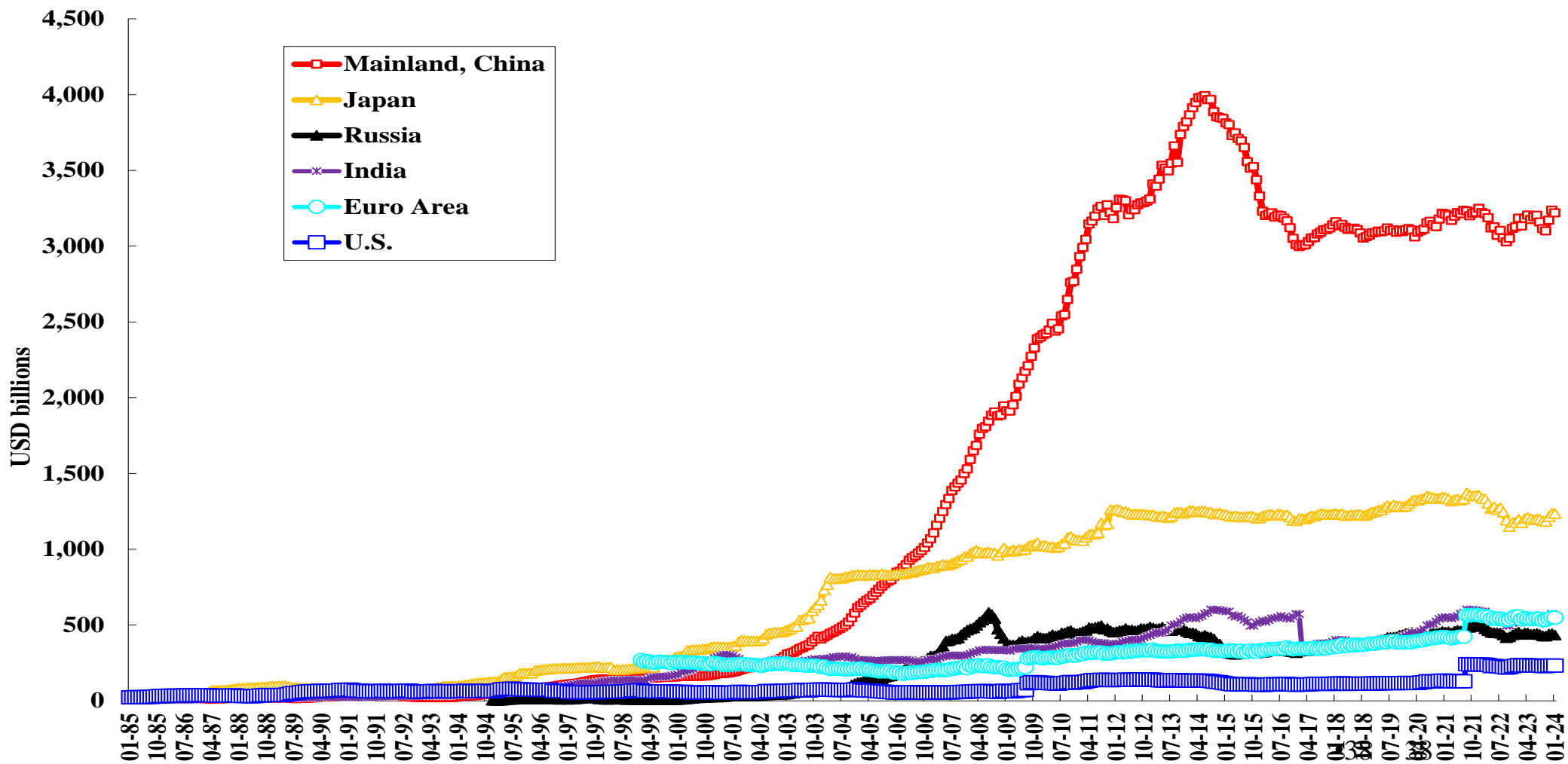


The Shifting Centres of Gravity of Individual, Corporate and Sovereign Wealth in the World

- ◆ According to the 2023 survey done by the Forbes magazine, there were a total of 2,640 US\$ billionaires in the world, amongst whom U.S. citizens accounted for 735 and Chinese (including Hong Kong and Macau) citizens accounted for 562. A similar survey by Hurun concluded that there were a total of 3,112 US\$ billionaires in the world, amongst whom U.S. citizens accounted for 691 and Chinese citizens accounted for 969. Even though the exact numbers and rankings differ, it is unmistakable that aggregate Chinese household wealth is at least of the same order of magnitude as U.S. household wealth. Of course, there may well be even many more unknown US\$ billionaires in China. The aggregate Chinese household wealth has also been increasing rapidly with the emergence of a sizeable middle class.
- ◆ Mainland China's stock market also has the second largest market capitalisation in the world, at US\$8.44 trillion, after the U.S., with its US\$50.86 trillion.
- ◆ China today has the world's largest foreign exchange reserves, at more than US\$3 trillion, followed by Japan with approximately US\$1 trillion. The central banks of Japan and China are also the largest and second largest holders of U.S. Treasury and Agency securities respectively.

Total Foreign Exchange Reserves minus Gold: Selected Economies

Total Foreign Exchange Reserves minus Gold, Selected Countries and Regions



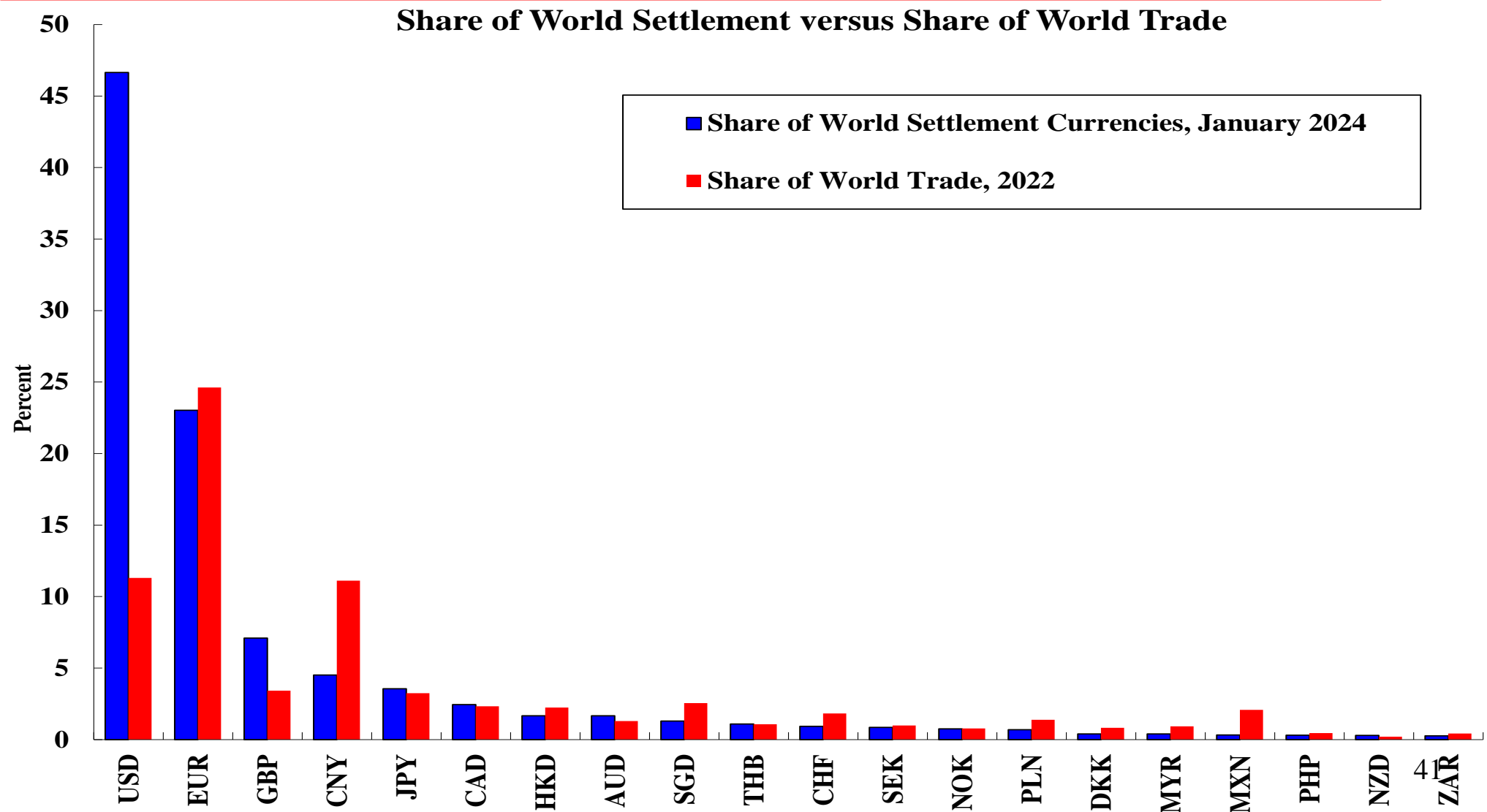
The Internationalisation of the RMB: Share of World Settlement versus Share of World Trade

- ◆ Since the early 1970s, the invoicing, clearing and settlement of bilateral trade between two countries is mostly done in U.S. Dollars.
- ◆ In 2000, after the establishment of the Euro Area, the invoicing, clearing and settlement of bilateral trade between two countries in the Euro Zone is one exclusively in the Euro.
- ◆ As mentioned above, clearing and settlement of bilateral trade in own currencies reduces transaction cost and exchange rate risks to both the exporting and the importing countries. The practice is gaining currency.
- ◆ One principal use of the foreign exchange reserves of a country is to pay for imports. If imports can be paid in a country's own currency, the level of foreign exchange reserves that has to be maintained can be significantly reduced.
- ◆ The main impetus for the internationalisation of the Renminbi comes from the fact that international trade between China and many of its trading partners is increasingly settled in each other's own national currencies.

The Internationalisation of the RMB: Share of World Settlement versus Share of World Trade

- ◆ In the following chart, we compare the share of world settlement of the currency of a country or region (blue column) in January 2024, with the share of world trade of that country or region (red column) in 2022.
- ◆ In 2022, the Euro Area accounted for the largest share of world trade, 24.6%, followed by the U.S, with 11.3%, and the Mainland China, with 11.1%. (We note that these shares are sensitive to changes in exchange rates.)
- ◆ In January 2024, the U.S. Dollar accounted for the largest share of world settlement, 46.6%, the Euro accounted for 23.0%, and the British Pound accounted for 7.1%. The Renminbi share in world settlement increased rapidly from 2.3% in March 2023, to 3.1% in July 2023 and 4.1% in December 2023 and 4.5% in January 2024 to become the fourth most frequently used settlement currency. The Japanese Yen was in fifth place, accounting for 3.6%. We note that for the U.S. Dollar, the British Pound and the Japanese Yen, their shares of settlement were all higher than the respective shares of these countries in world trade.

Share of World Settlement versus 2022 Share of World Trade, Selected Economies, Jan. 2024



The Internationalisation of the RMB: Share of World Settlement versus Share of World Trade

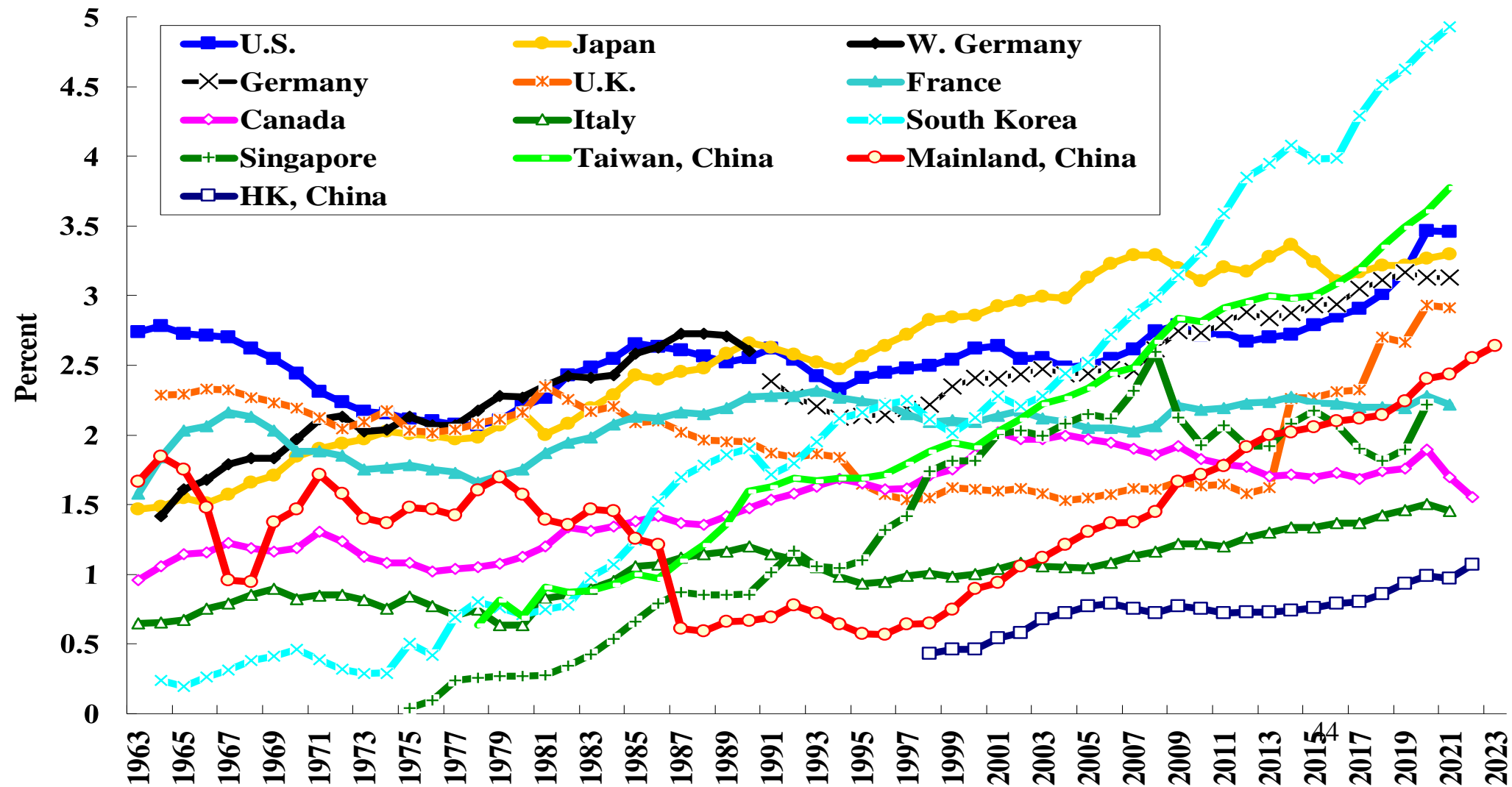
- ◆ In world settlement, the Japanese Yen's share was 3.8%, which was higher than Japan's share in world trade of 3.3%, while the Renminbi share in world settlement was only 4.1% even though China's share in world trade was 11.1%.
- ◆ If the share of Renminbi settlement could eventually reach China's share of world trade, it would become 11.1%, surpassing the share of the British pound to become the third most widely used settlement currency. There is a great deal of room for the Renminbi share of world settlement to continue to grow. But the Renminbi's share is not expected to catch up to the U.S. Dollar's share, which currently stands at 46.6%, for a long time.
- ◆ However, replacing the US dollar with the Renminbi as a medium of international exchange between other countries may not be in China's own best national interests. Instead, China should promote the own-currency settlement between bilateral trading-partner countries, as they did under the Bretton Woods system before 1971.

The Relative Quantity of Growth: Science and Technology

- ◆ R&D Expenditures
- ◆ Scientific and Engineering Publications
- ◆ Patent Grants
- ◆ Super-Computers

R&D Expenditures as a Percent of GDP: G-7 Countries, 4 East Asian NIES & China

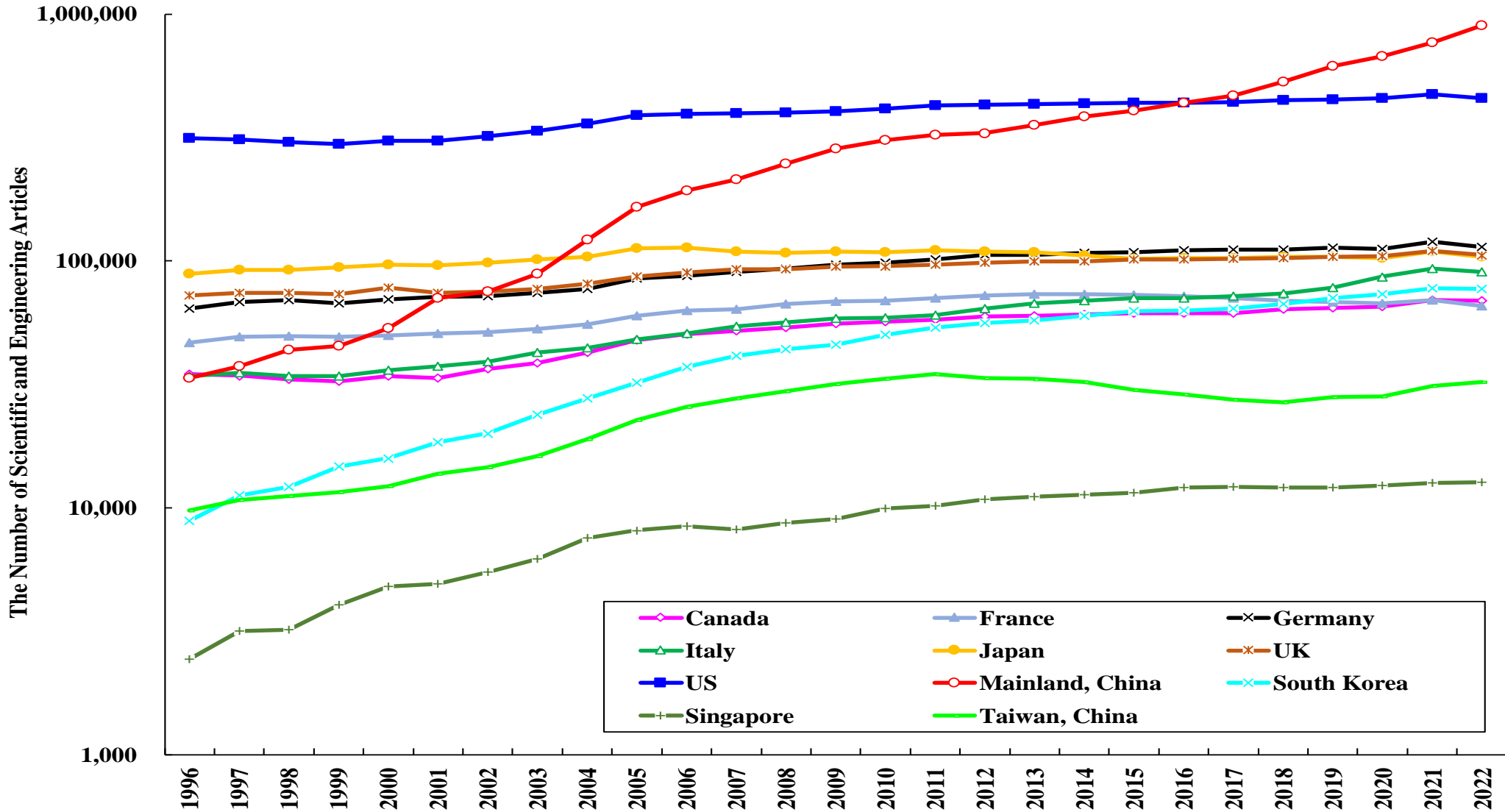
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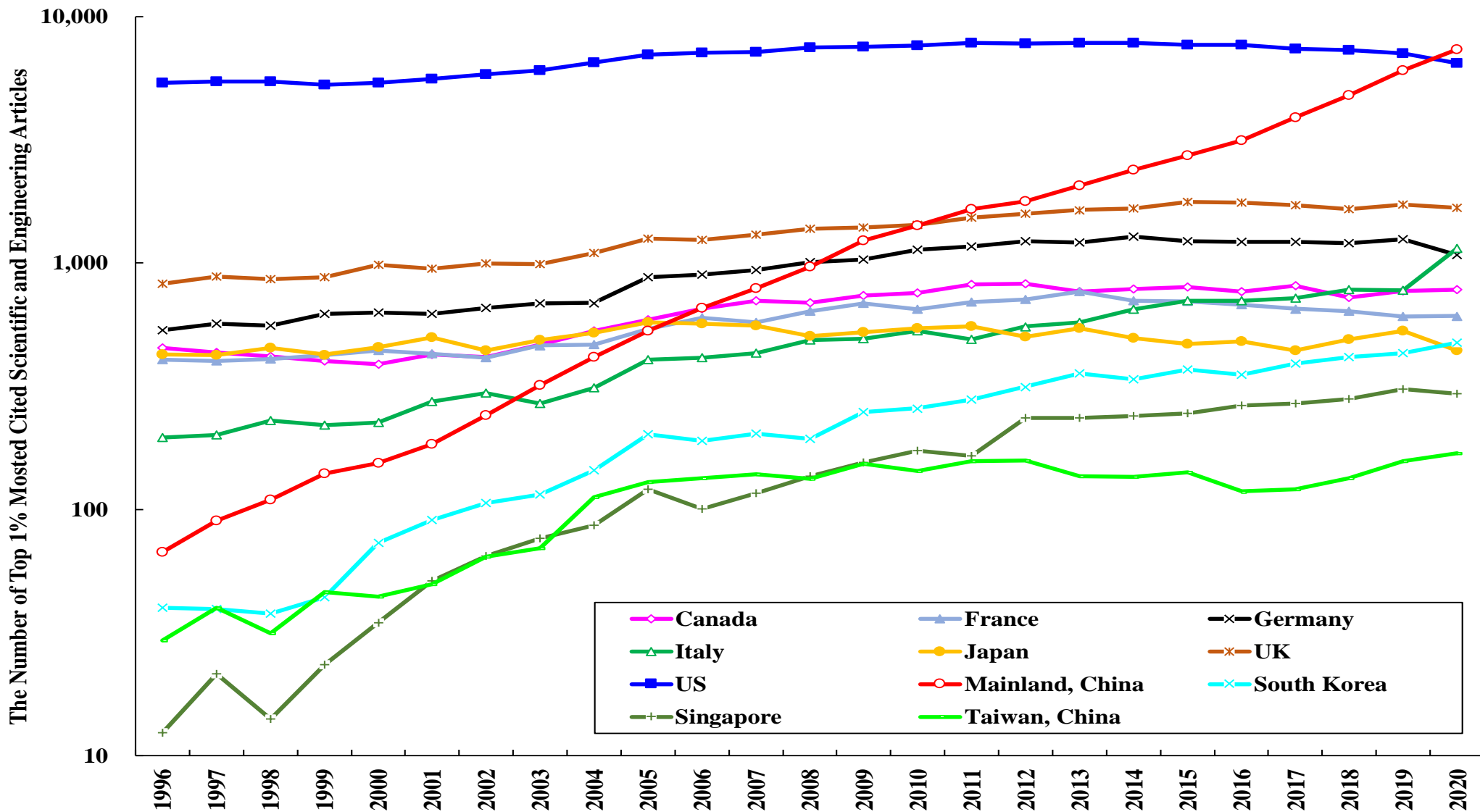
The Relative Quantity of Growth: Scientific and Engineering Articles Published

- ◆ Since 2014, China has strengthened intellectual property right protection significantly by establishing special intellectual property courts with sole nationwide jurisdiction over such matters.
- ◆ The total number of science and engineering scholarly articles published in international professional journals by Chinese authors exceeded that by U.S. authors in 2016. Chinese authors now collectively publish the largest number of such articles in the world.
- ◆ Chinese authors also surpassed U.S. authors in the number of top 1% most cited scientific articles in 2020. China trailed the U.S. and the European Union countries for many years.

The Relative Quantity of Growth: Scientific and Engineering Articles Published



The Relative Quantity of Growth: The Number of Top 1% Most Cited Articles

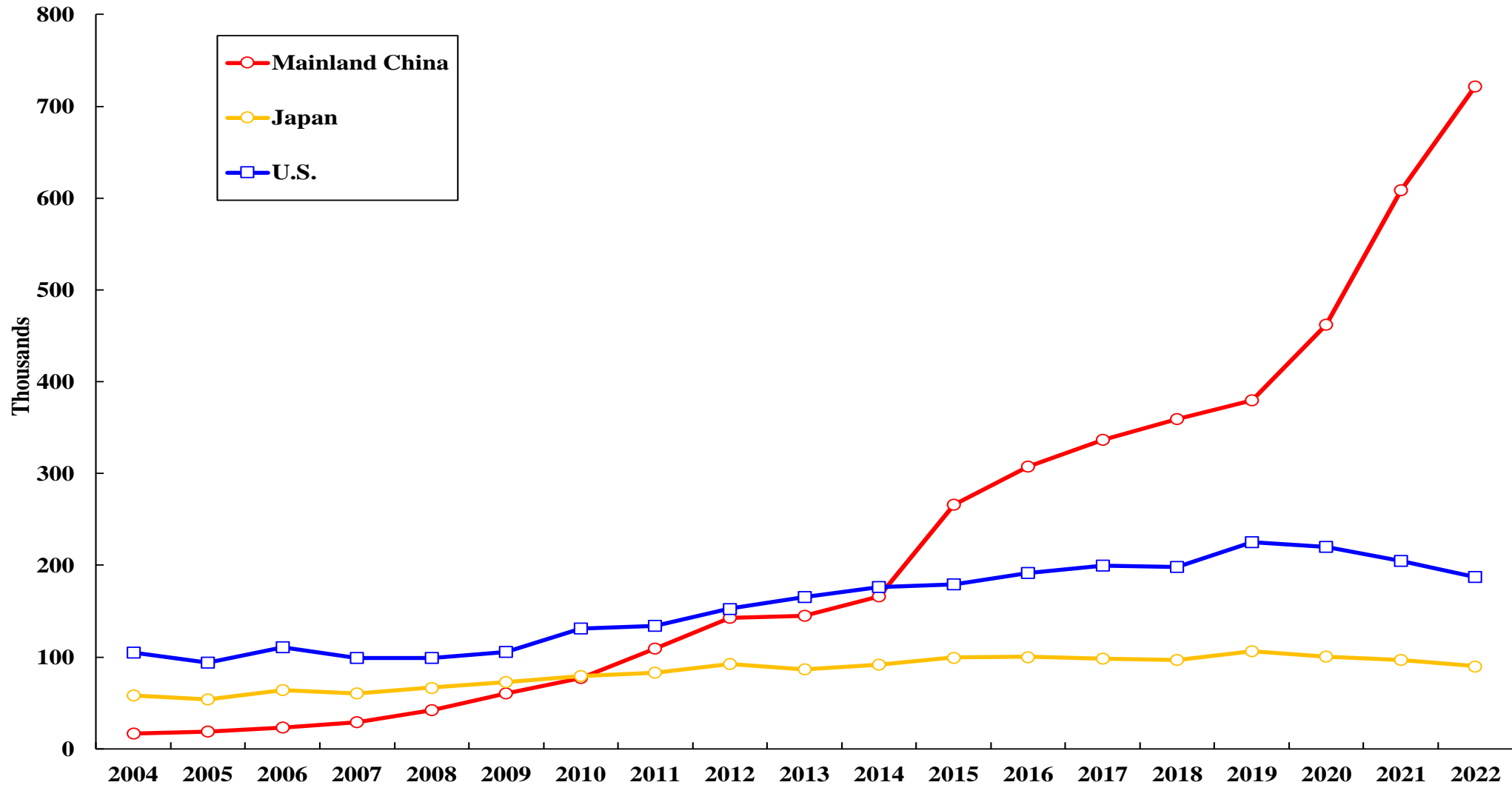


The Relative Quantity of Growth: Patent Grants Awarded

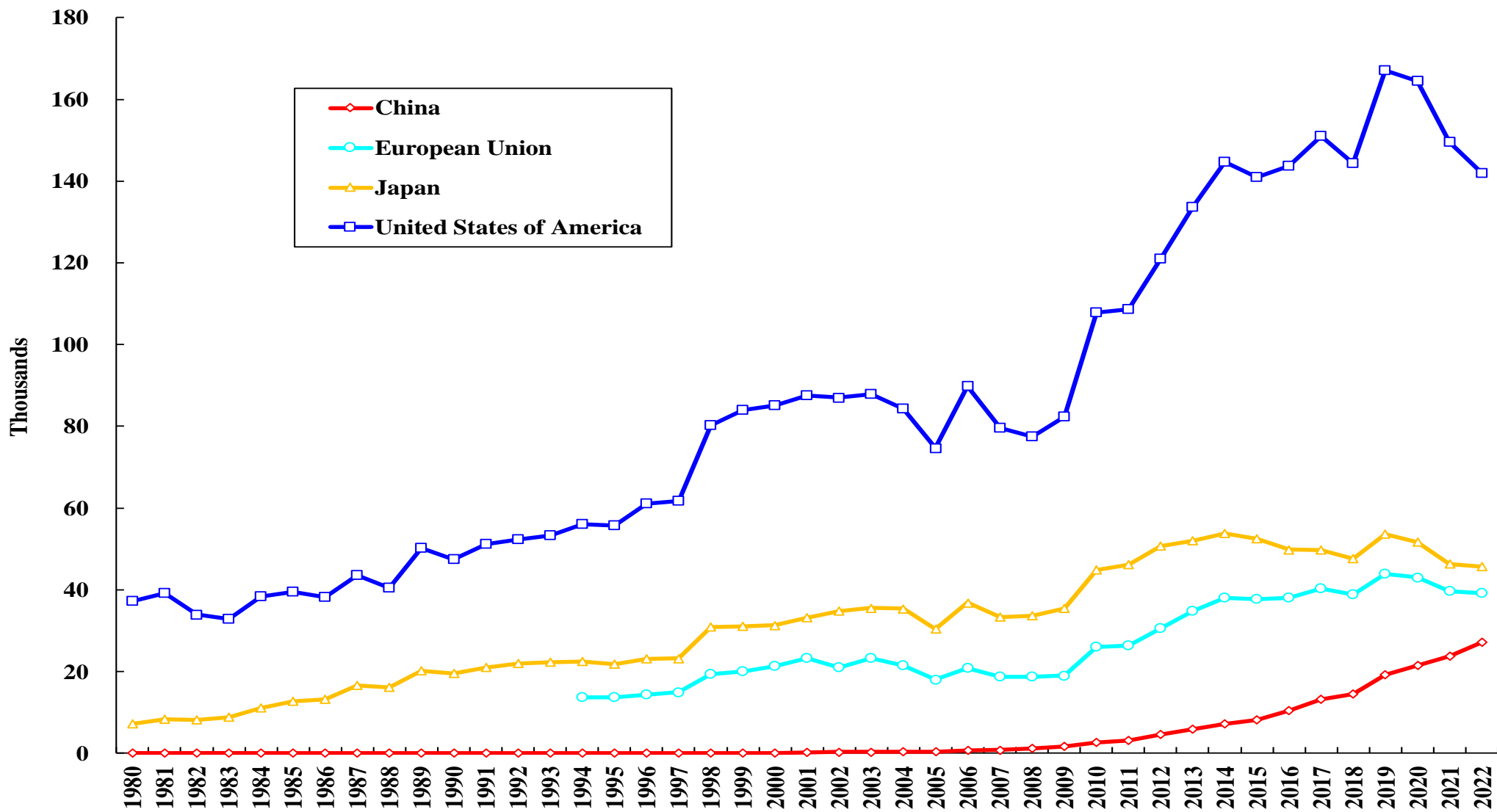
- ◆ The China National Intellectual Property Administration (CNIPA), China's patent office, today awards the largest number of patent grants of any country in the world.
- ◆ However, in terms of the number of the United States Patent and Trademark Office (USPTO) patents awarded, China still lags behind the U.S., Japan and the E.U. In fact, China also lags behind in terms of patents awarded by both the European Patent Office (EPO) and the Japan Patent Office.

Total Patent Grants Awarded by USPTO, EPO and CNIPA: Mainland China, Japan & the U.S.

Patent Grants Awarded by USPTO, EPO and CNIPA Combined: China, Japan and the U.S.

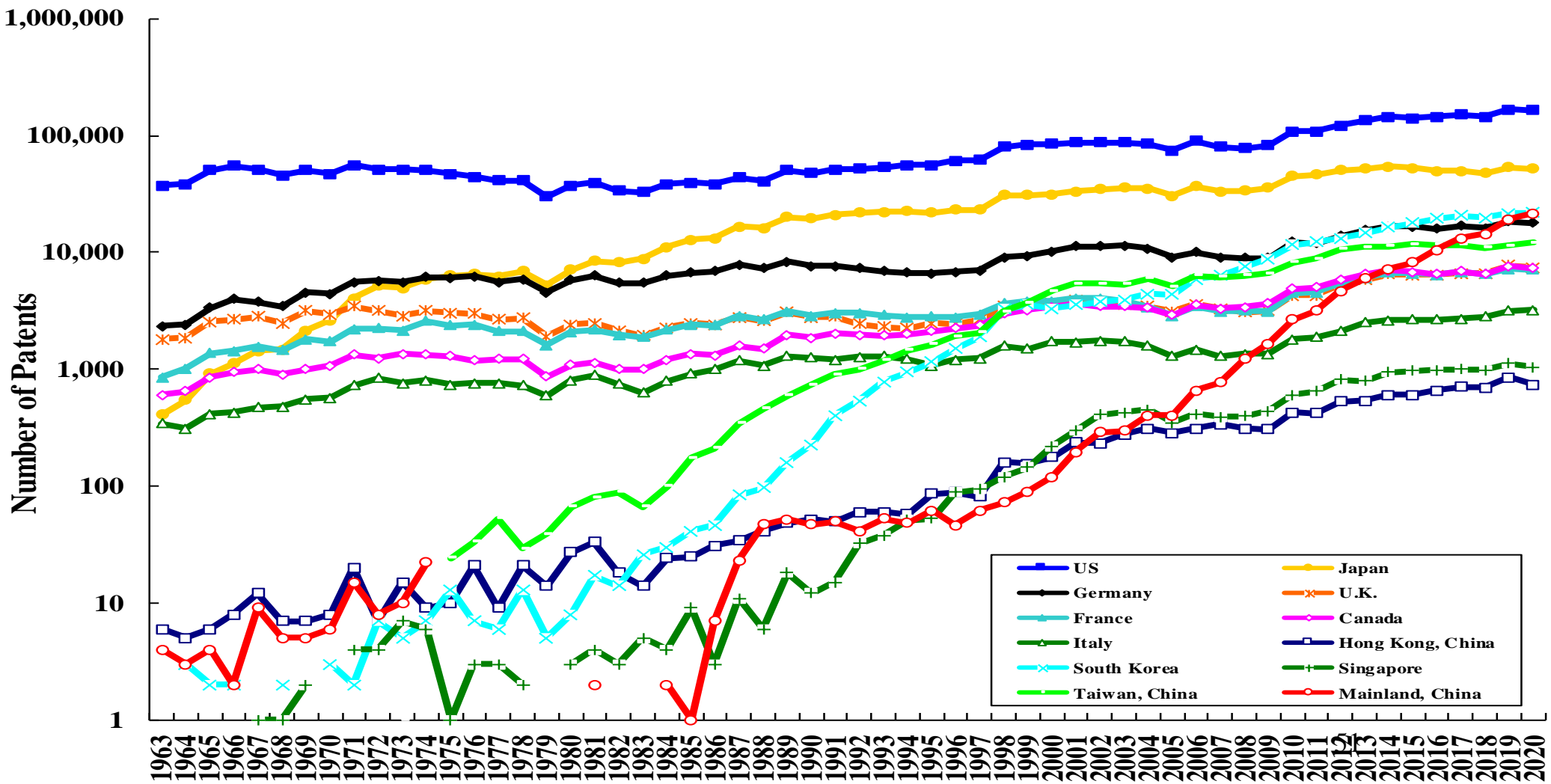


The Number of USPTO Patents Received by China, EU, Japan and the U.S.



Patents Granted in the United States: G-7 Countries, 4 East Asian NIEs & China

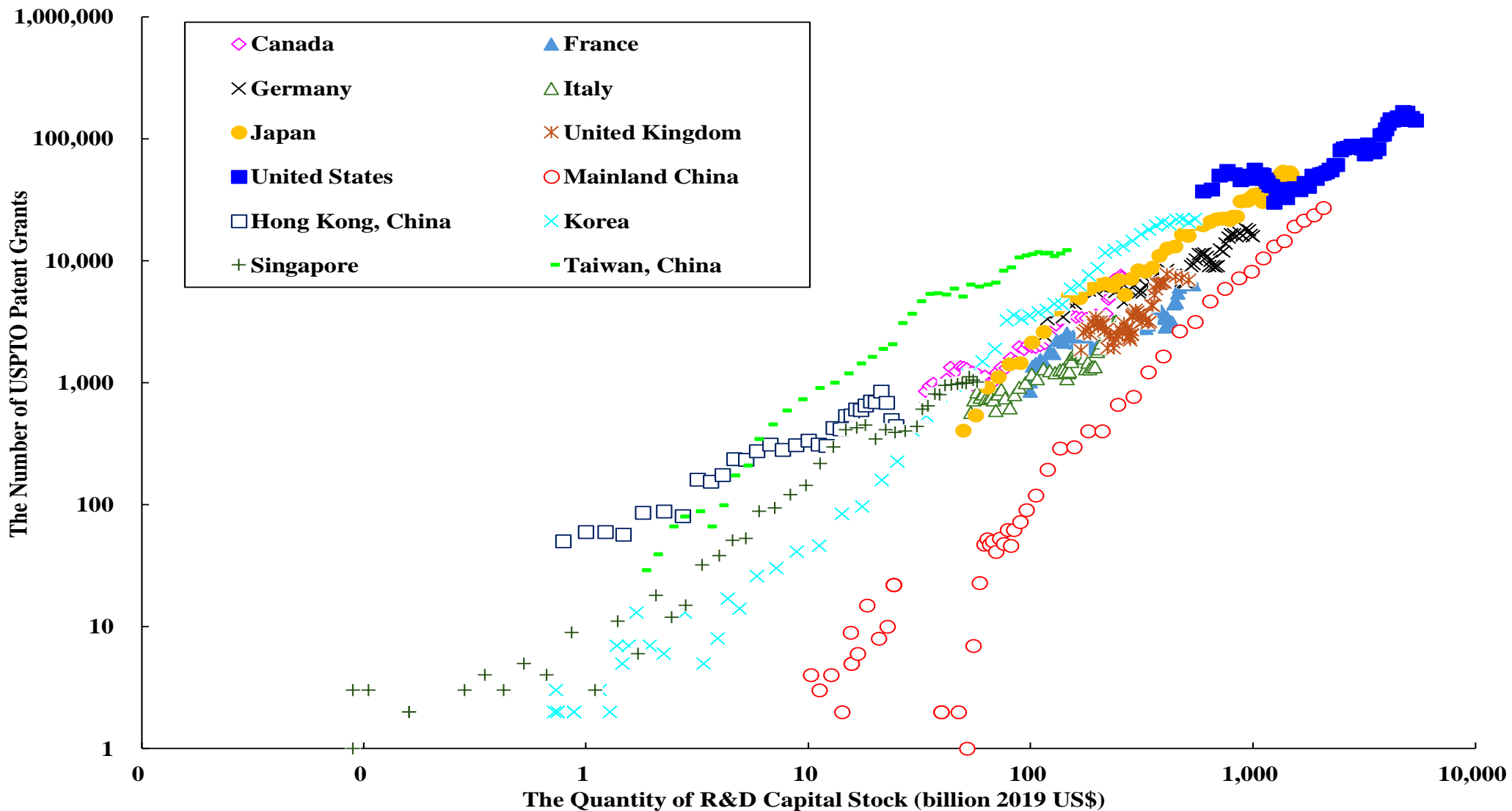
U.S. Patent Granted Annually: G7 Countries, 4 East Asian NIEs and China



The Relative Quantity of Growth: Patent Grants Awarded

- ◆ Lawrence J. Lau and Yanyan Xiong have established a positive relationship between the number of patents granted by the U.S. Patent and Trademark Office (USPTO) and the quantity of real R&D capital stock for a selection of developed and developing countries and regions in their book, Are There Laws of Innovation?, Singapore: World Scientific Publishing Company, 2022 (see the following Chart).
- ◆ The R&D capital stock of a country is defined as the cumulative real expenditure on R&D less a depreciation of 10% per annum.
- ◆ Basically, the larger the real R&D capital stock of a country or region is, the larger the number of USPTO patents received by that country or region will be.

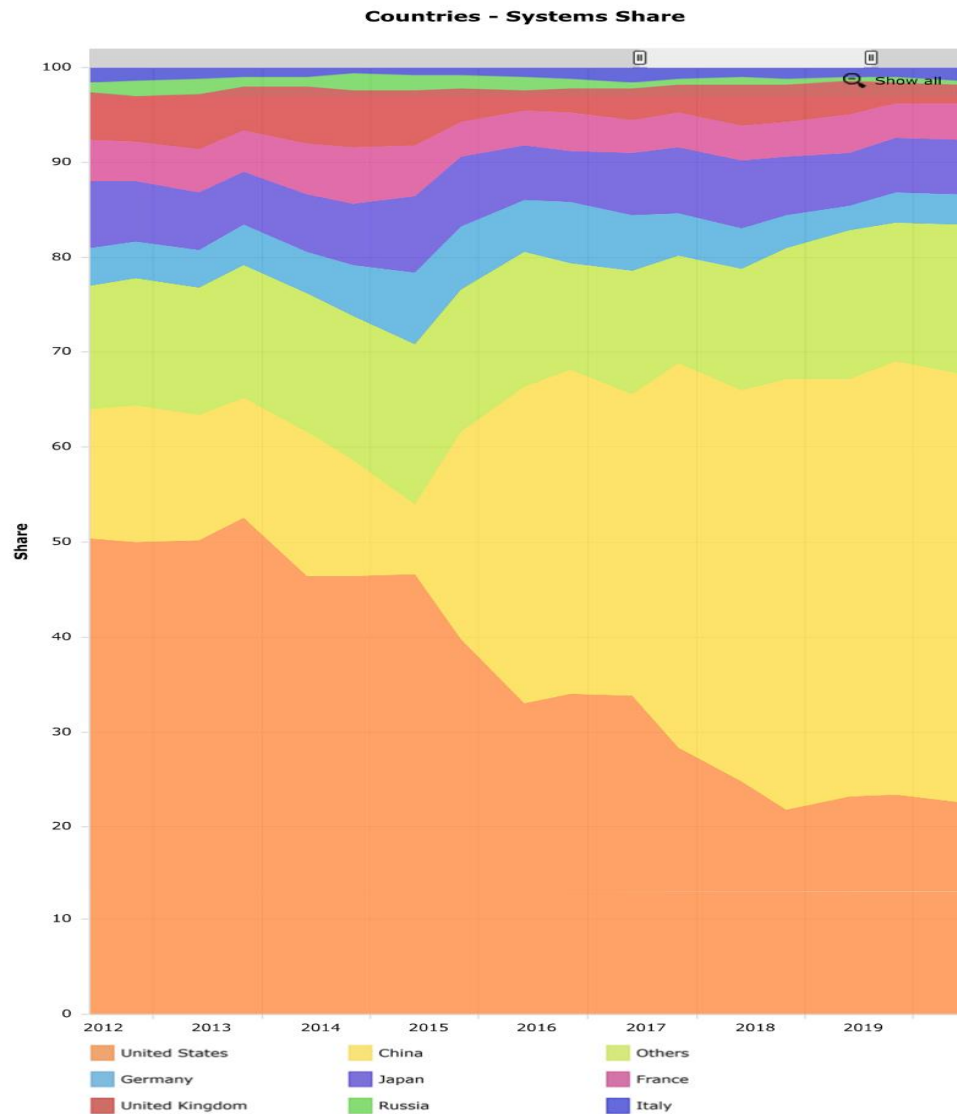
The Number of USPTO Patent Grants Received vs. the Real R&D Capital Stock



The Relative Quantity of Growth: Super-Computers

- ◆ In a list of the “Top 500” fastest super-computers of the world, ranked by their computational speeds, published in June 2023, 150 were in the U.S., 134 were in China, 36 in Germany, and 33 in Japan. The currently fastest super-computer is supposed to be the “Frontier” in Oak Ridge, Tennessee, U.S.A. (<https://www.top500.org/lists/top500/2023/06/highs/>)
- ◆ China, with a share of 26.8% on the 2023 list, compared to the U.S.’s 30%, has come a long way. In 2012, China’s share was less than 14% whereas the U.S. accounted for 50% (see the following Chart).
- ◆ However, there are a number of supercomputers in China that did not participate in the ranking contest of 2023. Moreover, some of the Chinese supercomputers were reportedly built entirely with domestically produced components and parts.

The Relative Quantity of Growth: Super-Computers



- ◆ On the left is a chart showing the shares of various countries in the TOP 500 List of the Fastest Super-Computers from 2012 to 2020. The progress made by China (coloured yellow) during this period is most remarkable, growing from approximately 14% to 26.8% (2023). The U.S. (coloured orange) share declined from 50% to 30% over the same period.

The Absolute Quality of Chinese Economic Growth

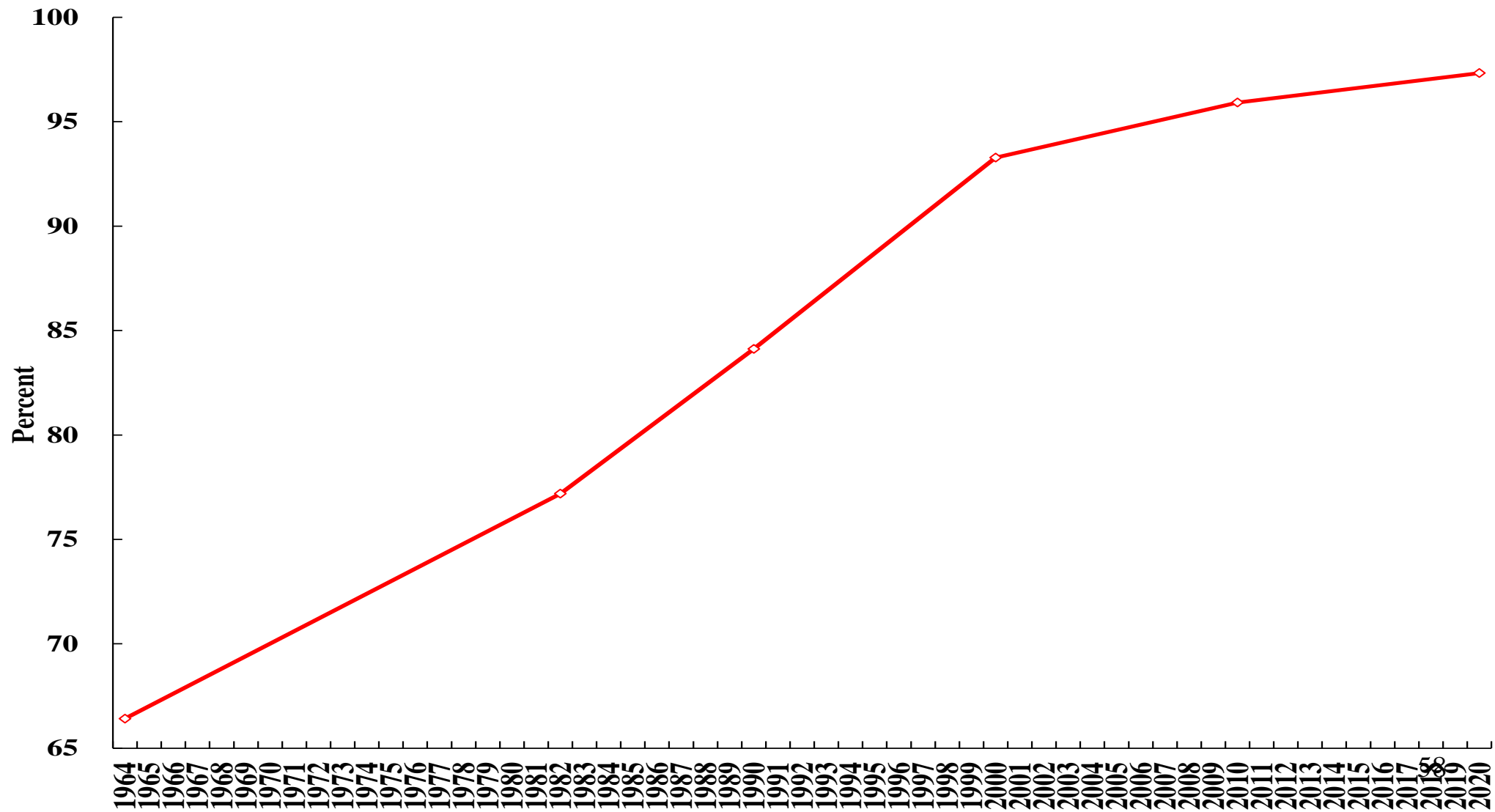
- ◆ Educational Attainments
- ◆ Public Health
- ◆ Innovation in Science and Technology
- ◆ Prevention of Climate Change
- ◆ The Distribution of Income
- ◆ The Eradication of Extreme Poverty

Educational Attainments:

Literacy

- ◆ Traditionally, for at least a couple of millennia, the Chinese people have always valued education highly, in large part because it was one of the very few channels for upward social mobility. In the social hierarchy of old China, scholars are on the very top, followed by farmers, and then by labourers, with the merchants at the very bottom. Being wealthy alone does not improve social status or earn respect.
- ◆ More generally, literacy (and the promotion of Putonghua) are clearly public goods because they enable all Chinese people to communicate with one another in both speech and writing.
- ◆ The literacy rate, which must have been way below 50% in 1949, increased from 66.4% in 1964 to 97.3% in 2020, thanks in part to the simplification of the Chinese characters undertaken in the 1950s and codified in 1964.
- ◆ The simplification has been subject to much criticism, some quite justifiable, but it did reduce the number of years of schooling required for an average person to be able to read a newspaper from eight to four years, a major accomplishment.

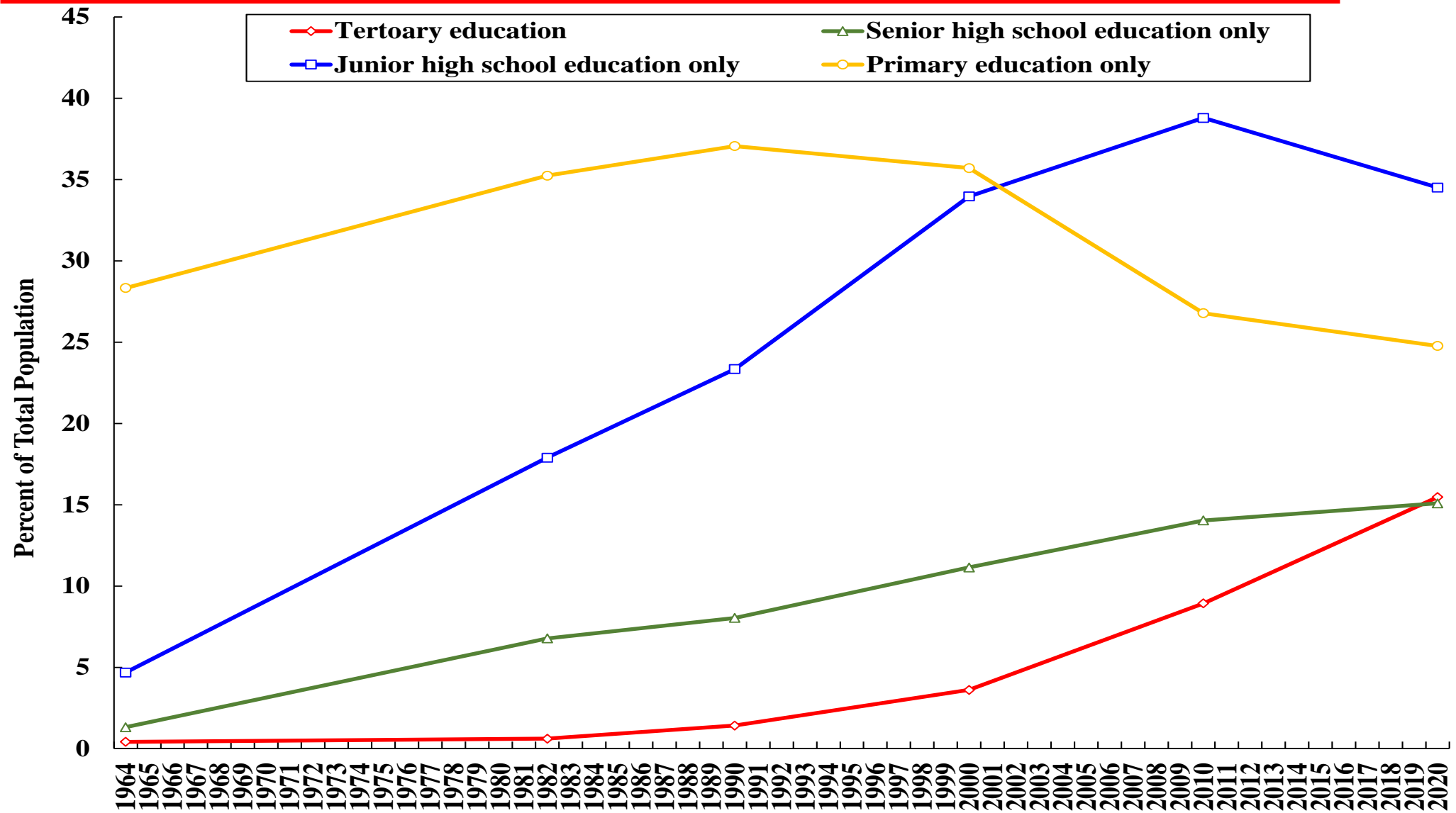
Educational Attainments: The Literacy Rate (Percent)



Educational Attainments

- ◆ Mandatory 9-year education for all was introduced in China in 1986. Today, most young people have had at least 12 years of education, even though senior secondary education is still not yet mandatory at this time.
- ◆ The proportions of people with only primary education (the yellow line) or junior secondary education (the blue line) have already peaked and begun to decline.
- ◆ The tertiary enrolment rates of graduates of secondary schools was 24.6% in 1989 and rose to 94.5% in 2016. This means almost everyone who wishes to attend a tertiary educational institution is now able to do so. (However, the proportion of the population aged 18-22 that were enrolled in tertiary education institutions in 2021 was only 57.8%, indicating that not everyone in that age cohort was able to complete senior secondary education.)
- ◆ The proportion of the total population with tertiary education (the red line), which was only 0.42% in 1964, rose to 15.47% in 2020, and is expected to increase further with time.

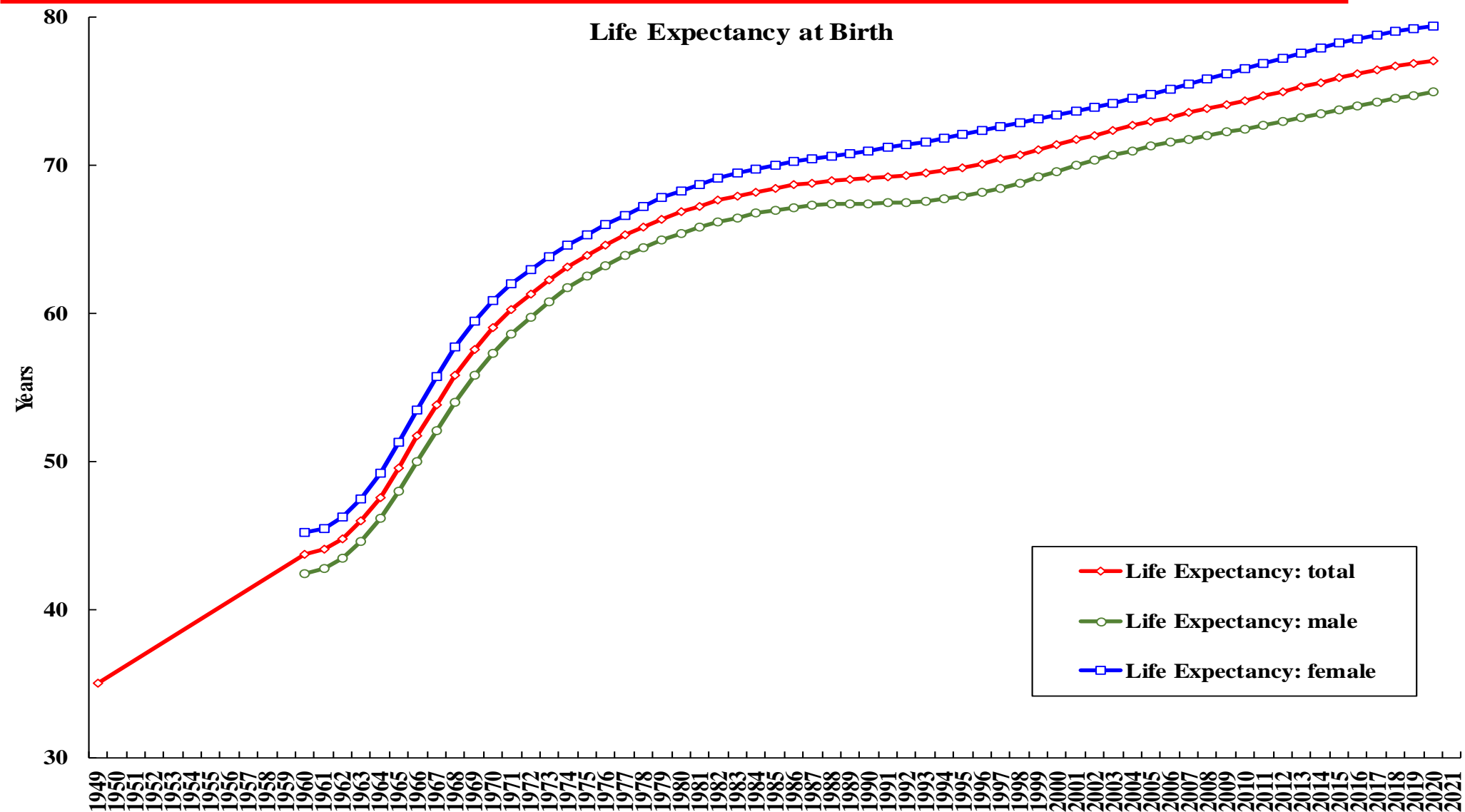
Educational Attainment Rates (Percent)



The Absolute Quality of Chinese Economic Growth: Public Health

- ◆ Much improvement has occurred in healthcare and public hygiene in China.
- ◆ The population mortality rate has declined by more than half from 2.0% in 1949 to 0.71% in 2020.
- ◆ Life expectancy at birth, which was only 35 years in 1949 and 67.8 years in 1981, grew to 77.47 years in 2023 (compared to 73 years for the world as a whole in 2019). Life expectancy at age 60 was 20.21 years in 2020.
- ◆ The COVID-19 epidemic was reasonably successfully managed in China. As of 31 December 2023, the COVID-19 epidemic infected cumulatively **99.3 million** persons and resulted in **0.122 million** direct deaths on the Mainland, with a quarter of the world's population. However, estimated cumulative excess deaths indirectly attributable to COVID-19 in China, for example, through crowding out, can be as high as **1.56 million** (however, this number is not comparable to the 7.0 million number below). By comparison, the world had, on the same date, a cumulative total of more than **774 million** (773,960,065) infected cases and more than **7.0 million** (7,015,550) fatalities (Source: Our World in Data)..

Public Health: Life Expectancy at Birth (Years)



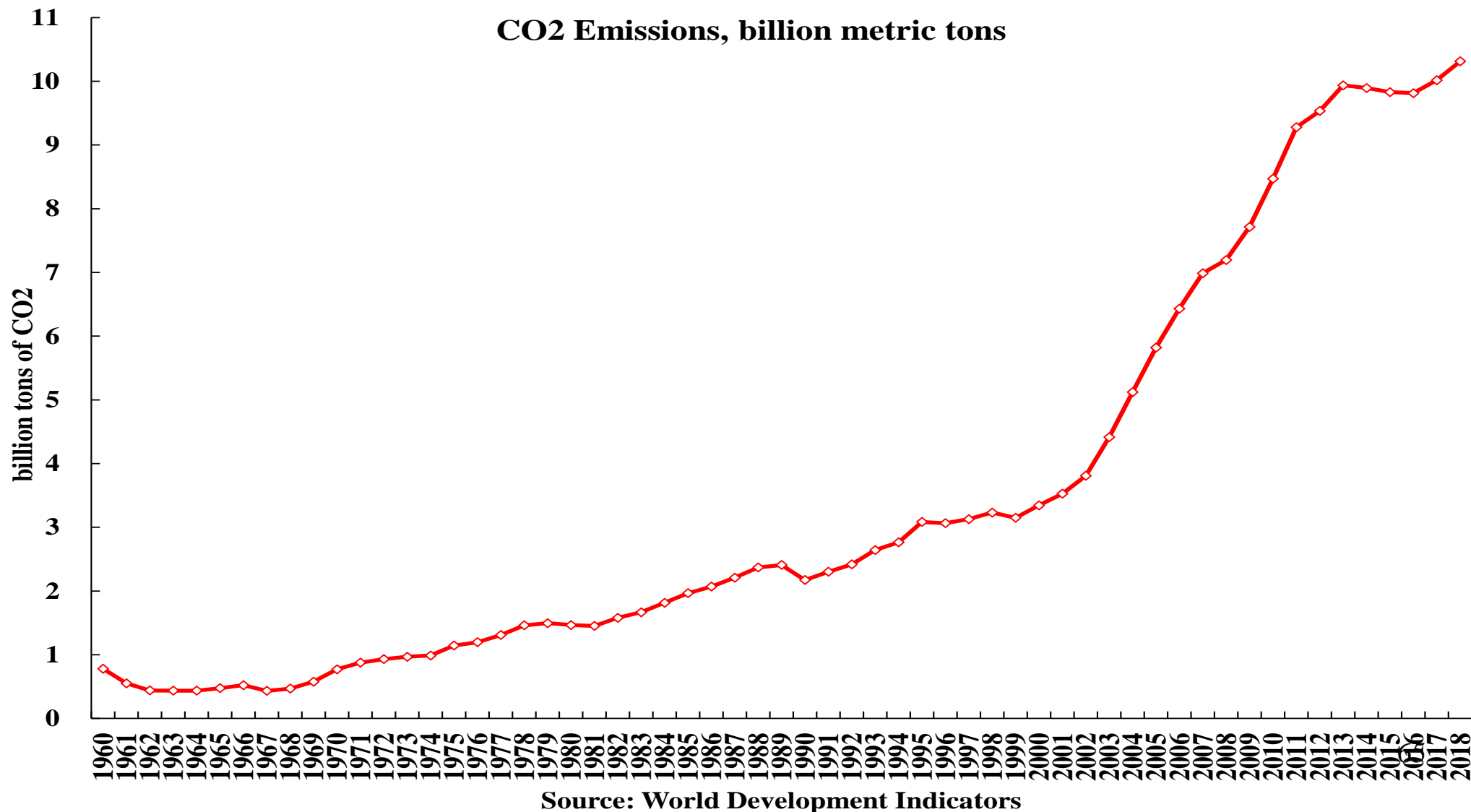
The Absolute Quality of Chinese Economic Growth: The Prevention of Climate Change:

- ◆ China was a major advocate, together with the U.S., of the Paris Agreement on climate change, which was adopted by 196 Parties at the United Nations Climate Change Conference (COP21) in Paris, France, on 12 December 2015.
- ◆ The committed goals set by the Chinese Government is to have aggregate Chinese carbon emission reach its peak by 2030 and fall to zero (thus achieving carbon neutrality) by 2060.
- ◆ China is in the forefront in the development of renewable energy such as solar and wind power and in alternative power sources such as thorium reactors and nuclear fusion. It is also a leader in the long-distance ultra-high voltage transmission of electricity and in batteries.
- ◆ China has also become the largest producers of electric vehicles in the world, potentially replacing the internal- combustion-engine vehicles which use fossil fuels.

Chinese Efforts to Prevent Climate Change: Peaking by 2030 and Neutrality by 2060

- ◆ President XI Jinping committed China to peak its carbon emissions by 2030 and to achieve carbon neutrality by 2060. Prevention of climate change is not only a Chinese public good, it is also a global public good.
- ◆ These objectives will be achieved through, for example:
 - ◆ Massive expansion of renewable energy, including hydro, massive solar and wind power farms, thorium reactors and potentially nuclear fusion, as sources of electricity generation, replacing the fossil fuels;
 - ◆ Ultra-high-voltage long-distance transmission of electricity from the West to the East;
 - ◆ Replacement of fossil-fuel vehicles with electric and hydrogen vehicles;
 - ◆ Substitution of airplanes by high-speed trains for domestic travel;
 - ◆ Large-scale re-forestation.
- ◆ Aggregate carbon dioxide emission has basically plateaued in China since the early 2010s, after a period of rapid increase. The aggregate emission has been growing very slowly in the past few years. If current trends continue, it is entirely feasible that aggregate emission will peak before 2030 and fall to zero by 2060.

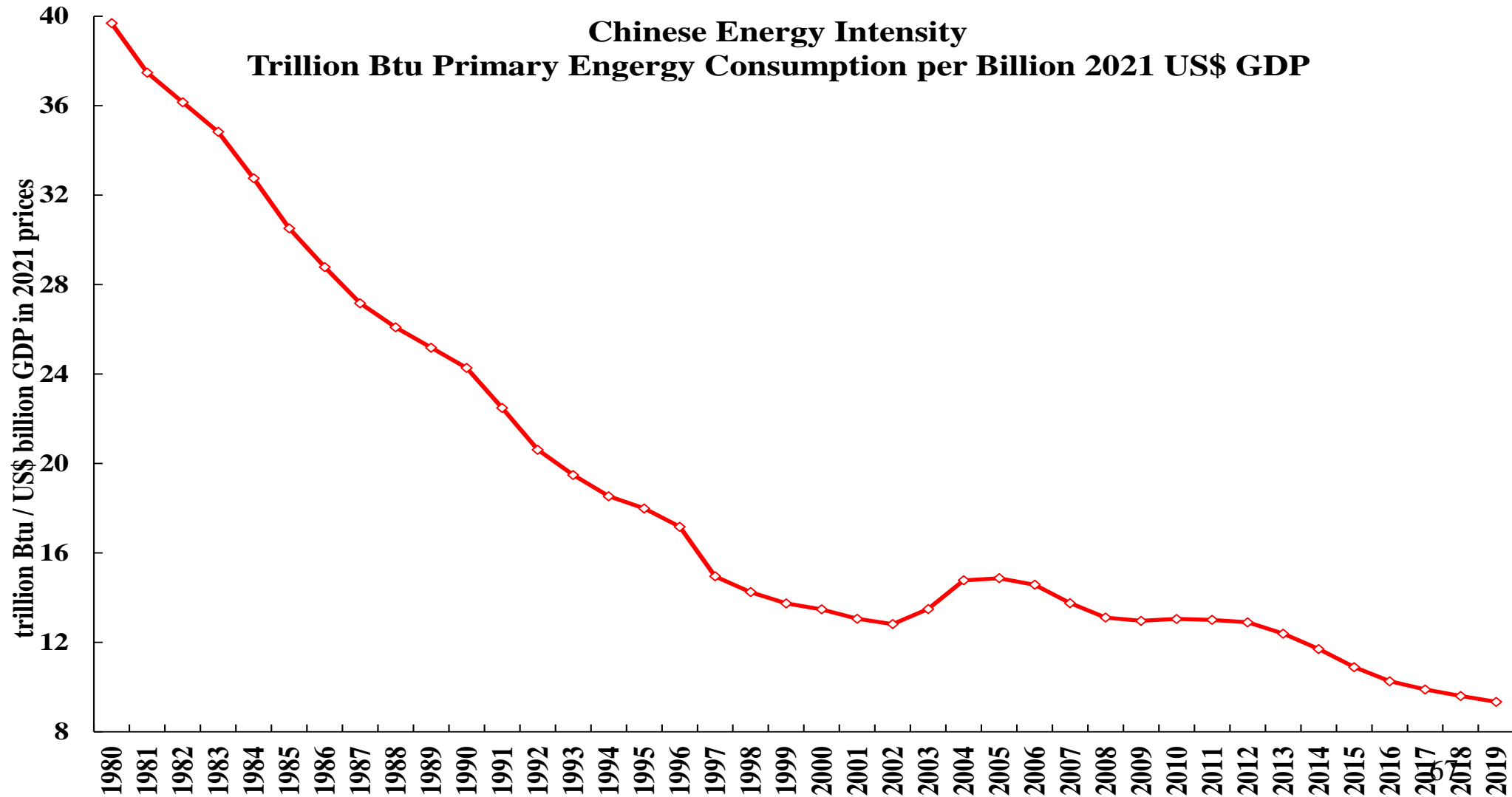
Chinese Carbon Dioxide Emissions, 1960-the Present: World Development Indicators Data



Chinese Efforts to Prevent Climate Change: The Decline of Energy Intensity

- ◆ The energy intensity, that is, the primary energy consumed per unit real GDP, has also been declining over time in China.
- ◆ This is due to a number of factors:
 - ◆ Energy conservation efforts both public and private as a result of prices, taxes and regulatory requirements;
 - ◆ Technological improvements, e.g., higher efficiency and lower transmission losses; and
 - ◆ The relative contraction of the energy-intensive secondary (manufacturing, mining and construction) sector and the relative expansion of the much less energy-intensive tertiary (services) sector.

The Energy Intensity—Primary Energy Consumed per Unit Real GDP, 1980-2019

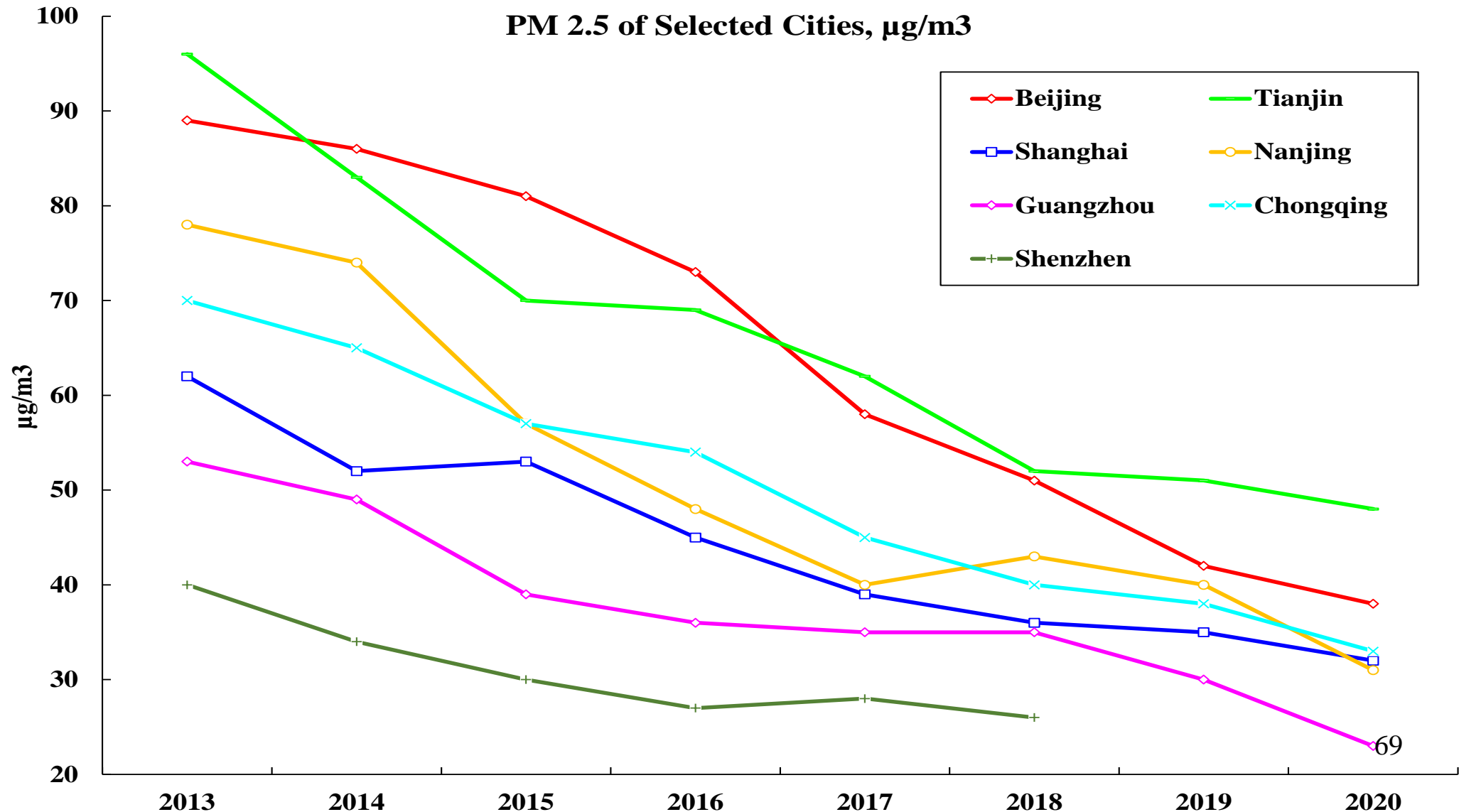


Source: U. S. Energy Information Administration

The Absolute Quality of Chinese Economic Growth: Air and Water Quality

- ◆ The quality of air in major Chinese urban centres has improved significantly.
- ◆ Fine particulate matter 2.5 (PM2.5) is an air pollutant that reduces visibility and causes the air to appear hazy when the level is high. It is also a concern for people's health.
- ◆ China implemented the new ambient air quality standard (GB3095-2012) in 2013. The levels of PM2.5 in the air of 31 major Chinese cities have been declining since. The actual levels of PM 2.5 of seven major cities—Beijing, Chongqing, Guangzhou, Nanjing, Shanghai, Shenzhen and Tianjin—between 2013 and 2020 are shown in the following chart.

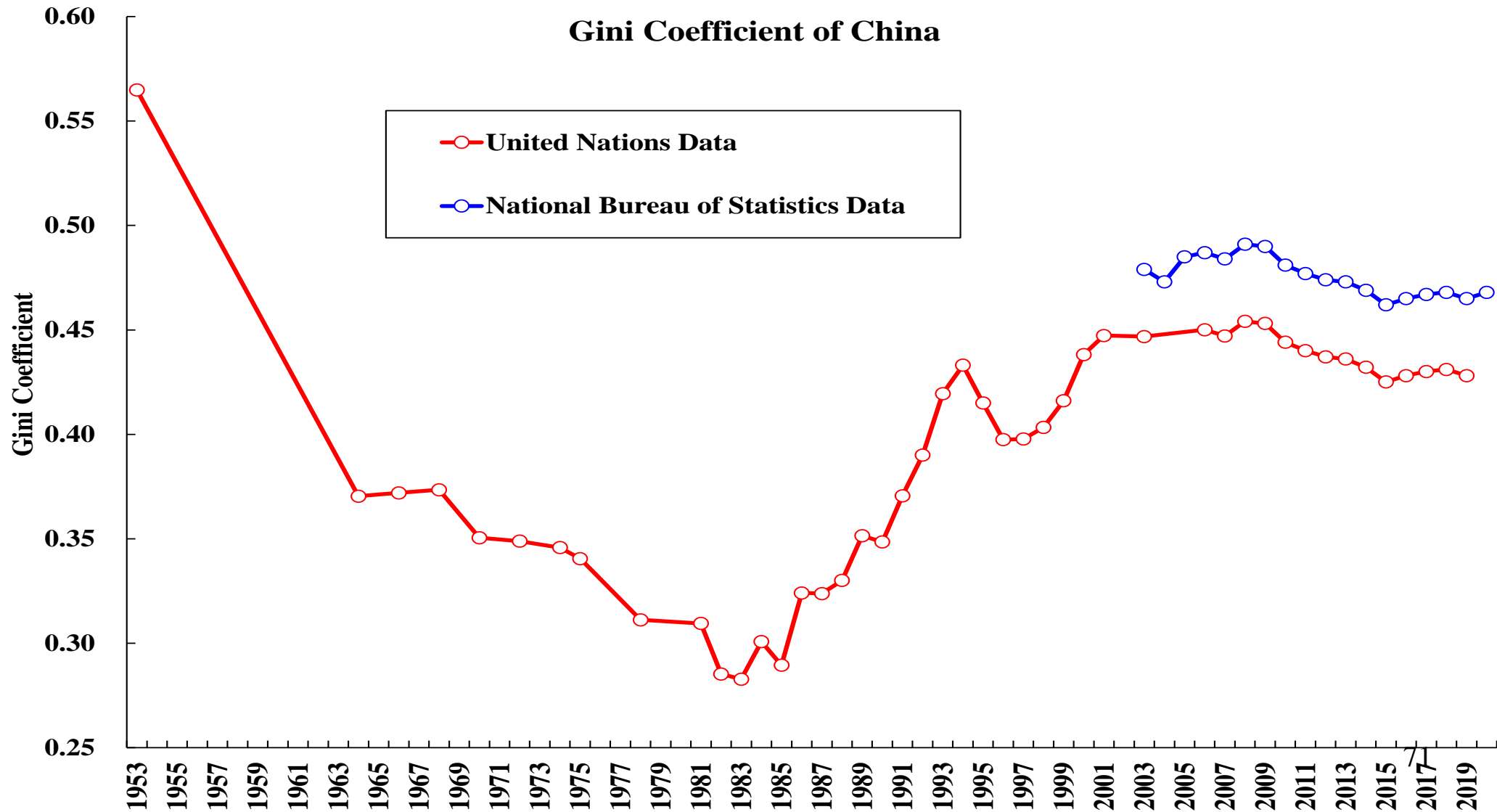
The Level of PM2.5 in the Air of Major Chinese Cities, microgramme per cubic metre



The Absolute Quality of Chinese Economic Growth: The Degree of Income Inequality

- ◆ The Gini coefficient is a measure of the degree of income inequality in an economy. Its value ranges from 0 to 1. 0 means perfect equality—all individuals receive the same identical income. 1 means perfect inequality—one individual receives all the income and everyone else receives nothing. The higher the value of the Gini coefficient, the more unequal is the income distribution.
- ◆ Historically, the Chinese Gini coefficient fell from 0.56 in 1953 to 0.28 in 1983, its lowest point, a tremendous improvement, according to data compiled by the United Nations. It then turned around and rose to a peak of 0.45 (0.49 according to the National Bureau of Statistics of China (NBSC)) in 2008. It has since declined slightly to 0.43 (0.47 according to NBSC) in 2020, compared to 0.49 for the U.S.
- ◆ This is a very high degree of income inequality, even though it is still lower than that in the 1950s. It is consistent with Mr. DENG Xiaoping's policy of letting some people get rich first. It is now time to let the other people get rich too. This is the reason for the “Common Prosperity” policy. (But it is important to distinguish between “common prosperity (共富)” and “equalised prosperity (均富)”.)

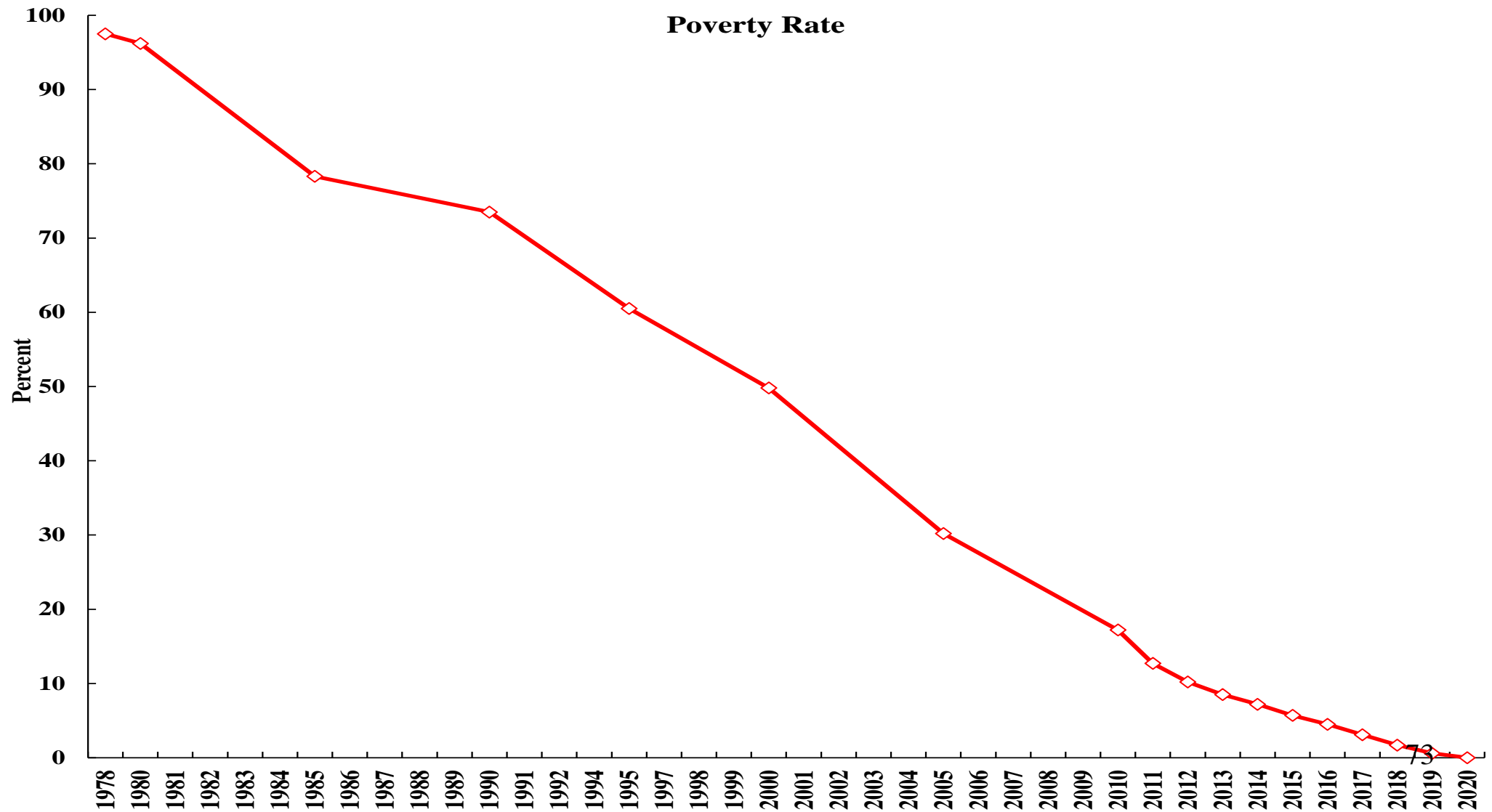
The Distribution of Income: The Evolution of the Chinese Gini Coefficient over Time



The Absolute Quality of Chinese Economic Growth: The Eradication of Extreme Poverty

- ◆ China has been the most successful in the eradication of chronic extreme poverty.
- ◆ The Chinese poverty standard of 2010 defines a family to be in poverty if its annual per capita income is below 2,300 Yuan in 2010 prices. This is equivalent to approximately 3,031 Yuan (US\$435) in 2022 prices.
- ◆ In 1978, before the beginning of the economic reform and opening, the poverty rate according to this standard was a whopping 97.5%! By the end of 2020, it reached zero. Granted that this is still a rather low level of annual income per capita, but at approximately US\$1.30 per person per day, it is slightly higher than the United Nations standard of one U.S. Dollar a day.
- ◆ We should emphasise that this is a permanent eradication of extreme poverty, rather than a one-off relief. The formerly extremely poor are now able to provide a decent living for themselves in a sustainable manner because of improvements of education and/or infrastructure.

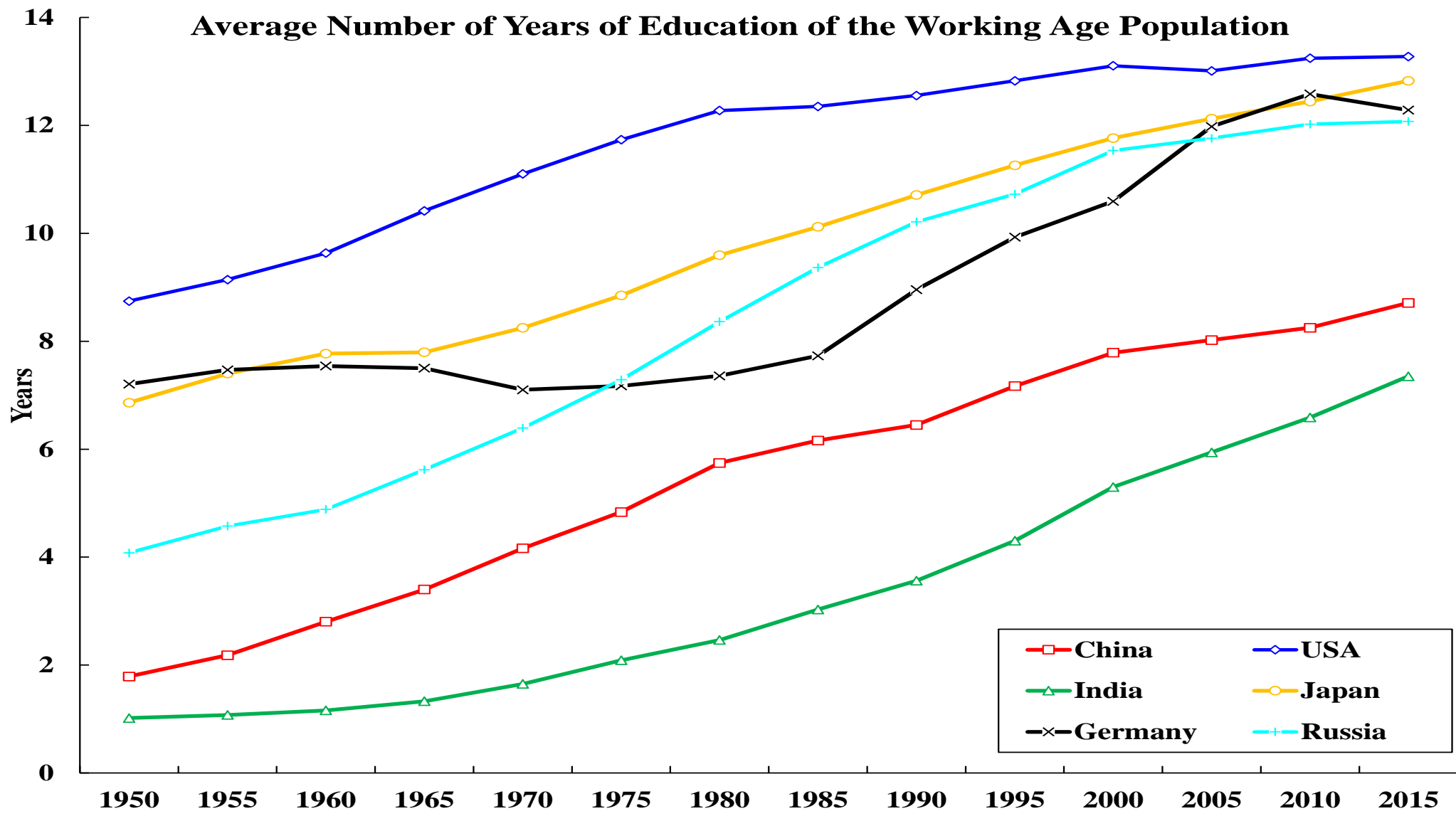
The Eradication of Extreme Poverty: The Share of Population under the 2010 Poverty Line (%)



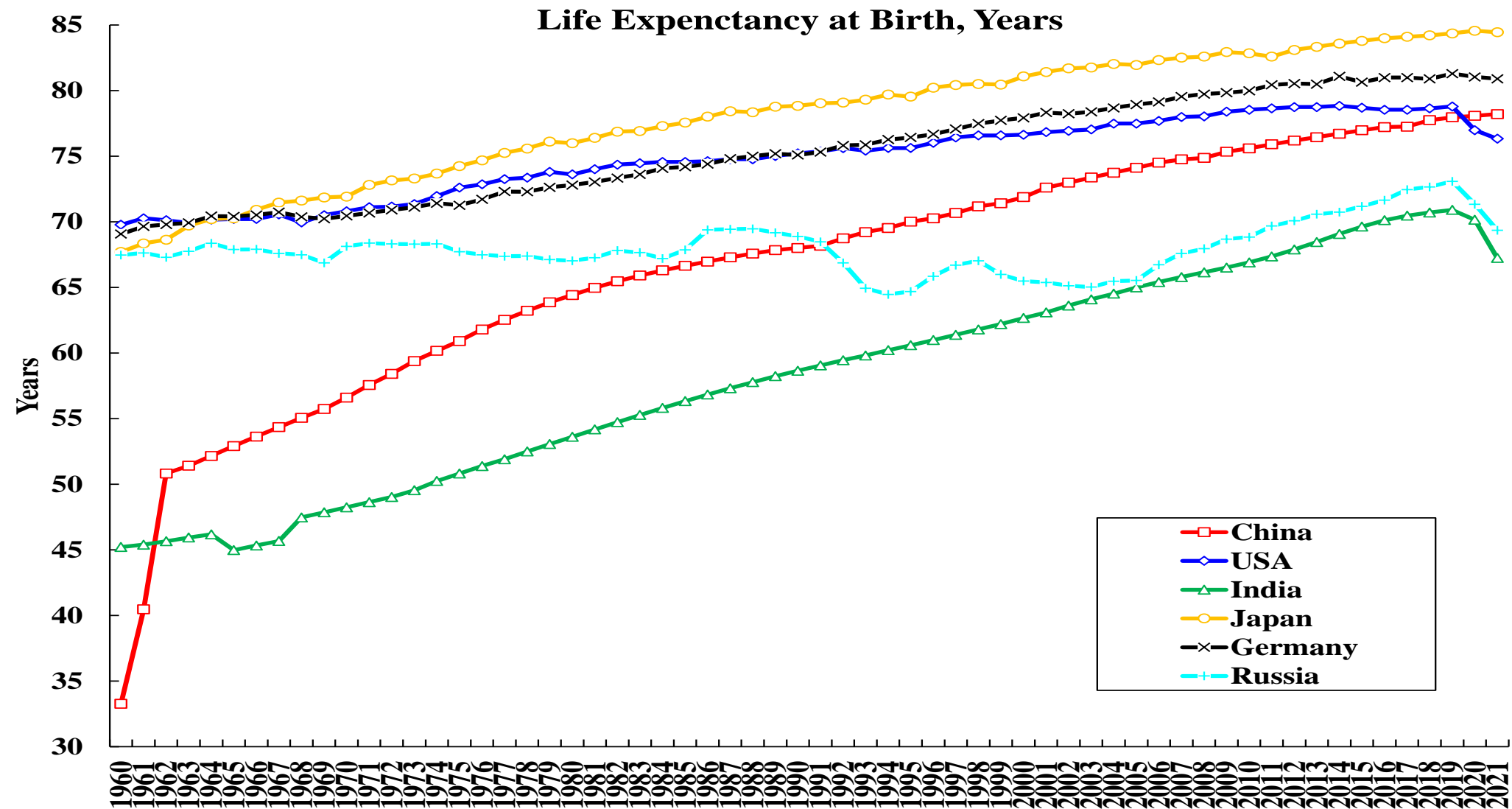
The Relative Quality of Growth

- ◆ Educational Achievements
- ◆ Public Health
- ◆ Innovations in Science and Technology
- ◆ Prevention of Climate Change

Average Number of Years of Education of the Working Age Population



Life Expectancy at Birth: An International Comparison



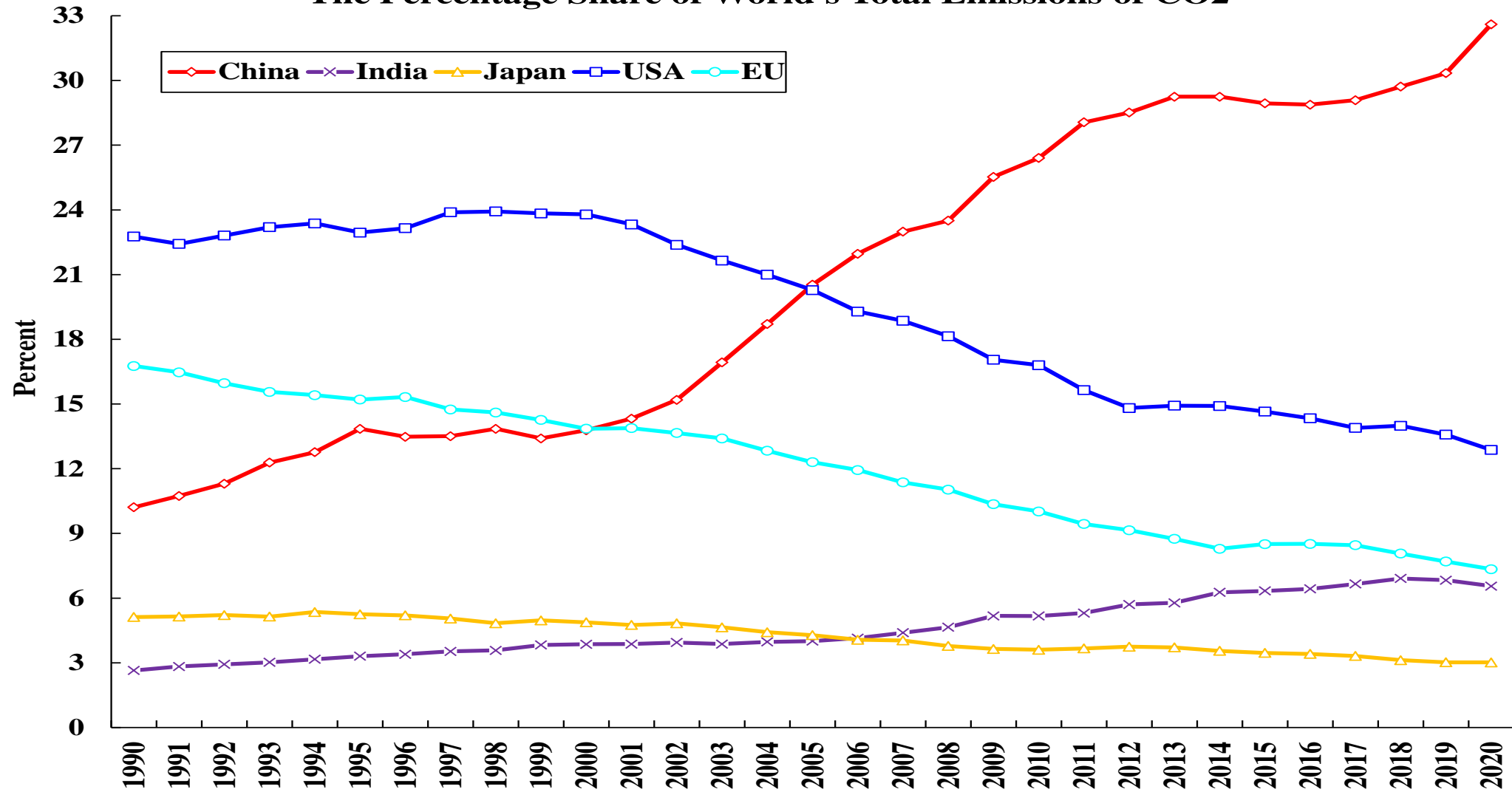
The Prevention of Climate Change:

The World Distribution of Carbon Emissions

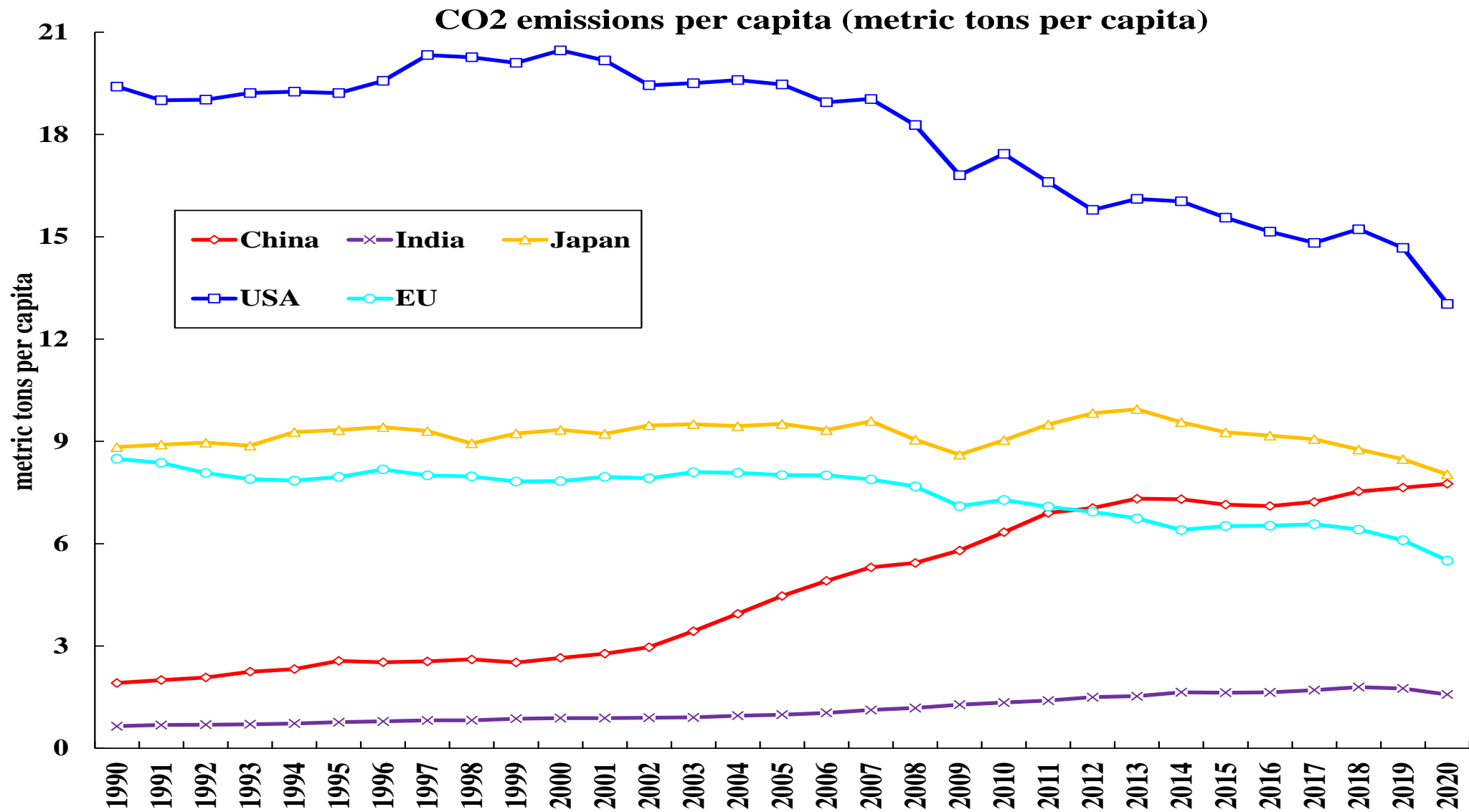
- ◆ Since 2005, China has become the largest carbon emitter in the World, overtaking the United States. They are followed by the European Union, India and Japan, in that order. (See the following charts, data for which have been obtained from the World Development Indicators (WDI) Database.)
- ◆ The emissions of the developed economies, the United States, EU and Japan, have all been declining over time, in part because of the rising share of the service sector in their GDPs. The emissions of China and India, driven by their growing GDPs, have been rising.
- ◆ However, on a per capita basis, the U.S. still has the highest, albeit declining, carbon emission in the world, followed by Japan and China.
- ◆ On an efficiency basis, that is, emission per unit real GDP, India is the worst emitter, followed by China, which has made a great deal of progress. The developed economies of the U.S., EU and Japan have significantly lower emission per unit GDP because of the dominance of the service sector in their economies.

The World Distribution of Carbon Emissions: The Shares of Emissions, Selected Countries

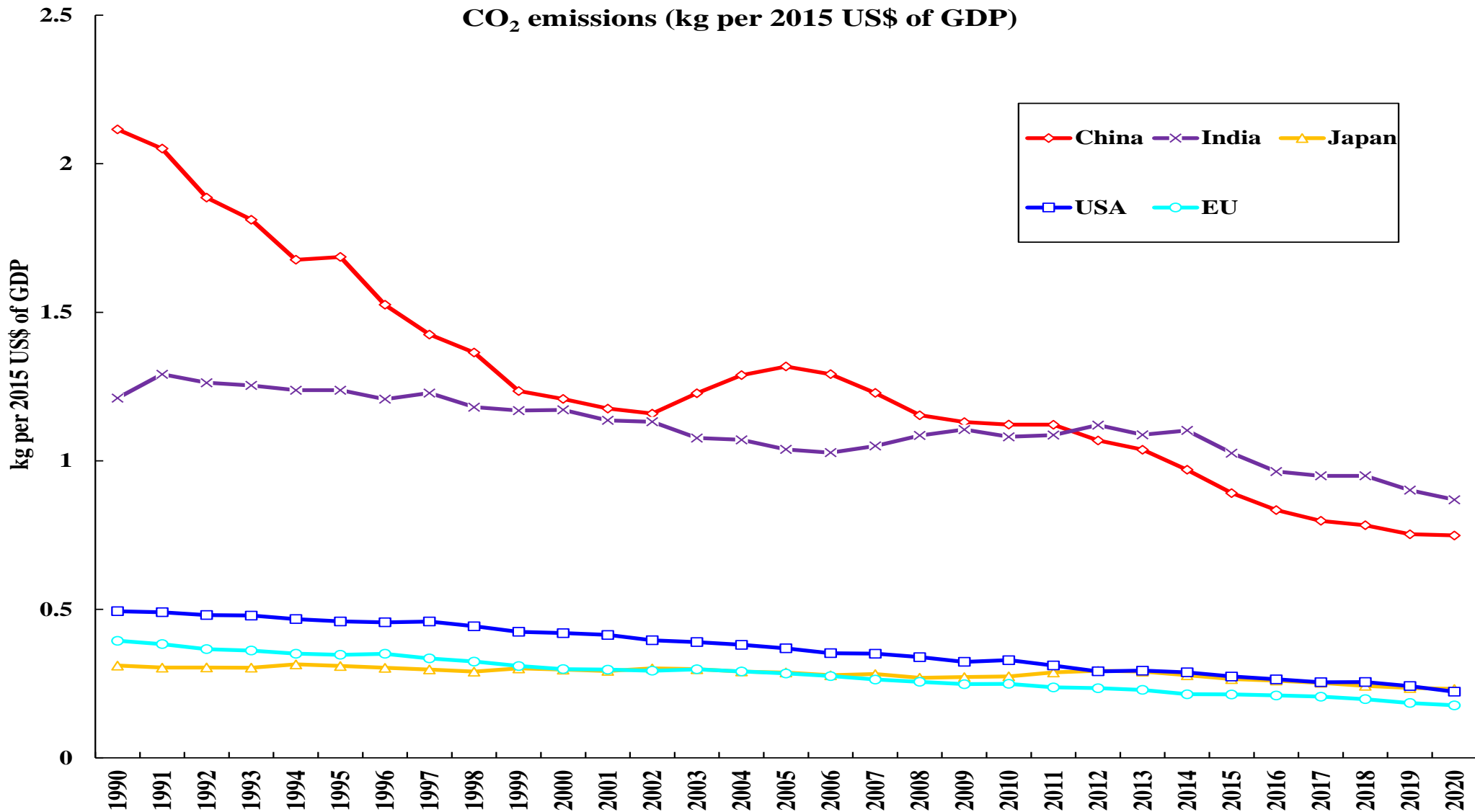
The Percentage Share of World's Total Emissions of CO2



The World Distribution of Carbon Emissions: Carbon Emissions per Capita



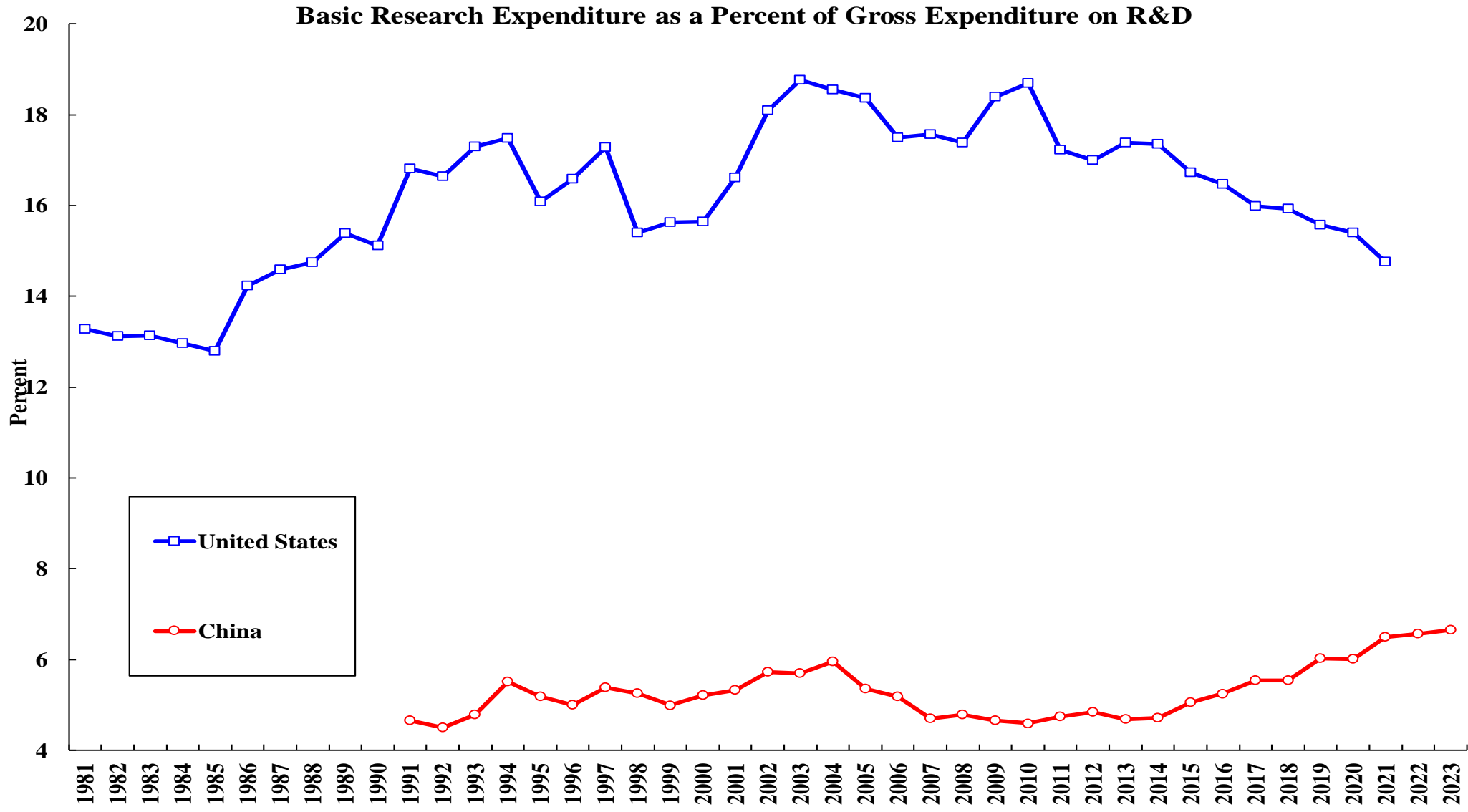
The World Distribution of Carbon Emissions: Emissions per Unit GDP, Selected Countries



Self-Reliance in Science and Technology

- ◆ China today is not only subject to U.S. export controls on high-technology hardware and software, but also faced restrictions by other countries such as Japan and the Netherlands, which are also participating in U.S.-advocated sanctions against China, especially if related to advanced semiconductor manufacturing. This may slow down China's economic growth to some extent, but it will not stop it completely. China will make significant new investments in these areas in order to produce the necessary components locally.
- ◆ The past experience of innovation catch-up is that once proven to be feasible, alternative paths to the same outcome will be discovered. It is just a matter of time.
- ◆ However, breakthrough discoveries and inventions depend on sustained long-term investment in basic research. In 2023, China devoted less than 7% of its R&D expenditures on basic research, while the United States spent nearly 15%. China should significantly increase its investment in long-term basic research.
- ◆ The most important thing to recognise is that self-reliance and independent innovation should not be equated with complete self-sufficiency.

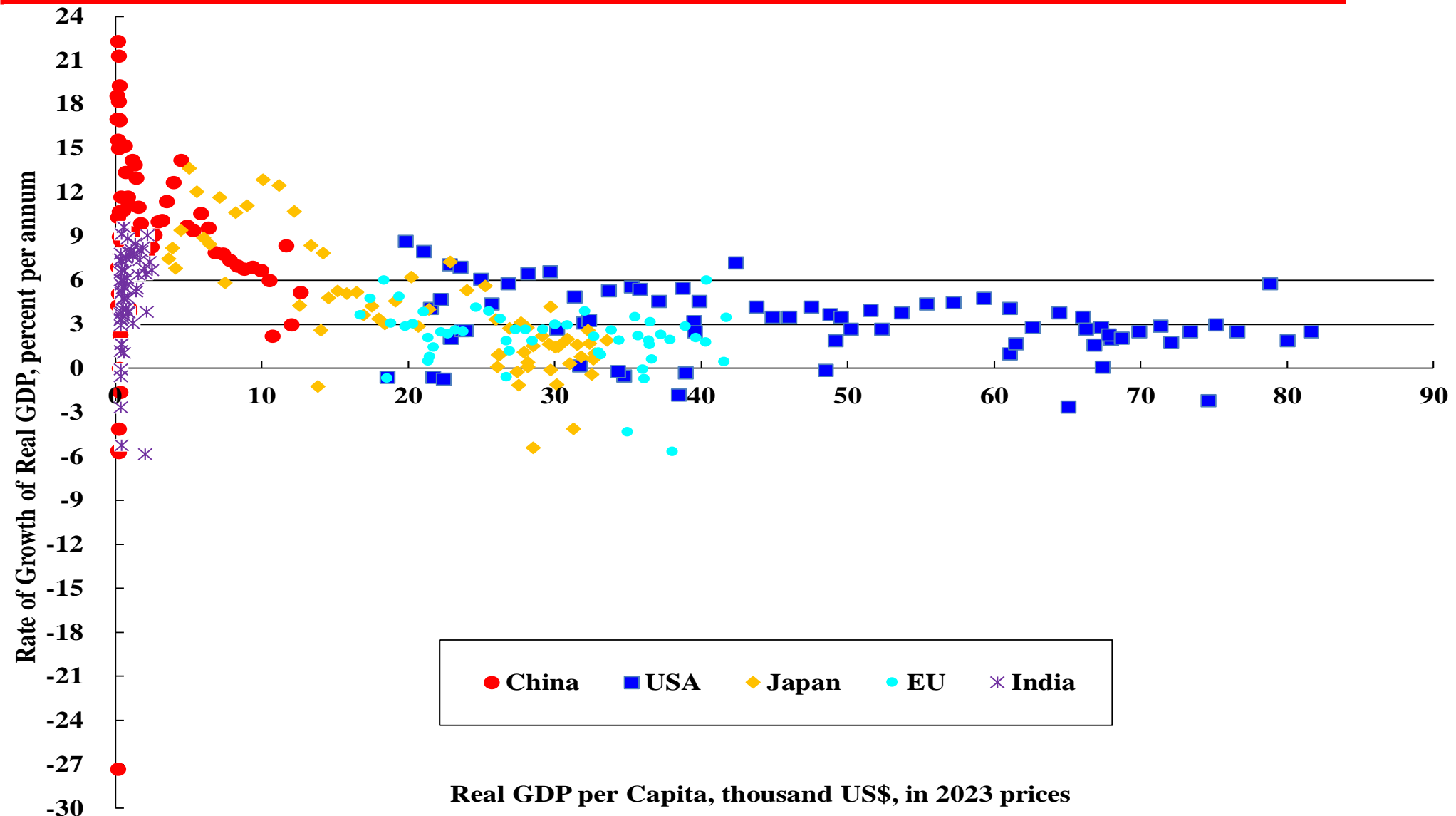
Basic Research Expenditure as a Percent of Gross Expenditure on R&D



Long-Term Projections of the Chinese Economy

- ◆ I conclude with some long-term projections of the Chinese economy to 2050.
- ◆ It is an empirical regularity that as the real GDP per capita of an economy rises, the real rate of growth of the economy will decline.
- ◆ This is demonstrated in the following chart in which the real rates of economic growth of China (red), the European Union (turquoise), India (purple), Japan (yellow) and the U.S. (blue) are plotted against their respective real GDPs per capita. As expected, there is a negative relationship between the rate of growth of real GDP and the level of real GDP per capita. (Data for the Euro Area as a whole only go back to 1970 and miss the high-growth years.)
- ◆ However, we note that China, with a GDP per capita of US\$12,626 in 2023, is currently still operating in the range that permitted average annual rates of growth much higher than 6% for EU, Japan and the U.S. in earlier periods. The real GDP per capita of the U.S. was US\$81,610 in 2023, with its economy operating within a range below 3% average annual rate of growth. India, with a per capita real GDP of less than US\$2,500 in 2023, still operates in the high-growth range.
- ◆ Perhaps when Chinese real GDP per capita reaches US\$30,000 in 2023 prices, projected to occur around 2040, the Chinese average annual real rate of economic growth will begin to decline to 5% or below.

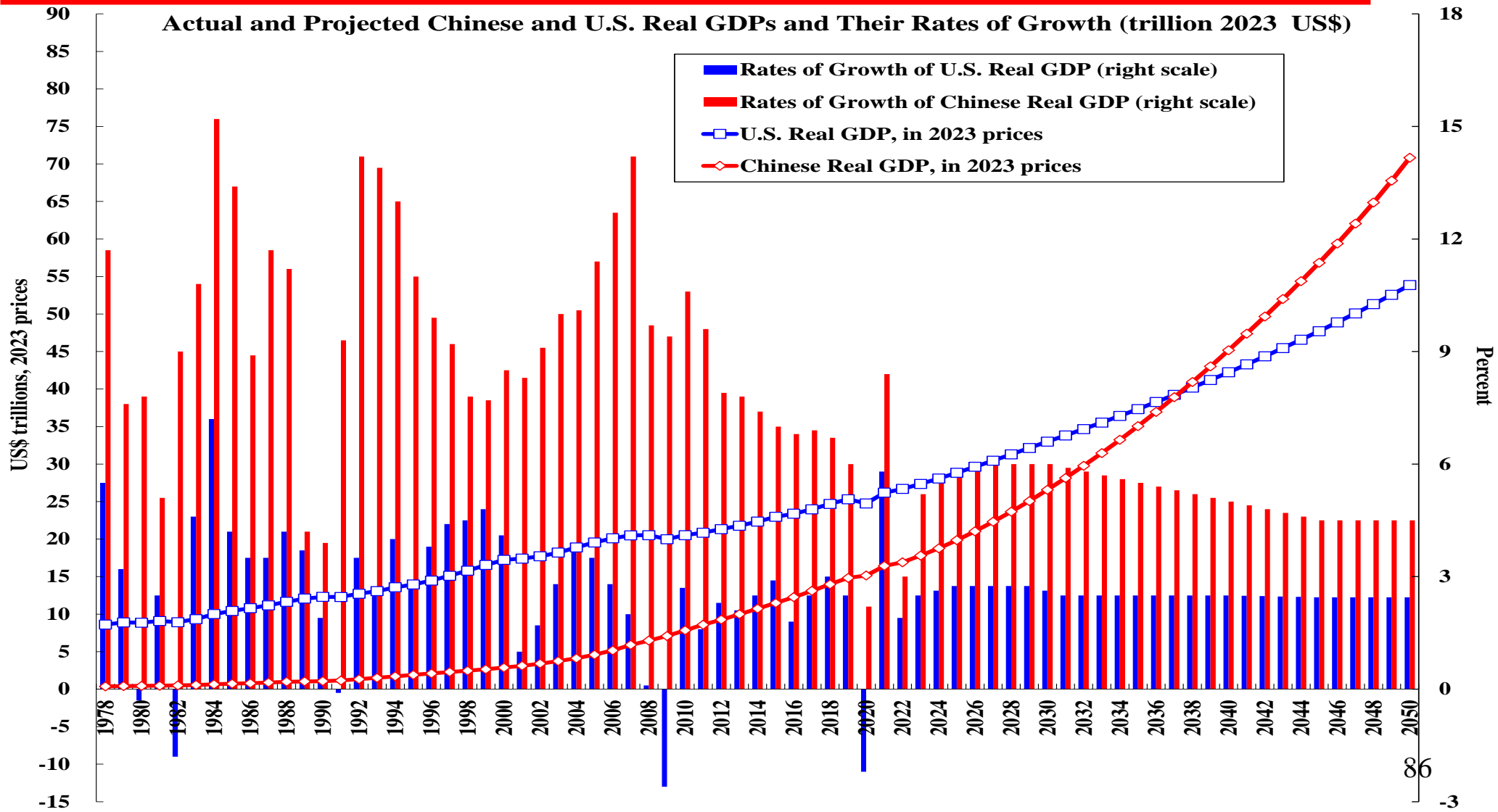
Rate of Growth of Real GDP vs Real GDP per Capita: EU, China, India, Japan and the U.S.



Long-Term Projections of the Chinese Economy

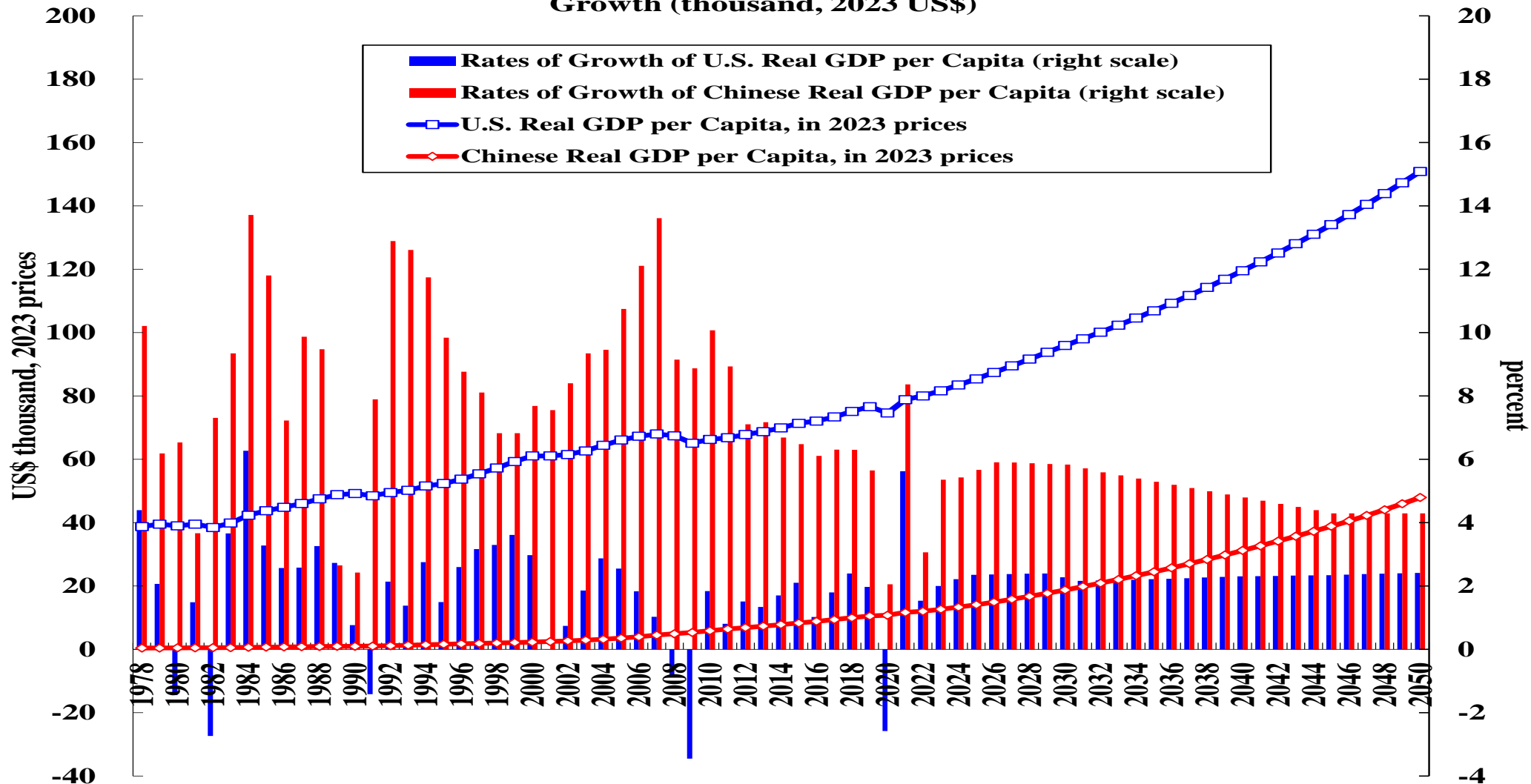
- ◆ Over the next decade, China's economy will continue to grow faster than North America and Europe, although growth will slow in all three. My personal forecast is that by 2038, real GDP on the Chinese Mainland will reach US\$40.9 trillion at 2023 prices, slightly higher than the US\$40.2 trillion of the United States. Even so, the projected Chinese real GDP per capita, US\$28,367, would still be not quite one quarter of the real GDP per capita of the United States, US\$114,232, at that time.
- ◆ In fact, in which year Chinese real GDP will catch up with the U.S. real GDP is very much related to the exchange rate of the Renminbi against the US\$. In March 2023, the exchange rate of the Renminbi against the US\$ was 6.32 Yuan per US\$. At yearend 2023, the exchange rate of the Renminbi against the US\$ was 7.08 Yuan per US\$, a difference of 12%. Thus, at 2023 prices and exchange rate, the Chinese GDP is projected to catch up with U.S. GDP in 2038, much later than my previous forecasts.
- ◆ Of course, in Purchasing-Power-Parity (PPP) terms, Chinese GDP already reached parity with U.S. GDP in 2015. This finding was supported by both the International Monetary Fund and the World Bank.
- ◆ China's natural resources per capita, such as arable land, clean water, mineral deposits, etc., are far less than that of the United States, so it is not easy for its real GDP per capita to surpass that of the United States. If it can be done at all, it will likely be at the very end of this century.

Actual and Projected Chinese and U.S. Real GDPs and Their Rates of Growth (2023 US\$)



Actual and Projected Chinese and U.S. Real GDPs per Capita and Rates of Growth

Actual and Projected Chinese and U.S. Real GDP per Capita and Their Rates of Growth (thousand, 2023 US\$)



Concluding Remarks

- ◆ The economic development of China during the past seven plus decades is characterised by not only quantitative growth, but also significant improvements in the “quality” of growth. Most of the improvements in quality have been brought about through the provision of more and better public goods .
- ◆ Provision of public goods such as education, public health, elderly care, environmental preservation, protection and restoration, basic research, infrastructure, social safety net, and alleviation of poverty has been vastly expanded over the past seventy years, with significant positive results.
- ◆ Enhancing the quality of economic growth also constitutes a form of re-distribution in kind, for example, clean air and water, which can be enjoyed by everyone, and hence also directly advances the goal of “common prosperity”.
- ◆ The provision of public goods has also raised the potential GDP of the Chinese economy through its effects on increasing the aggregate demand for investment and consumption, the productivity of the labour force, and the rate of return on other fixed-assets investment. For example, the productivity of the Chinese labour force has been greatly enhanced because of the improvements in its quality in terms of both educational attainment and life expectancy.

Concluding Remarks

- ◆ However, enhancing the quality of growth sometimes results in the short-term reduction of the measured quantity of growth, so that there is a trade-off between quantity and quality.
- ◆ The provision of public goods that enhance the quality of growth such as clean air and water or mass transit frequently results in negative value-added at market prices, and will therefore reduce rather than enhance the rate of growth of measured GDP. This is one reason why the average predicted rate of growth of the Chinese economy over the next decade or two is between 5% and 6% rather than at the previous 8%.
- ◆ Despite the significant rise in the value of the Gini coefficient in China, the welfare of all Chinese people has improved significantly since the economic reform and opening in 1978.

Concluding Remarks

- ◆ The Chinese economy must also remain open. Without economic globalisation and Chinese accession to the World Trade Organization (WTO) in 2001, the Chinese economy would not be where it is today. Self-reliance and independent innovation should not be equated with complete self-sufficiency. We should always keep in mind that China is implementing a dual-circulation rather than a mono-circulation development strategy.
- ◆ Educational and scientific exchanges between China and the United States and the rest of the world should also be maintained as much as possible. It is only with the help of scientists who have studied or worked abroad, such as Deng Jiaxian, Qian Sanqiang, Qian Xuesen, Zhu Guangya and Sun Jiadong, that China has been able to develop the "two bombs and one satellite" relatively quickly. Without them, these efforts may have to take much longer to succeed.
- ◆ The China-U.S. strategic competition will eventually end with both countries accepting each other under the principles of peaceful coexistence, mutual respect, and win-win cooperation, and the relationship will be sustained by "economic interdependence."