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China and the U.S.: Cooperation, Competition and/or Conflict

An Experimental Assessment

PART TWO: CHINA'S EMERGING ECONOMIC POWER

Economics Have the Lead, But Military Power is Catching Up

Working Draft
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Photo: GOH CHAI HIN/AFP/ Getty Images

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China's Steadily Emerging Role as a Global and Pacific Economic Superpower - I

There is no practical way that China's emergence as a major military power can be separated from its emergence as an economic superpower. In fact, one of the key problems in analyzing China's strategy is estimating the extent to which China's leadership decouples any given aspect of its military strategy and actions from an integrated effort to use both economic and military power simultaneously to achieve its objectives. Chinese strategy cannot be analyzed in purely military terms. China focuses on hybrid goals and operations that seek to use both economic and military forms of leverage to "win," and to do so without any form of meaningful conflict.

It is also clear that China's economic progress has led China's emergence as a superpower, not the growth of its military capabilities. This point is made quite clearly by China's military leaders in China's 2019 Defense White Paper,

> Since the introduction of reform and opening-up, China has been committed to promoting world peace, and has voluntarily downsized the PLA by over 4 million troops. China has grown from a poor and weak country to be the world's second largest economy neither by receiving handouts from others nor by engaging in military expansion or colonial plunder. Instead, it has developed through its people's hard work and its efforts to maintain peace. China has made every effort to create favorable conditions for its development through maintaining world peace, and has equally endeavored to promote world peace through its own development. China sincerely hopes that all countries will choose the path of peaceful development and jointly prevent conflicts and wars.
>
> China is committed to developing friendly cooperation with all countries on the basis of the Five Principles of Peaceful Coexistence. It respects the rights of all peoples to independently choose their own development path, and stands for the settlement of international disputes through equal dialogue, negotiation and consultation. China is opposed to interference in the internal affairs of others, abuse of the weak by the strong, and any attempt to impose one's will on others. China advocates partnerships rather than alliances and does not join any military bloc. It stands against aggression and expansion, and opposes arbitrary use or threat of arms. The development of China's national defense aims to meet its rightful security needs and contribute to the growth of the world's peaceful forces. History proves and will continue to prove that China will never follow the beaten track of big powers in seeking hegemony. No matter how it might develop, China will never threaten any other country or seek any sphere of influence.

Ever since the economic reforms of Deng Xiaoping began in the late 1970s, it has been China's economic growth, modernization, and diversification that has allowed China to modernize and change the structure and role of its military forces. Accordingly, any analysis of China's strategy must begin with a focus on its economic successes and the extent that they are likely to continue in the future.

If China's economic success does continue, China's military forces are now modernizing at a rate where they will probably catch up with China's economic progress within the next decade. China will the become a military superpower as well as an economic one. It is not clear how China will then rank with the U.S. in both economic and military terms, and there does not seem to be any clear way to predict the relative level of U.S. and Chinese power – either in in Asia or the world as a whole. What does seem clear, however, is that there are no present indications that any other single nation or power bloc will then be able compete directly with the U.S and China in both economic and military terms.

China's Steadily Emerging Role as a Global and Pacific Economic Superpower - II

This section provides a range of metrics that show the scale of China's emergence as a major economic power, and how it now compares to other states. It addresses the positive trends in Chinese development, China's progress in technology and manufacturing, and then the major challenges that China still has to meet.

There are eight key points that need to be considered in evaluating these trends:

- Economic and political power will be at least as important as military power, and cooperation will often offer more than competition.
- This not a "zero sum game." Competition is often hard to separate from cooperation. A given lead does not mean that both nations and the global economy do not benefit from the overall increase in development, technology, and growth.
- Short of a major war — where virtually all scenarios would do critical damage to both sides — relative economic progress and success will determine the degree to which any side is a "winner."
- There are no guarantees of future progress. Both the U.S. and China face major internal structural economic and demographic civil challenges.

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China's 70th Anniversary White Paper on Economic Growth - I

China's economic strength has greatly increased. From 1952 to 2018, China's industrial added value increased from RMB12 billion to RMB30.5 trillion, up 970 times at constant prices, with an average annual growth rate of 11 percent. GDP increased from RMB67.9 billion to RMB90 trillion, up 174 times at constant prices, with an average annual growth rate of 8.1 percent, and per capita GDP increased from RMB119 to RMB64,644, up 70 times at constant prices. According to World Bank statistics, at market exchange rates China's economy in 2018 was worth US$13.6 trillion, second only to the US economy which was worth US$20.5 trillion. Currently, China is the only country that possesses all the sections in the United Nations' International Standard Industrial Classification of All Economic Activities (ISIC), with the output of many industrial products ranking first in the world.

China has made remarkable progress in technology. Significant achievements such as nuclear bombs, ballistic missiles, manmade satellites, manned spaceflight, super hybrid rice, supercomputers, synthetic bovine insulin, artemisinin, and high-speed rail, have provided strong support for social and economic development.

China's foreign trade has been increasing constantly. In 2009, China became the world's largest exporter of goods and second largest importer of goods; in 2013, China China became the world's largest trader in goods. Since reform and opening up in 1978, foreign investment in China has seen a substantial increase, and China has become very attractive to global investment. China has become the world's second largest economy, largest manufacturer, largest trader in goods, second largest consumer of commodities, second largest recipient of foreign direct investment (FDI), and largest holder of foreign exchange reserves (see Table 1).

Table 1 Growth of China's Economic Strength

Category	1952	2018	Growth
GDP	RMB67.9 billion	RMB90 trillion	174 times
Fiscal revenue	RMB6.2 billion (in 1950)	RMB18.33 trillion	12.5% annually on average
Industrial added value	RMB12 billion	RMB30.5 trillion	970 times
Per capita GDP	RMB119	RMB64,644	70 times
Final consumption rate	78.9%	54.3%	--
Non-financial FDI	US$920 million (in 1983)	US$135 billion	146 times

China is the main stabilizing force and power source of the world economy

From 1979 to 2018 China's economy grew rapidly at an average annual rate of 9.4 percent, and became an important engine of global economic growth. In 2008, the world suffered a serious financial crisis and the world economy was hit hard. Through a series of effective measures to deal with the crisis, China's economy recovered rapidly and continued to maintain a medium- and high-speed growth. As a result, China became the main stabilizing force and power source of the world economy.

China is the biggest contributor to world economic growth. Since the 18th CPC National Congress in 2012, China has implemented the concepts of innovative,

China and the World in the New Era, The State Council Information Office of the People's Republic of China, September 2019, pp. 4

China's 70th Anniversary White Paper on Economic Growth - II

coordinated, green, open and inclusive development. It has adapted to, steered, and led the new normal of economic development, strengthened supply-side structural reform, and maintained a sustainable and healthy economic development with increasing quality and efficiency. In the past three years, China's economic aggregate has exceeded RMB70, 80, and 90 trillion successively, accounting for nearly 16 percent of the world economy. From 2013 to 2018, China contributed more than 28 percent of world economic growth on average. Estimates show that without China, the average annual growth rate of the world economy from 2013 to 2016 would have slowed by 0.6 percentage point and the intensity of fluctuation would have increased by 5.2 percent. According to a report released by the McKinsey Global Institute (MGI), the aggregate index of the world's exposure to China's economy gradually rose from 0.4 to 1.2 between 2000 and 2017, with China accounting for 35 percent of global manufacturing output. (MGI, "China and the world: Inside the dynamics of a changing relationship", July 2019.)

*China and the World in the New Era***,** The State Council Information Office of the People's Republic of China, September 2019, pp. 4, 15-16

OSD on Chinese Economic Policies and Goals: 2019 -I

Key Takeaways

- China is non-compliant with some of its World Trade Organization (WTO) obligations.
- Recognizing that "Made in China 2025" and OBOR have sparked concerns about China's intentions, China's leaders have softened their rhetoric when promoting these programs without altering the programs' fundamental strategic goals.
- China continues to operate as a centrally controlled, planned economy. China restricts inbound investment, limits other countries' exports, and pursues state-guided investment overseas, including in strategic sectors.

Sustaining China's economic growth is one of the CCP's strategic objectives. China's incomplete transition to a market economy has resulted in laws, regulations, and policies governing the tradable goods and services sectors, market access, and foreign direct investment that disadvantage foreign firms vis- à-vis their Chinese counterparts. China's senior leaders recently reaffirmed their commitment to CCP control over the state-led economic apparatus, including through state-directed investment and innovation. In March 2018, the Office of the U.S. Trade Representative released findings of an investigation under Section 301 of the Trade Act of 1974 that determined the acts, policies, and practices of the Chinese government related to technology transfer, intellectual property, and innovation are unreasonable or discriminatory and burden or restrict U.S. commerce, resulting in harm to the U.S. economy of at least $50 billion per year.

China is non-compliant with some of its World Trade Organization (WTO) obligations, and China does not adhere to some of the agreed- upon rules and fundamental principles that undergird WTO agreements. In addition, because of its status as a "developing country" under the WTO framework, China is allowed to continue certain protectionist measures. Concerns include industrial policies that support domestic industries at the expense of foreign counterparts, commercial joint venture requirements, technology transfer requirements, subsidies to lower the cost of inputs, continued excess capacity in multiple industries, sector-specific limits on foreign direct investment, discriminatory cybersecurity and data transfer rules, insufficient intellectual property rights enforcement, inadequate transparency, and lack of market access particularly in the agriculture and service sectors. Market access remains challenging for foreign firms, as China's restriction of inbound investment results in persistent underperformance in other countries' services exports, particularly in the banking, insurance, Internet-related, professional, and retail services sectors.

Some recent Chinese laws seek further restrictions on foreign firms:

- *National Security Law*: Adopted in July 2015, the law limits foreign access to the information and communications technology (ICT) market in China on national security grounds.
- *Counterterrorism Law*: Adopted in December 2015, the law requires telecommunications operators and Internet service providers to provide information on technical support assistance to public and state security organizations "conducting prevention and investigation of terrorist activities."
- *Cyber Security Law*: The law, which went into effect in June 2017, promotes development of indigenous technologies and restricts sales of foreign ICT. The law also mandates that foreign companies submit ICT for government-administered national security reviews, store data in China, and seek government approval before transferring data outside of China.

Office of the Secretary of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China; Chinese Military Power*, May 2019, p. 120-121

OSD on Chinese Economic Policies and Goals: 2019 - II

As China restricts inbound investment and limits other countries' exports to China, it also pursues state-directed investment overseas. Along with heavy investments in infrastructure and commodities to support its economic growth, China is investing in technologies that will be foundational for future innovations with both commercial and military applications.

China obtains foreign technology through imports, foreign direct investment, the establishment of foreign research and development (R&D) centers, joint ventures, research and academic partnerships, talent recruitment, and industrial and cyberespionage. In December 2018, two Chinese nationals were indicted for conspiracy to commit computer intrusions, conspiracy to commit wire fraud, and aggravated identity theft. The Chinese nationals worked for a company in China called Huaying Haitai Science and Technology Development Company and acted in association with the Chinese Ministry of State Security's Tianjin State Security Bureau. Through their involvement with a hacking group operating in China known as Advanced Persistent Threat 10 (APT10), the Chinese nationals conducted global campaigns of computer intrusions targeting intellectual property and confidential business and technological information at managed service providers. The APT10 group stole hundreds of gigabytes of sensitive data and targeted the computers of victim companies involved in aviation, space and satellite technology, manufacturing technology, pharmaceutical technology, oil and gas exploration and production technology, communications technology, computer processor technology, and maritime technology.

Recent government policies have promoted innovation focused on strengthening domestic industry, while placing additional restrictions on foreign firms. Recognizing that some of its programs such as "Made in China 2025" and OBOR have sparked concerns about China's intentions, China's leaders have softened their rhetoric when promoting these programs without altering their fundamental strategic goals.

- *"Made in China 2025"*: China has become aware of acute concerns that advanced industrial countries have regarding "Made in China 2025," and in June 2018, Chinese media outlets were ordered to downplay use of the term. Announced in May 2015, the "Made in China 2025" plan sets targets for higher levels of domestic manufacturing in strategic industries by 2020 and 2025 with the goal of increasing indigenous innovation. China plans to award subsidies and strengthened protection of domestic industries, while increasing pressure on foreign firms to transfer technology in order to do business in China. The plan also seeks to favor domestic enterprises at the expense of foreign participants in China's markets.
- *OBOR*: OBOR is intended to develop strong economic ties with other countries, shape their interests to align with China's, and deter confrontation or criticism of China's approach to sensitive issues. Countries participating in OBOR could develop economic dependence on Chinese capital, which China could leverage to achieve its interests. The growth of China's global economic footprint also makes its interests increasingly vulnerable to international and regional turmoil, terrorism, piracy, and serious natural disasters and epidemics, which places new requirements on the PLA to address these threats. Some OBOR investments could create potential military advantages for China, should China require access to selected foreign ports to pre-position the necessary logistics support to sustain naval deployments in waters as distant as the Indian Ocean, Mediterranean Sea, and Atlantic Ocean to protect its growing interests.

China has employed economic tools coercively during periods of political tensions with its neighbors. Following the collision of a PRC- flagged fishing boat with a Japanese Coast Guard vessel near the Senkaku Islands, China halted exports to Japan in 2010 of rare earth elements used in high-tech industries. In 2016, after the visit of the Dalai Lama to Mongolia, China suspended talks on a major assistance loan, worsening Mongolia's fiscal challenges and eventually driving it to seek a bailout from the International Monetary Fund. China also increased fees on imports of mining products from Mongolia and temporarily closed an important border crossing. China used economic and diplomatic pressure unsuccessfully in 2017 in an attempt to urge South Korea to reconsider the deployment of the Terminal High-Altitude Area Defense (THAAD) system.

Office of the Secretary of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China; Chinese Military Power*, May 2019, pp. 10-11

Positive and Negative Trends in China's Economy and Shifts in Chinese Demographics

China's Major Economic Successes

There are many different estimates of the exact levels of China's economic progress, but the range of estimates in this section make it clear that China has made major progress, can now compete with the size of the U.S. economy in at least PPP terms, has a major lead in global trade, and has sharply increased its per capita income – although China's per capita remains far below the levels of the wealthiest industrialized states.

The UN estimates that the rising population pressure that has been a critical problem for China since the 1950s will now decline sharply, along with its challenge in creating new jobs for its youth and dealing with a high child dependency on state aid and wage earners. The decline in extreme poverty has been particularly impressive, although a major challenge still remains – particularly in rural areas in central and western China.

As the following sections show, this progress has been reinforced by major progress in increasing the size of China's manufacturing base, and its level of technical sophistication. China has also made major progress in its technology base, research and development activities, and level of technical education.

China's 70th Anniversary White Paper on Trade and Investment

From 1978 to 2018, China attracted a total of more than US$2 trillion in non-financial FDI, and nearly 1 million foreign-invested enterprises were set up in the country. In 2018, almost half a million foreign students came to study in China. Since its accession to the WTO in 2001, China's participation in economic globalization has delivered more substantial and speedy outcomes (see Box 2). From 2001 to 2018, China's imports of goods increased from US$244 billion to US$2.1 trillion. The rise was 13.6 percent per annum on average, 6.8 percentage points higher than the global average. China's imports of services increased from US$39.3 billion to US$525 billion, up by a yearly average of 16.5 percent and accounting for 9.4 percent of the global total.

From 1978 to 2018, China's total imports and exports of goods increased by a factor of 223, and its total imports and exports of services increased by a factor of 147. By November 2018, China had trade relations with more than 230 countries and regions. It had signed 17 free trade agreements with 25 countries and regions, and joined almost all major international economic and financial organizations and multilateral economic mechanisms. According to WTO statistics, in 2017 China's shares of the world's total imports and exports of goods were 10.2 percent and 12.8 percent; in 2018, the two figures were 10.8 percent and 12.8 percent. From 2001 to 2018, the two figures grew by a yearly average of 13.8 percent. The above figures confirm that China's position as the world's largest trader in goods has been further consolidated.

…In 2018, China's overseas investment reached US$143 billion, up by a factor of 53 since 2002, a yearly average growth of 28.2 percent. China's foreign trade has been growing year by year. From 1978 to 2018, China's foreign trade amounted to US$52.2 trillion; in 2018, China's exports of goods were US$2.5 trillion and its exports of services US$267 billion. In recent years, China has maintained its position as the world's largest source of overseas tourists; in 2018, Chinese outbound tourists numbered nearly 150 million.

*China and the World in the New Era***,** The State Council Information Office of the People's Republic of China, September 2019, pp. 8-9

China vs. US — GDP and Trade: CIA 2019

China

GDP (purchasing power parity):

$23.21 trillion (2017 est.)

$21.72 trillion (2016 est.)

$20.35 trillion (2015 est.)

note: data are in 2017 dollars

country comparison to the world: 1

GDP (official exchange rate):

$12.01 trillion (2017 est.)

note: because China's exchange rate is determined by fiat rather than by market forces, the official exchange rate measure of GDP is not an accurate measure of China's output; GDP at the official exchange rate substantially understates the actual level of China's output vis-a-vis the rest of the world; in China's situation, GDP at purchasing power parity provides the best measure for comparing actual across countries

GDP - real growth rate:

6.9% (2017 est.)

6.7% (2016 est.)

6.9% (2015 est.)

country comparison to the world: 21

GDP - per capita (PPP):

$16,700 (2017 est.)

$15,700 (2016 est.)

$14,800 (2015 est.)

Exports:

$2.215 trillion (2017 est.)

$1.99 trillion (2016 est.)

country comparison to the world: 1

Exports - partners:

US 19%, Hong Kong 12.4%, Japan 6%, South Korea 4.8% (2017)

Exports - commodities:

electrical and other machinery, including computers and telecommunications equipment, apparel, furniture, textiles

Imports:

$1.74 trillion (2017 est.)

$1.601 trillion (2016 est.)

country comparison to the world: 2

Imports - commodities:

electrical and other machinery, including integrated circuits and other computer components, oil and mineral fuels; optical and medical equipment, metal ores, motor vehicles; soybeans

Imports - partners:

South Korea 9.7%, Japan 9.1%, US 8.5%, Germany 5.3%, Australia 5.1% (2017)

United States

GDP (purchasing power parity):

$19.49 trillion (2017 est.)

$19.06 trillion (2016 est.)

$18.77 trillion (2015 est.)

note: data are in 2017 dollars

country comparison to the world: 2

GDP (official exchange rate):

$19.49 trillion (2017 est.)

GDP - real growth rate:

2.2% (2017 est.)

1.6% (2016 est.)

2.9% (2015 est.)

country comparison to the world: 145

GDP - per capita (PPP):

$59,800 (2017 est.)

$58,900 (2016 est.)

$58,400 (2015 est.)

note: data are in 2017 dollars

country comparison to the world: 19

Exports:

$1.553 trillion (2017 est.)

$1.456 trillion (2016 est.)

country comparison to the world: 2

Exports - partners:

Canada 18.3%, Mexico 15.7%, China 8.4%, Japan 4.4% (2017)

Exports - commodities:

agricultural products (soybeans, fruit, corn) 8.2%, industrial supplies (organic chemicals) 26.8%, capital goods (transistors, aircraft, motor vehicle parts, computers, telecommunications equipment) 48.0%, consumer goods (automobiles, medicines) 16.8% (2008 est.)

Imports:

$2.381 trillion (2017 est.)

$2.208 trillion (2016 est.)

country comparison to the world: 1

Imports - commodities:

agricultural products 4.9%, industrial supplies 32.9% (crude oil 8.2%), capital goods 30.4% (computers, telecommunications equipment, motor vehicle parts, office machines, electric power machinery), consumer goods 31.8% (automobiles, clothing, medicines, furniture, toys) (2008 est.)

Imports - partners:

China 21.6%, Mexico 13.4%, Canada 12.8%, Japan 6.8%, Germany 6% (2017)

CIA, "China" and "United States," *World Factbook*, accessed 2 July 2019

The PPP versus Nominal GDP Debate

The rapid growth of the Chinese economy has led many analysts to speculate if and when China will overtake the United States as the "world's largest economic power." The "actual" size of China's economy has been a subject of extensive debate among economists. Measured in U.S. dollars using nominal exchange rates, China's GDP in 2017 in nominal U.S. dollars was $11.9 trillion, about 62% of the size of the U.S. economy, according to estimates made by the IMF. China's 2017 per capita GDP in nominal dollars was $8,583, which was 14.4% of the U.S. level.

Many economists contend that using nominal exchange rates to convert Chinese data (or those of other countries) into U.S. dollars fails to reflect the true size of China's economy and living standards relative to the United States. Nominal exchange rates simply reflect the prices of foreign currencies vis-à-vis the U.S. dollar, and such measurements exclude differences in the prices for goods and services across countries. To illustrate, one U.S. dollar exchanged for local currency in China would buy more goods and services there than it would in the United States. This is because prices for goods and services in China are generally lower than they are in the United States. Conversely, prices for goods and services in Japan are generally higher than they are in the United States (and China). Thus, one dollar exchanged for local Japanese currency would buy fewer goods and services there than it would in the United States. Economists attempt to develop estimates of exchange rates based on their actual purchasing power relative to the dollar in order to make more accurate comparisons of economic data across countries, usually referred to as purchasing power parity (PPP).

The PPP exchange rate increases the (estimated) measurement of China's economy and its per capita GDP. According to the IMF (which uses price surveys conducted by the World Bank), prices for goods and services in China are about half the level they are in the United States. Adjusting for this price differential raises the value of China's 2017 GDP from $11.9 trillion (nominal dollars) to $23.1 trillion (on a PPP basis) (see **Table 1**).17 IMF data indicate that China overtook the United States as the world's largest economy in 2014 on a PPP basis…

China's share of global GDP on a PPP basis rose from 2.3% in 1980 to an estimated 18.3% in 2017, while the U.S. share of global GDP on a PPP basis fell from 24.3% to an estimated 15.3%...This would not be the first time in history that China was the world's largest economy (see **text box**). China's economic ascendency has been impressive, especially considering that in 1980, China's GDP on a PPP basis was only one-tenth that of the United States (see **Figure 6**). The IMF predicts that by 2022, China's economy will be 46.6% larger than the U.S. economy on a PPP basis.

Table 1. Comparisons of Chinese, Japanese, and U.S. GDP and Per Capita GDP in Nominal U.S. Dollars and a Purchasing Power Parity Basis: 2017

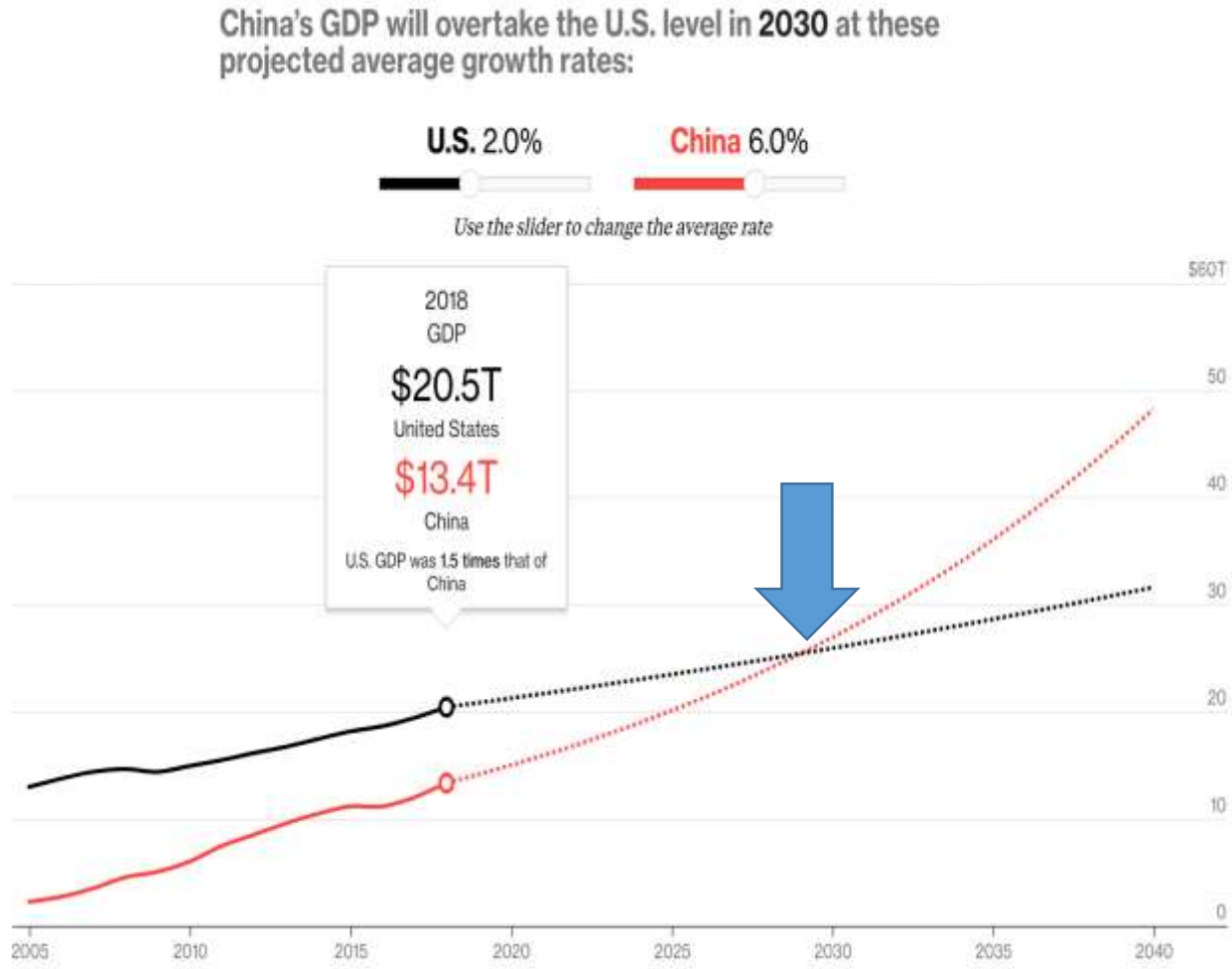
	China	United States
Nominal GDP ($ billions)	11,938	19,362
GDP in PPP ($ billions)	23,122	19,362
Nominal Per Capita GDP ($)	8,583	59,495
Per Capita GDP in PPP ($)	16,624	59,495

China's Economic Rise: History, Trends, Challenges, and Implications for the United States, Congressional Research Service, Updated February 5, 2018, https://crsreports.congress.gov, RL33534, pp. 10

Who Will Lead in the Future? China vs. US GDP: 2005-2040: 2% vs. 6%

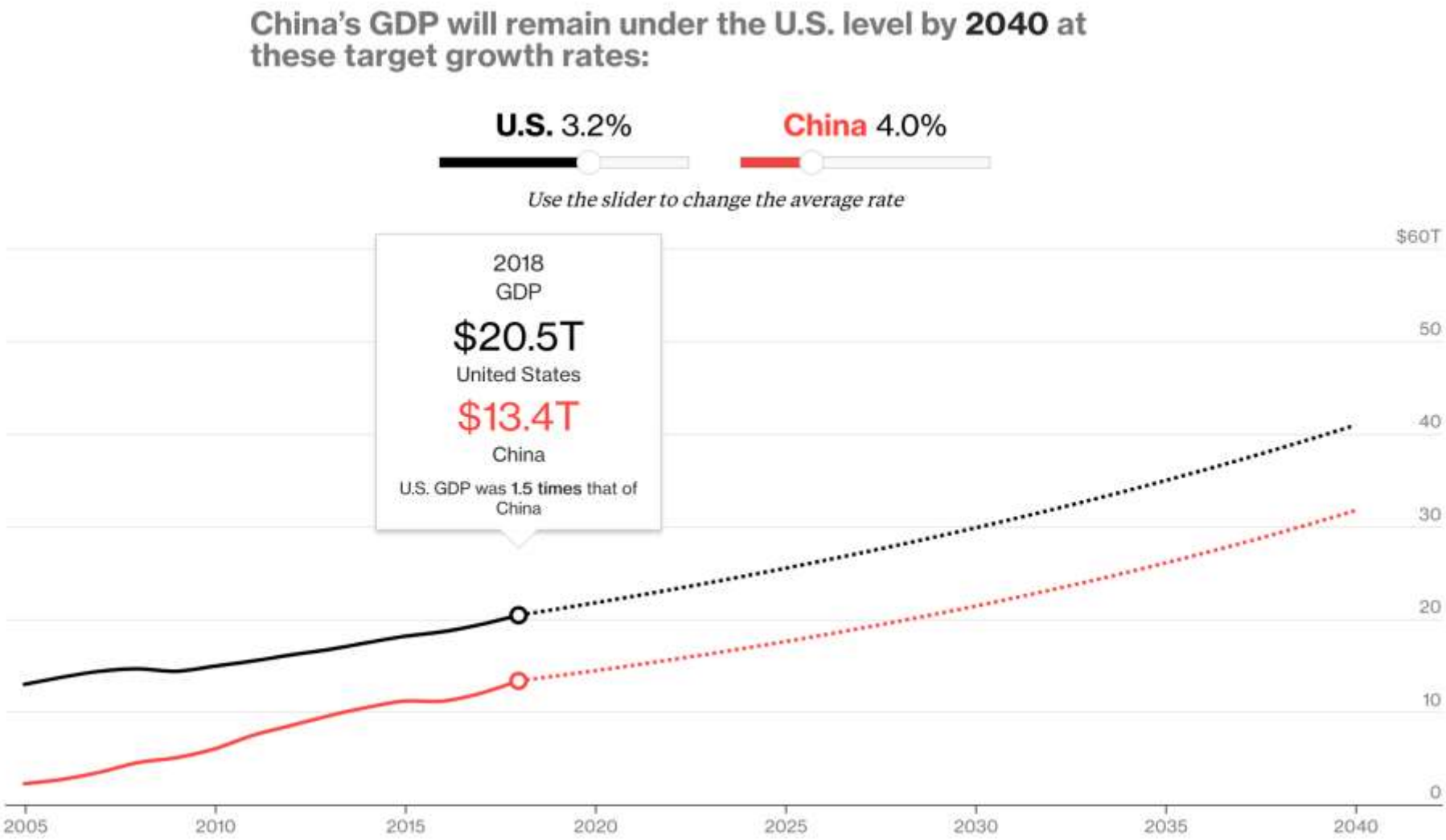
CIA World Factbook

Category	China	U.S.
Population (M)	1,385.0 (2019)	329.0 (2019)
GDP (PPP) $US Trillions	$23.21 (2017)	$19.49 (2017)
GDP (PPP) Per Capita ($US).	$16,700 (2017)	$59,800 (2017)
GDP Growth. Rate in %	6.9% (2017)	2.2% (2017)
Gross National. Saving % of GDP	45.8% (2017)	18.9% (2017)



Malcolm Scott, Cedric Sam: *Here's How Fast China's Economy Is Catching Up to the U.S.*, Bloomberg May 21, 2019, https://www.bloomberg.com/graphics/2016-us-vs-china-economy/; CIOA World Factbook, accessed September 11, 2019

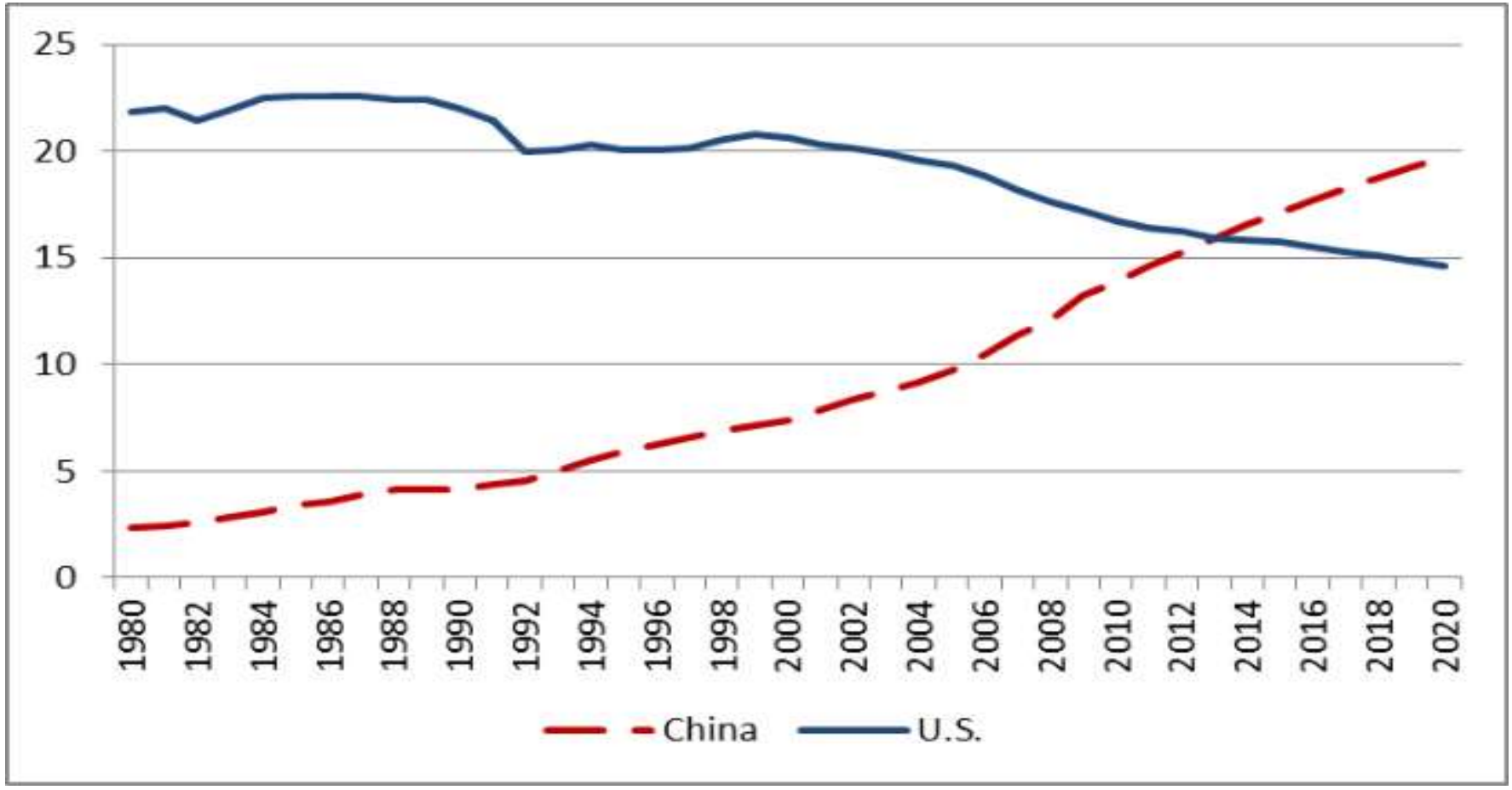
Who Will Lead in the Future? China vs. US GDP: 2005-2040: 3.2% vs. 4%



Malcolm Scott, Cedric Sam: *Here's How Fast China's Economy Is Catching Up to the U.S.*, Bloomberg May 21, 2019, https://www.bloomberg.com/graphics/2016-us-vs-china-economy/

Who Will Lead in the Future? IMF Projection of China vs. U.S. GDP as Percent of Global Total

(in PPP Terms): 1980-2020)



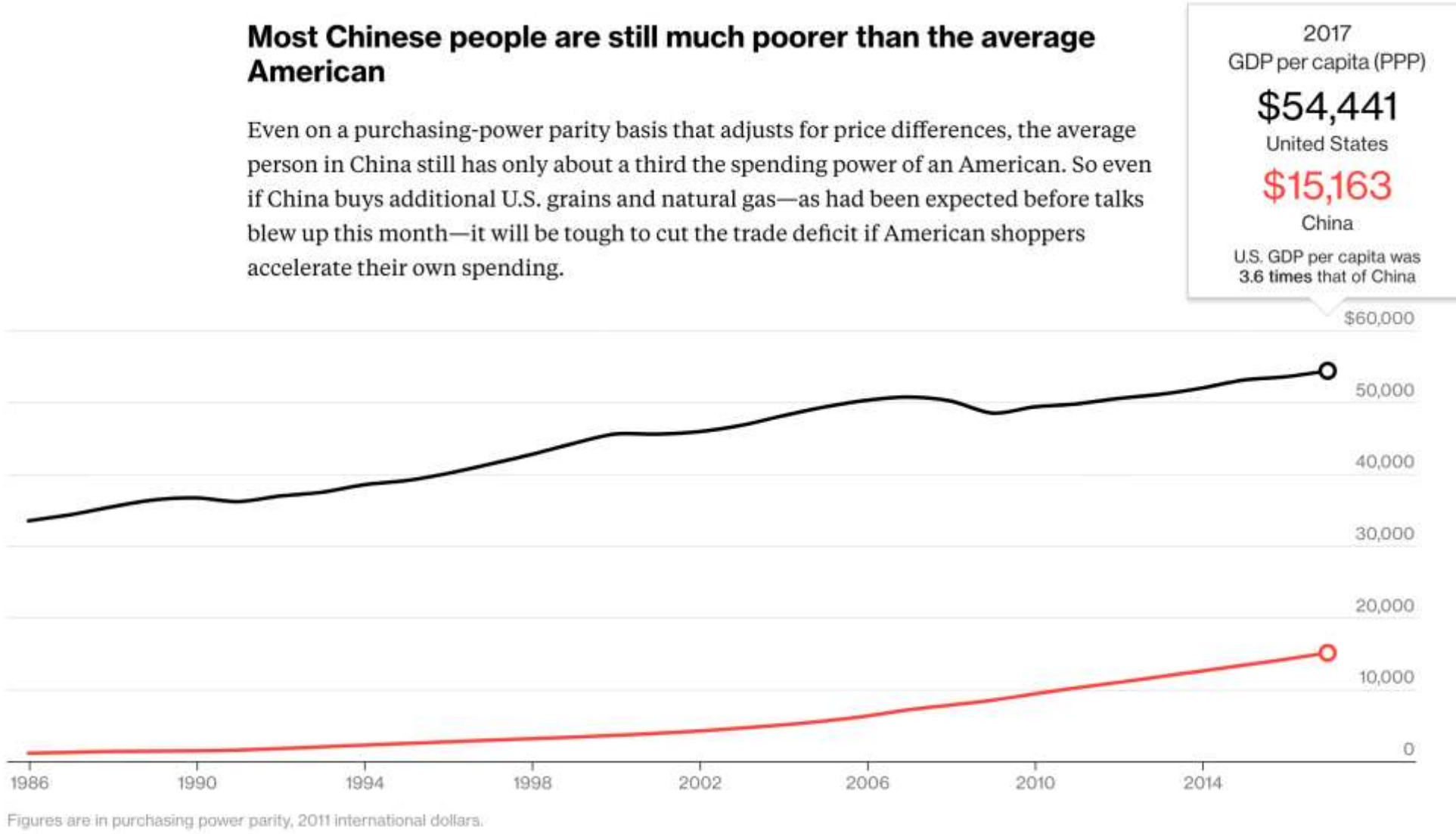
"The PPP measurement raises China's 2016 nominal per capita GDP (from $8,583) to $16,624, which was 27.9% of the U.S. level. Even with continued rapid economic growth, it would likely take many years for Chinese living standards to approach U.S. levels. For example, the EIU projects that, even by the year 2050, Chinese living standards would be half of U.S. levels."

Wayne M. Morrison, *China's Economic Rise: History, Trends, Challenges, and Implications for the United States*, Congressional Research Service, Updated February 5, 2018, https://crsreports.congress.gov, RL33534, pp. 10

Chinese vs. US Per Capita Income: 1986-2017

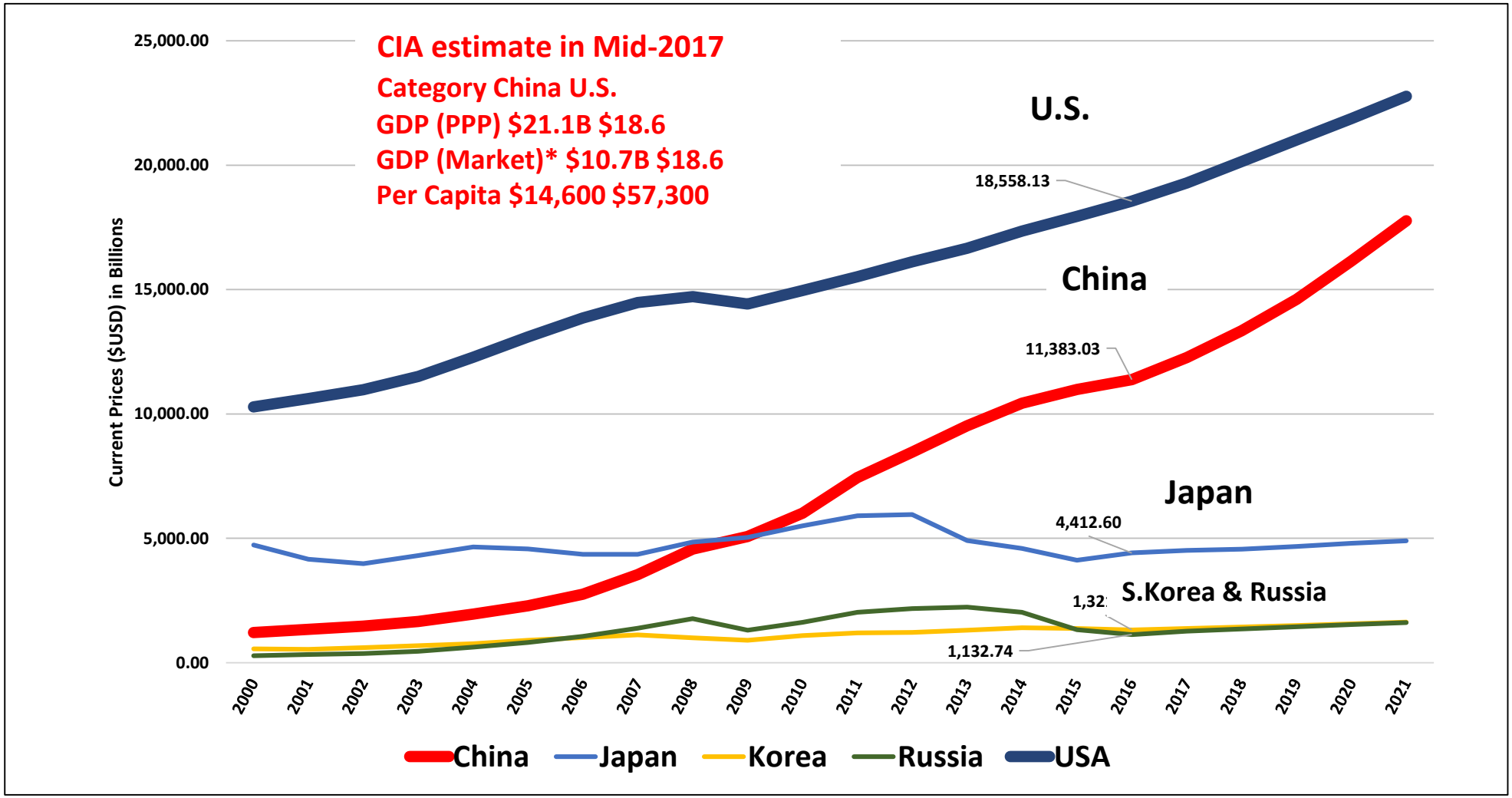
Most Chinese people are still much poorer than the average American

Even on a purchasing-power parity basis that adjusts for price differences, the average person in China still has only about a third the spending power of an American. So even if China buys additional U.S. grains and natural gas—as had been expected before talks blew up this month—it will be tough to cut the trade deficit if American shoppers accelerate their own spending.



Malcolm Scott, Cedric Sam: *Here's How Fast China's Economy Is Catching Up to the U.S*. Bloomberg May 12, 2016 | Updated: May 21, 2019, Sources:, IMF (via Bloomberg). Additional work by: Christopher Cannon, Michael Keller and Ailing Tan

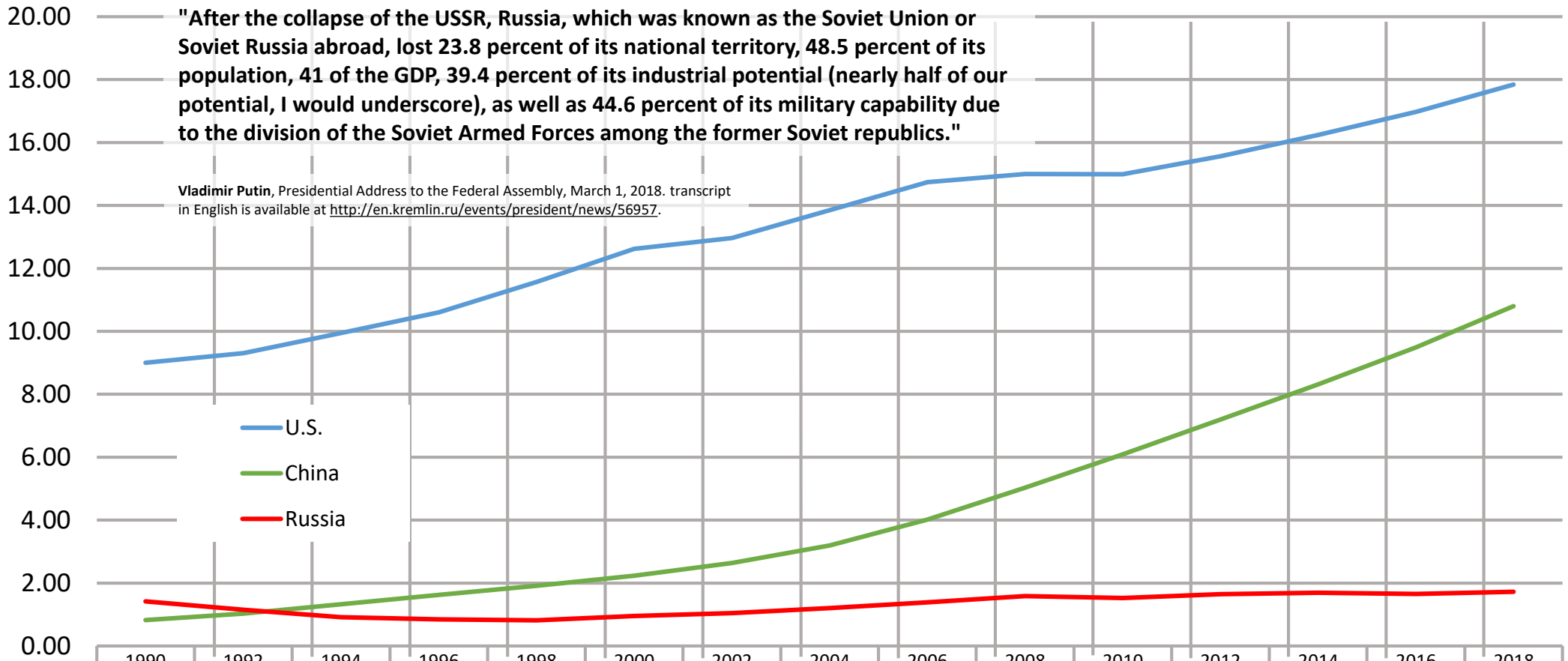
IMF Estimate of China's Comparative Rise in GDP: 2000-2021



Source: CIA World Factbook and IMF, *World Economic Outlook Database*, April 2016, accessed June, 29 2016, https://www.imf.org/external/pubs/ft/weo/2016/01/weodata/index.aspx, adapted by Anthony H. Cordesman and Joseph Kendall at the Center for Strategic and International Studies. (* Official exchange rate)

Russia's Fading Economic Power: GDPs of the U.S., China, and Russia since 1990

(in trillions of 2010 constant $USD)



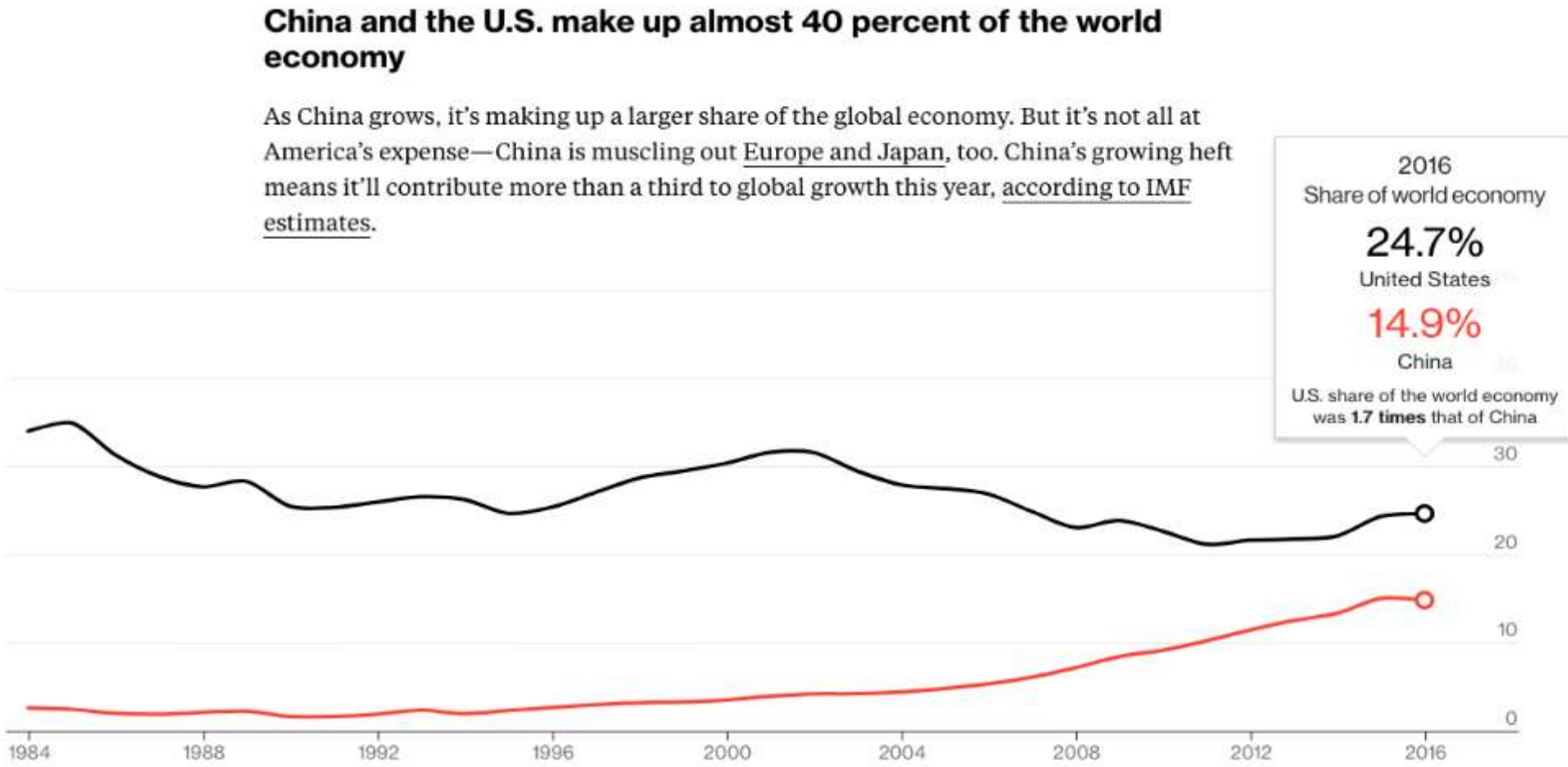
"After the collapse of the USSR, Russia, which was known as the Soviet Union or Soviet Russia abroad, lost 23.8 percent of its national territory, 48.5 percent of its population, 41 of the GDP, 39.4 percent of its industrial potential (nearly half of our potential, I would underscore), as well as 44.6 percent of its military capability due to the division of the Soviet Armed Forces among the former Soviet republics."

Vladimir Putin, Presidential Address to the Federal Assembly, March 1, 2018. transcript in English is available at http://en.kremlin.ru/events/president/news/56957.

	1990	1992	1994	1996	1998	2000	2002	2004	2006	2008	2010	2012	2014	2016	2018
U.S.	9.00	9.31	9.95	10.60	11.57	12.62	12.97	13.85	14.74	15.00	14.99	15.57	16.24	16.97	17.84
China	0.83	1.03	1.33	1.62	1.91	2.23	2.64	3.20	4.02	5.03	6.09	7.19	8.32	9.49	10.80
Russia	1.42	1.15	0.92	0.85	0.81	0.95	1.05	1.20	1.39	1.58	1.52	1.65	1.69	1.66	1.72

Source: The World Bank. 2019. World Development Indicators. Washington, D.C.: The World Bank (producer and distributor). http://data.worldbank.org/data-catalog/world-development-indicators.

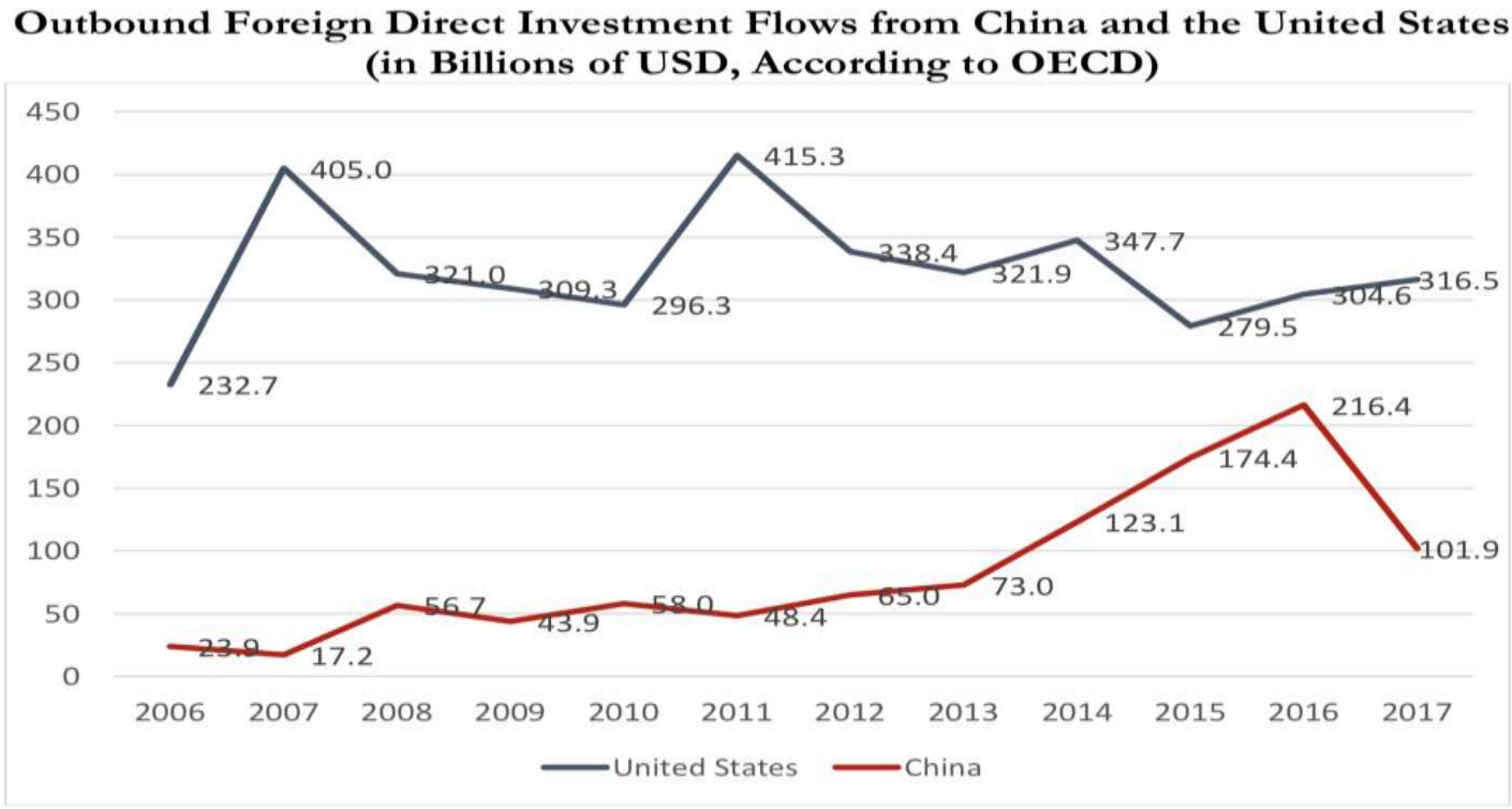
Who Will Lead in the Future? Chinese vs. US as Percent of Global Economy: 1984-2040



Malcolm Scott, Cedric Sam: *Here's How Fast China's Economy Is Catching Up to the U.S*. Bloomberg May 12, 2016 | Updated: November 06, 2017, Sources:, IMF (via Bloomberg). Additional work by: Christopher Cannon, Michael Keller and Ailing Tan

Trends in Foreign Direct Investment: 2006-2017

(In $US Billions)



Source: U.S. Department of Defense, *Assessment on U.S. Defense Implications of Expanding Global Access,* December 2018, p. 14.

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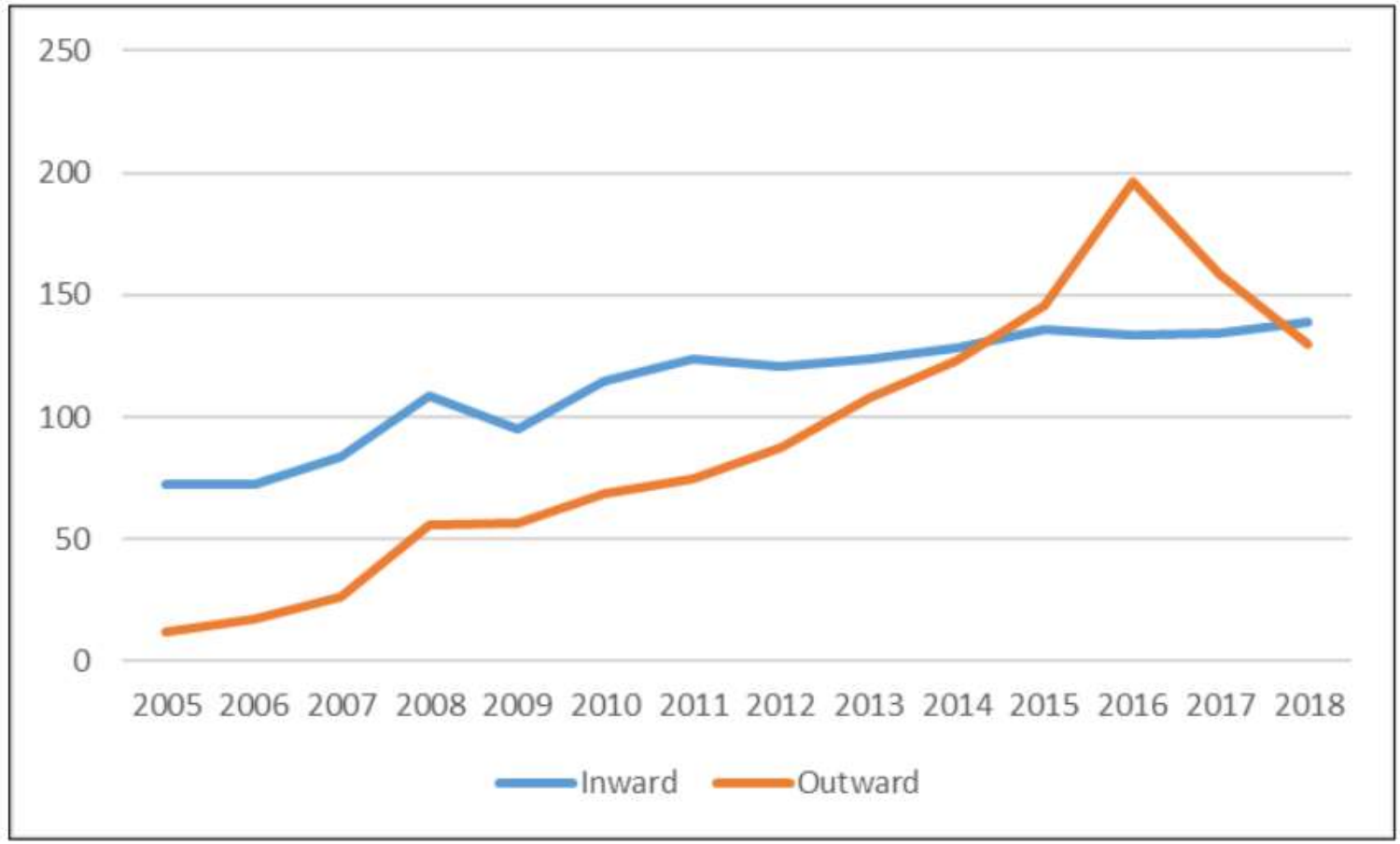
Estimates of China's Annual FDI Inflows and Outflows: 2005-2018

($ billions)



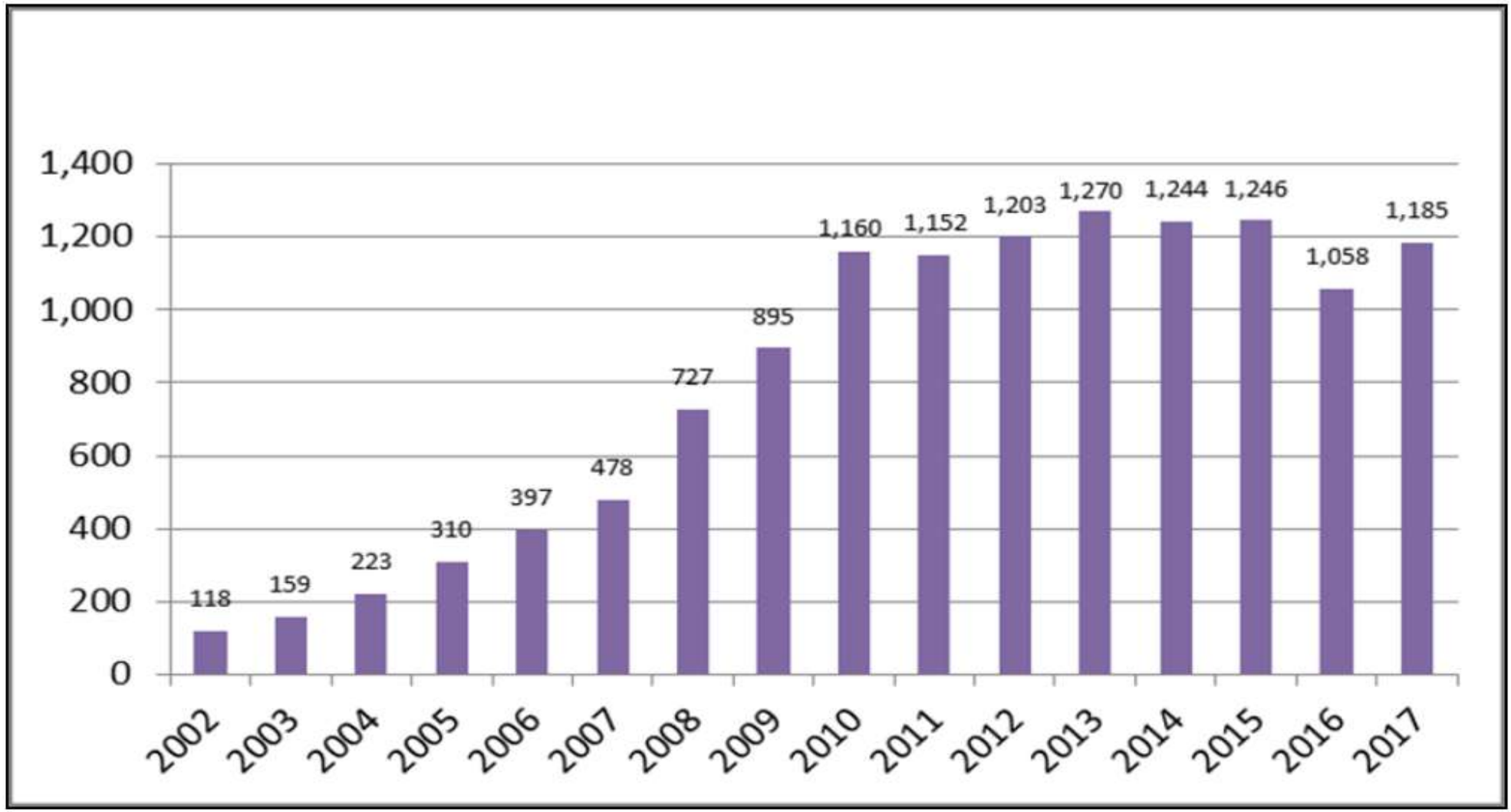
Source: UNCTAD

Notes: UNCTAD FDI data differ from that reported by China.

Source: Wayne M. Morrison, *China's Economic Rise: History, Trends, Challenges, and Implications for the United States*, Congressional Research Service, Updated June 25, 2019, https://crsreports.congress.gov, RL33534, pp. 16.

China's Holdings of U.S. Securities: 2002-2017

(In $US Billions)

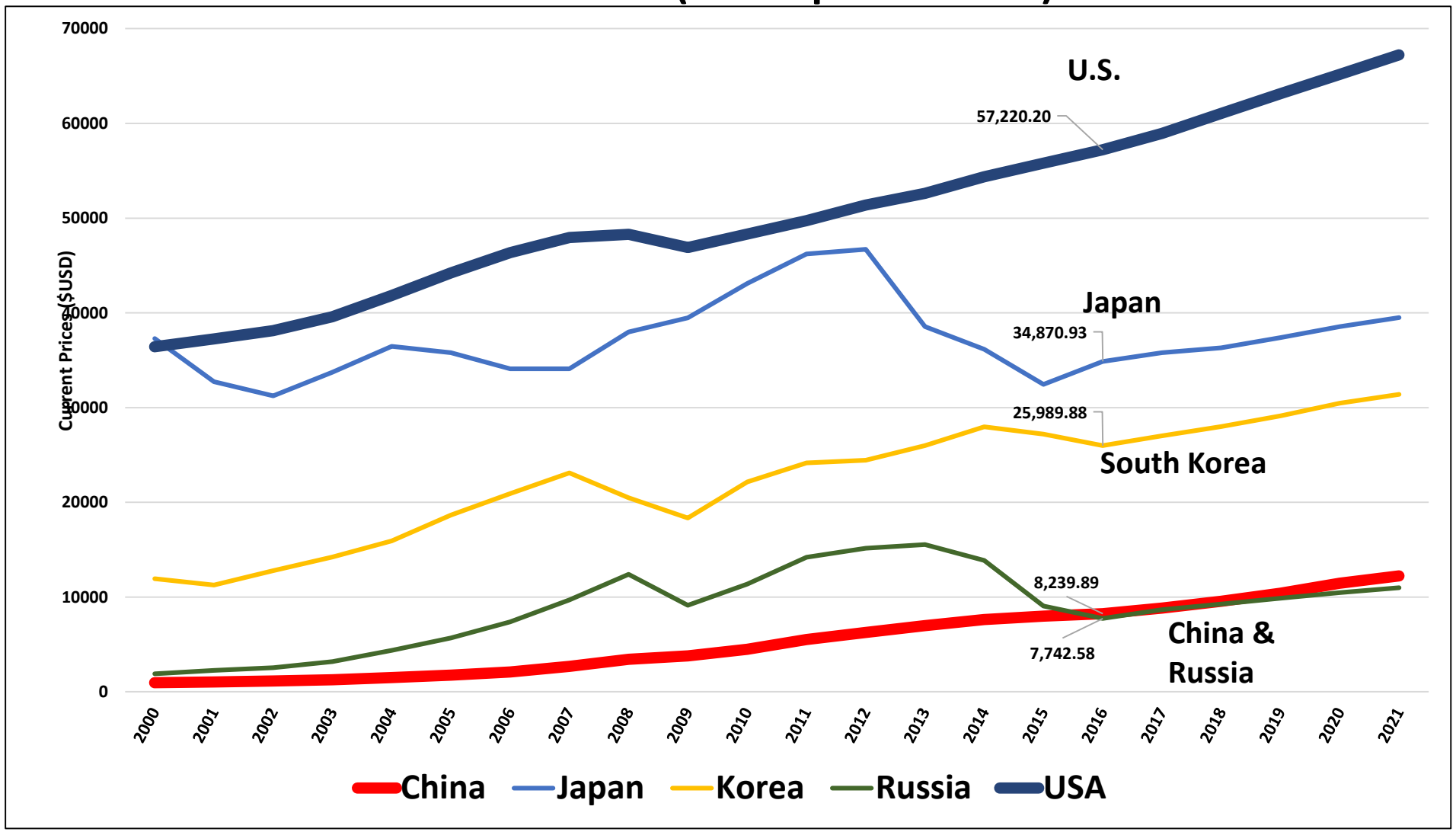


Source: U.S. Department of the Treasury.

Notes: Data are year-end and exclude Hong Kong and Macau, which are treated separately.

Source: *Wayne Morrison, China-U.S. Trade Issues*, CRS, April 16, 2018, RL 33536, p. 22.

Shifts in Wealth (Per Capita Income)



Source: IMF, *World Economic Outlook Database*, April 2016, accessed June 29, 2016, https://www.imf.org/external/pubs/ft/weo/2016/01/weodata/index.aspx adapted by Anthony H. Cordesman and Joseph Kendall at the Center for Strategic and International Studies.

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China's 70th Anniversary White Paper on Poverty and Peoples Well-Being -II

China has established a preliminary social security system covering elderly care, medical care, minimum subsistence, housing, and education – the largest in scale and covering the largest population in the world. By the end of 2018:

- Participants in urban workers' basic elderly care insurance numbered 419 million;
- Participants in unemployment insurance numbered 196 million;
- Participants in work injury compensation insurance numbered 239 million;
- Basic elderly care insurance covered more than 900 million people;
- Basic medical insurance covered more than 1.3 billion people, almost everyone in the country.

Over the past 70 years, China's life expectancy has increased from 35 in 1949 to 77 in 2018, higher than the world's average of 72. Over the past 70 years, the Chinese people have witnessed profound changes in their mindset. They have carried forward fine traditional Chinese culture, spread modern Chinese values, and enriched and invigorated their cultural life. According to a global wellbeing report released by the Boston Consulting Group (BCG) in 2018, in the past decade, China's ranking rose by 25 places, the fastest rate among the 152 countries covered.(BCG, "Striking a Balance Between Well-Being and Growth: The 2018 Sustainable Economic Development Assessment", September 2018.)

…Before reform and opening up started in 1978, urban and rural residents in China focused their spending on food and clothing. In 1978, the urban and rural Engel coefficients were as high as 57.5 percent and 67.7 percent. Since 1978, the level of consumption in China has greatly improved, and the cultural life of its people has become richer. In 2010, the urban and rural Engel coefficients fell to 31.9 percent and 37.9 percent. Since the 18th CPC National Congress in 2012, living standards have further improved and great strides have been made towards a moderately prosperous society in all respects. In 2018, the urban and rural Engel coefficients dropped to 27.7 percent and 30.1 percent. The following is a list of number of objects owned per 100 households:

- 33 cars, 95.3 percent up from 2013,
- 59.2 motorcycles, 49.9 percent up,
- 249.1 mobile phones, 22.6 percent up,
- 109.3 air conditioners, 55.3 percent up,
- 56.4 range hoods, 32.7 percent up; and
- 85 water heaters, 32.4 percent up.

*China and the World in the New Era***,** The State Council Information Office of the People's Republic of China, September 2019, pp. 6-8, 18

China's 70th Anniversary White Paper on Poverty and Peoples Well-Being -I

The Chinese people's lives have been greatly improved. A persevering effort has provided the Chinese people with adequate food and clothing, and made it possible for them to live decent lives and move towards a moderately prosperous society in all respects (see Table 2). China's rural population living under the current poverty line decreased from 770 million in 1978 to 16.6 million in 2018, and China's rural poverty incidence dropped from 97.5 percent to 1.7 percent, down by 95.8 percentage points (see Figure 1). This is an outstanding achievement in the history of poverty reduction (see Box 1).

Table 2 Improvement of the Chinese People's Living Standards

Year / Index	Early years after the founding of PRC	1980	2018
Proportion of rural population living under the current poverty line	Extreme poverty	96.2%	1.7%
Per capita disposable income	RMB98 (in 1956)	RMB171 (in 1978)	RMB28,228
Life expectancy	35	65	77
Infant mortality rate	200‰	48‰	6.1‰
Preschool enrollment rate	20%	95.5% (in 1978)	Completion rate of nine-year compulsory education: 94.2%
Average years of schooling for people aged 15 and above	80% illiterate	5.3	9.6
Gross enrollment rate for higher education	0.22%	2.22%	48.1%

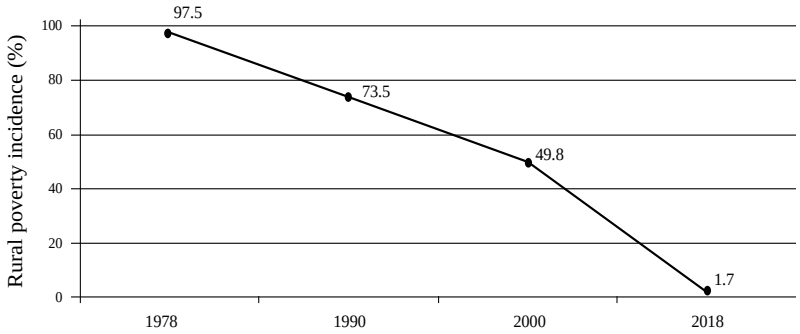

Figure 1 China's Rural Poverty Incidence, 1978-2018

Box 1 China's Achievements in Poverty Elimination

Since the 18th CPC National Congress in 2012, China has launched targeted poverty alleviation and made notable progress. China's rural impoverished population was reduced from 99 million in 2012 to 16.6 million in 2018, a total reduction of 82.4 million, down by 13 million every year on average. China's poverty incidence dropped from 10.2 percent to 1.7 percent, down by nearly 9 percentage points. In 2019, China planned to help at least another 10 million poor and about 330 poor counties out of poverty.

Over more than 40 years of reform and opening up since 1978, according to the World Bank's international poverty line of US$1.9 per person per day, more than 800 million Chinese population have shaken off poverty, accounting for more than 70 percent of the global figure over the same period. China has become the first developing country to realize the poverty reduction objective in the United Nations Millennium Development Goals. UN Secretary-General António Guterres praised China as the largest contributor to global poverty reduction. In 2018, the UN General Assembly adopted a resolution on eliminating rural poverty, which included the concept and practice of targeted poverty alleviation initiated by China. China has provided a wealth of experience for the global fight against poverty.

China and the World in the New Era, The State Council Information Office of the People's Republic of China, September 2019, pp. 6-8

Declines in Chinese Poverty II
(at Consumption Rates of $1.90 A Day Per Capita)

Evaluation of Poverty Population around the World:
Poverty Line Using US$1.90 Per Day in 2011 PPP (millions)

Regions	1981	1990	2002	2011	2012
East Asia and Pacific	1,142.5	995.5	552.7	173.1	137.2
China	877.8	755.8	409.1	106.2	87.4
Europe and Central Asia	—	8.8	29.2	11.4	10.1
Latin America and the Caribbean	87.7	78.2	70.5	35.3	33.7
Middle East and North Africa	—	13.5	—	—	—
South Asia	537.7	574.6	583.0	361.7	309.2
Sub-Saharan Africa	—	287.6	399.0	393.6	388.8
Total	1,997.3	1,958.6	1,645.1	983.3	896.7
Total less China	1,119.5	1,202.8	1,236	877.1	809.3

Evaluation of Poverty in China, 1981–2012:
Poverty Line Using US$1.90 Per Day in 2011 PPP

Year	Head Count (%)	Number of Poor	Poverty Gap (%)
1981	88.32	877.8	43.19
1984	75.75	785.4	29.4
1987	60.84	659.5	21.73
1990	66.58	755.8	24.37
1993	57	671.7	20.57
1996	42.05	512.0	13.04
1999	40.54	507.9	13.23
2002	31.95	409.1	10.23
2005	18.75	244.4	4.94
2008	14.65	194.1	3.87
2010	11.18	149.6	2.66
2011	7.9	106.2	1.76
2012	6.47	87.4	1.37
2013	1.85	25.2	

Source: World Bank, , China-Systemic Country Diagnostic, Report No. 113092-CN, 2017, pp. 43,47.
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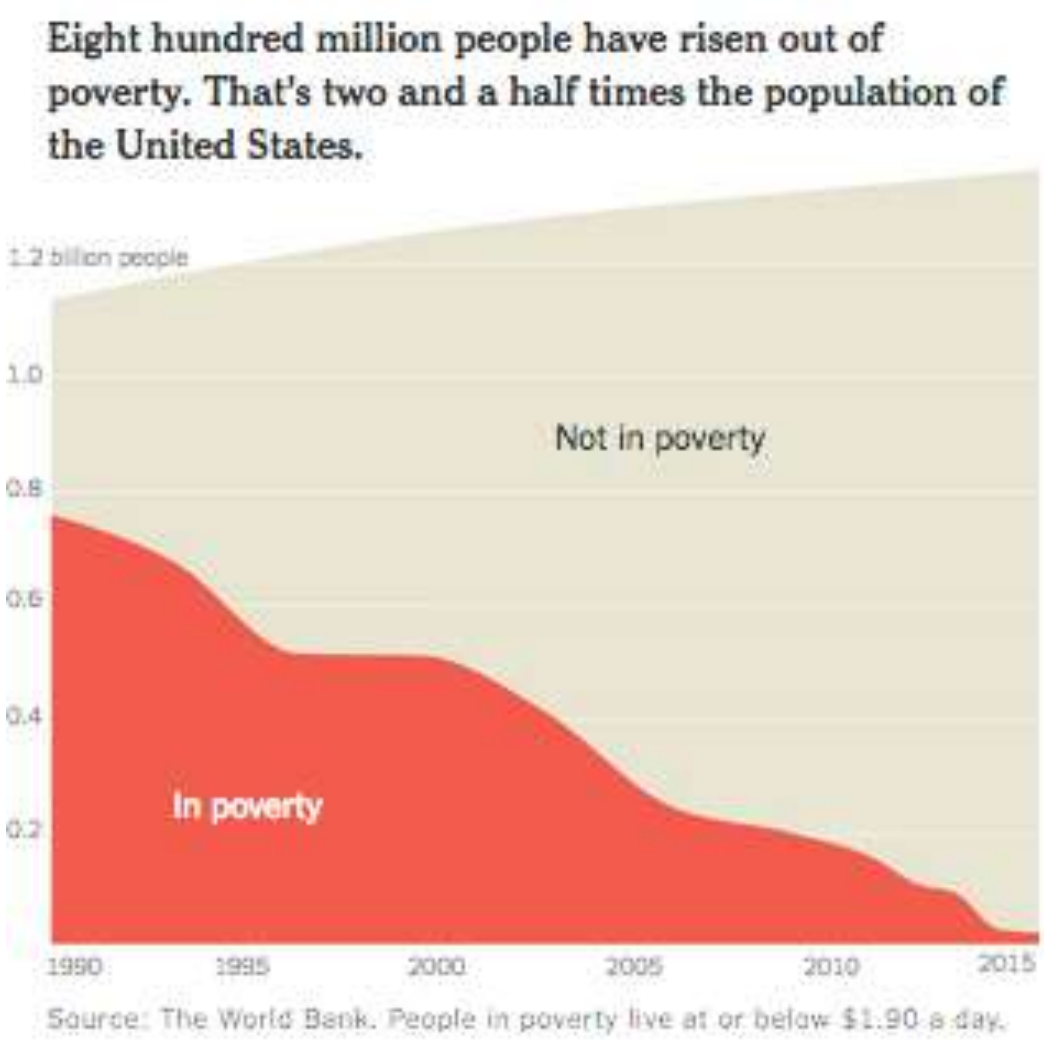
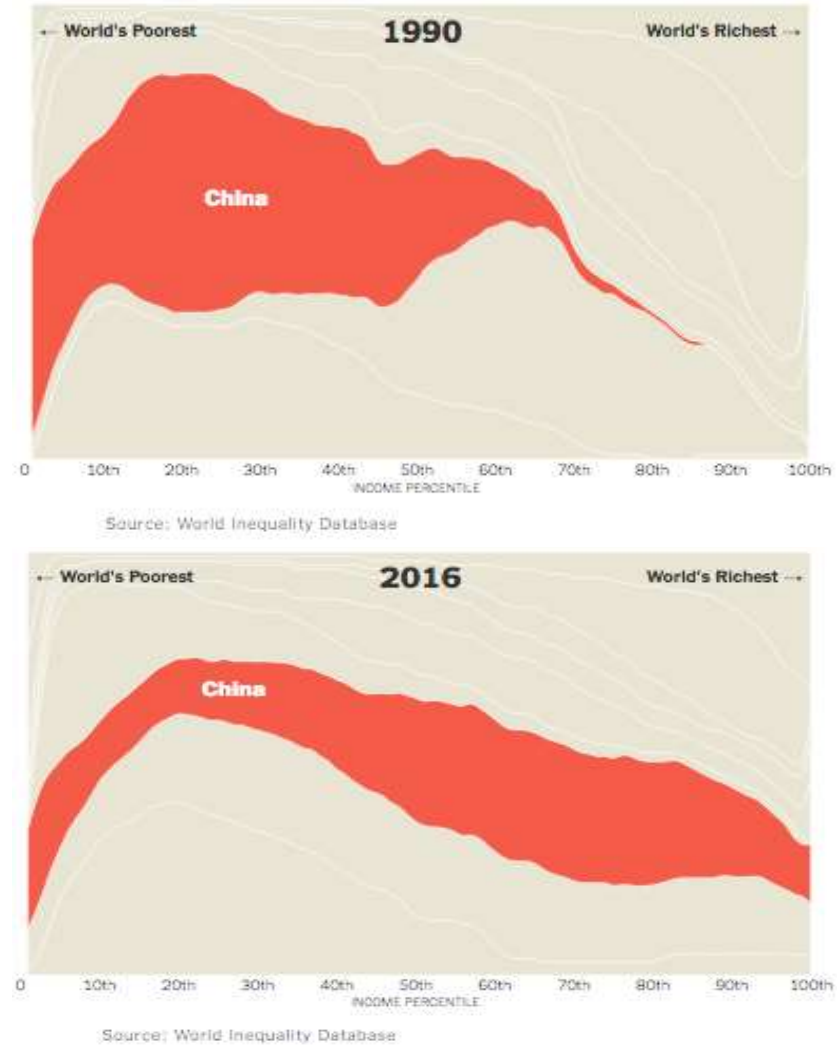
Decline in Chinese Poverty - II





Source: JAVIER C. HERNÁNDEZ and QUOCTRUNG BUI , "The American Dream Is Alive. In China," *New York Times*, . November 18, 2018, https://www.nytimes.com/interactive/2018/11/18/world/asia/china-social-mobility.html

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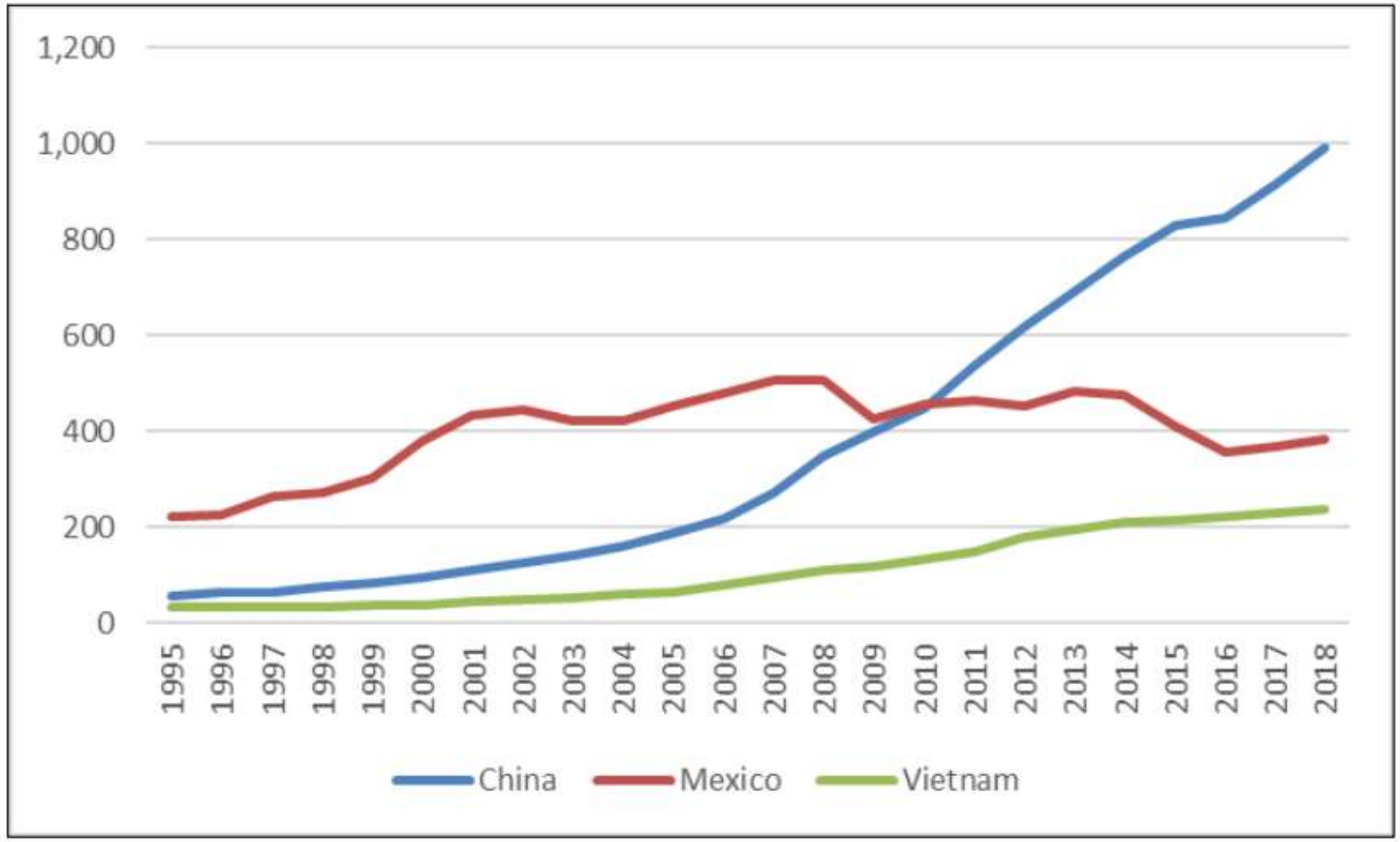
Average Monthly Wages for China, Mexico, and Vietnam: 1990-2018

(nominal U.S. dollars)



Source: Economist Intelligence Unit.

Notes: Because data are listed in U.S. dollars rather than local currency, changes to wages may also partially reflect changes to exchange rates with the U.S. dollar. However, such data may reflect average labor costs in dollars that U.S.-invested firms might face in their overseas operations.

Source: Wayne M. Morrison, *China's Economic Rise: History, Trends, Challenges, and Implications for the United States*, Congressional Research Service, Updated June 25, 2019, https://crsreports.congress.gov, RL33534, pp. 12.

China's Changing Manufacturing Base and Trade Patterns

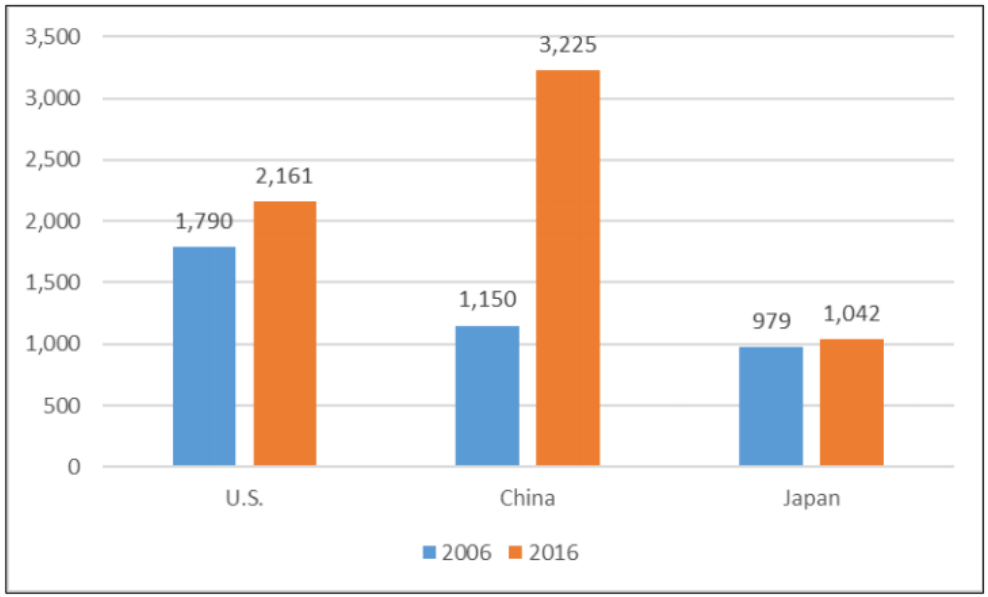
China's Progress in Manufacturing

Once again, there are many ways to calculate the progress in China's manufacturing sector, and its implications for China's industrial base. There is little doubt, however, that China's manufacturing sector is now much larger than that of the U.S. and other Asian economic powers like Japan. It has become a key reason that China is now a leading importer of commodities and other goods, but also of the reason for a major shift from labor-intensive to high technology manufacturing.

As DIA notes, China has used this progress to make steady improvements in its defense industrial base. It not only is doing so in key areas of conventional arms manufactures, but increasingly in cutting edge areas of military technology. There are still many areas where China lags behind the U.S., but it is catching up in many areas and has already made great improvements in deploying key weapons like precision strike systems.

China versus U.S. Manufacturing

Gross Value Added Manufacturing in China, the United States, and Japan: 2006 and 2016
($ billions)



China has emerged as the world's largest manufacturer according to the United Nations. The Graph shows estimates of the gross value added of manufacturing in China, the United States, and Japan expressed in U.S. dollars from 2005 to 2014.

Gross value added data reflect the actual value of manufacturing that occurred in the country (i.e., they subtract the value of intermediate inputs and raw materials used in production). These data indicate that China overtook Japan as the world's second-largest manufacturer on a gross value added basis in 2006 and the United States in 2010.

In 2014, the value of China's manufacturing on a gross value added basis was 39.6% higher than the U.S. level. Manufacturing plays a considerably more important role in the Chinese economy than it does for the United States. In 2014, China's gross valued added manufacturing was equal to 27.7% of its GDP, compared to 12.1% for the United States.

Source: Wayne M. Morrison, *China's Economic Rise: History, Trends, Challenges, and Implications for the United States*, Congressional Research Service, Updated June 25, 2019, https://crsreports.congress.gov, RL33534, pp. 12.

China's 70th Anniversary White Paper on Industrialization and Urbanization

The economic structure is undergoing a profound adjustment, industrial upgrading is continuing, and new economic growth areas are constantly emerging. The urbanization rate of permanent residents reached 59.6 percent in 2018 and will increase steadily. The number of permanent urban residents will continue to increase. This will bring a wide range of needs in various areas, such as infrastructure, real estate, new retail, medical treatment and public health, education, culture and entertainment, and provide an important engine for economic development. New industries and business forms are emerging.

In 2018, the added value of high-tech manufacturing increased by 11.7 percent over the previous year. Corresponding figures for strategic emerging industries and equipment manufacturing were 8.9 percent and 8.1 percent. New energy vehicles, intelligent televisions, lithium-ion batteries and integrated circuits increased by 66.2, 17.7, 12.9 and 11.2 percent, respectively.

The growth rate of the information service industry is as high as 30.7 percent, and the growth rate of mobile games, online shopping, ride-sharing platforms, travel platforms, big data cloud computing and other sub-industries is 30 to 50 percent. Each sub-industry has given birth to a number of "unicorn" enterprises.

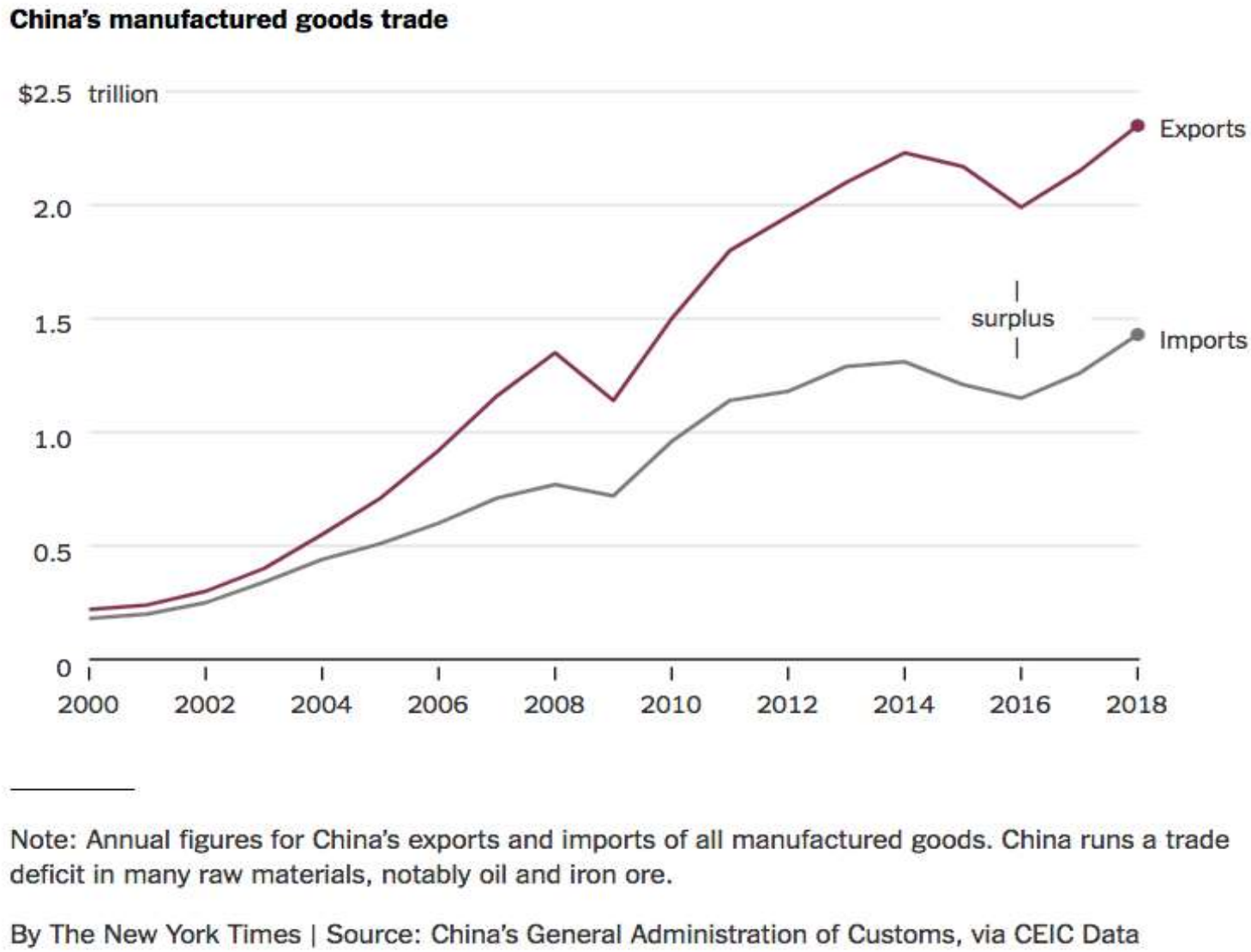
According to an MGI report, by 2040, the integration between China and the rest of the world is expected to drive economic value of US$22 trillion to US$37 trillion, equivalent to 15 to 26 percent of global GDP. Strengthened cooperation between China and other countries will create enormous economic value.

MGI, "China and the world: Inside the dynamics of a changing relationship", July 2019.

China and the World in the New Era, The State Council Information Office of the People's Republic of China, September 2019, pp. 17

Chinese Surplus in Manufactured Goods: 1991-2017

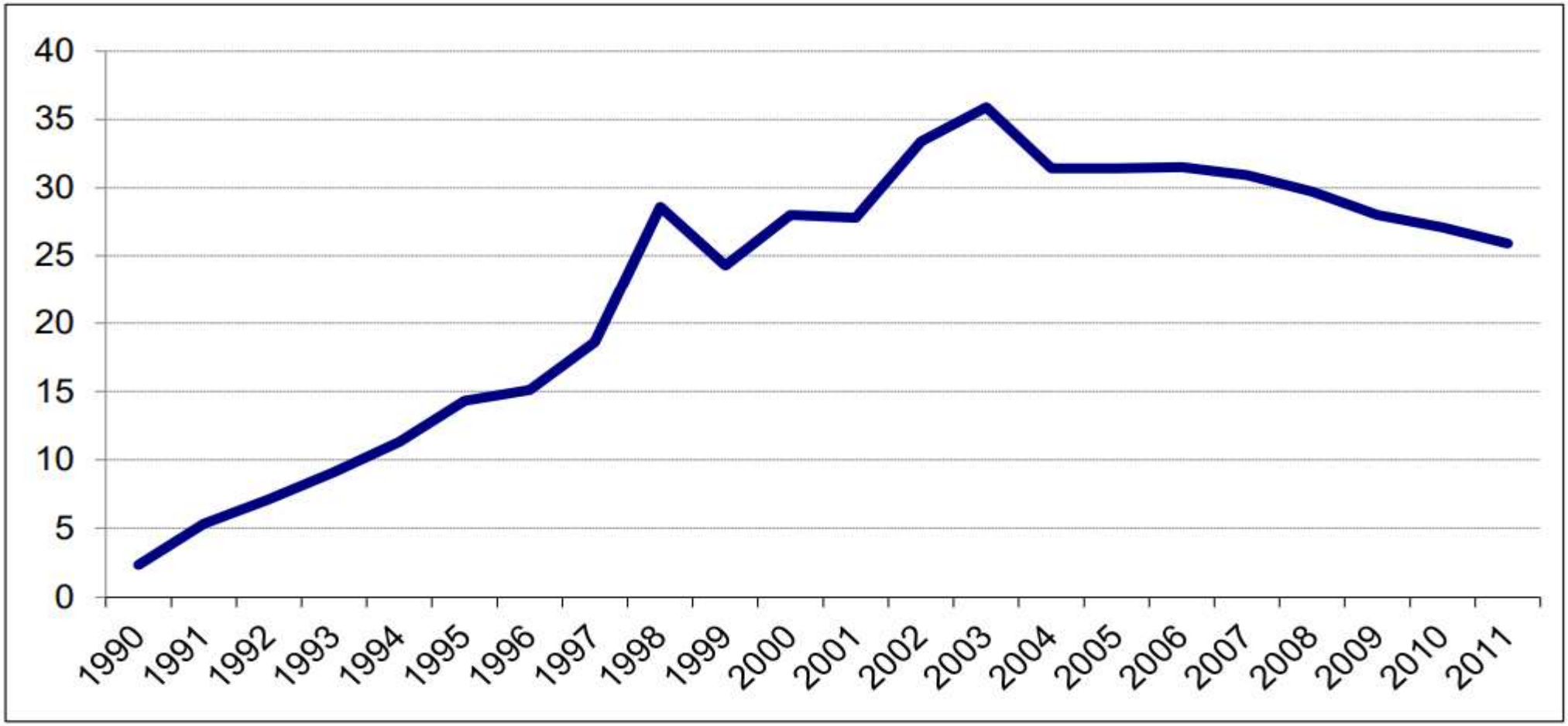
($US Trillions)



Source: By Keith Bradsher,. "China Needs New Places to Sell Its Mountain of Stuff," New York Times, July 26, 2019

Industrial Output by Foreign-Invested Firms in China as a Share of National Output Total: 1990-2011

(percentage)

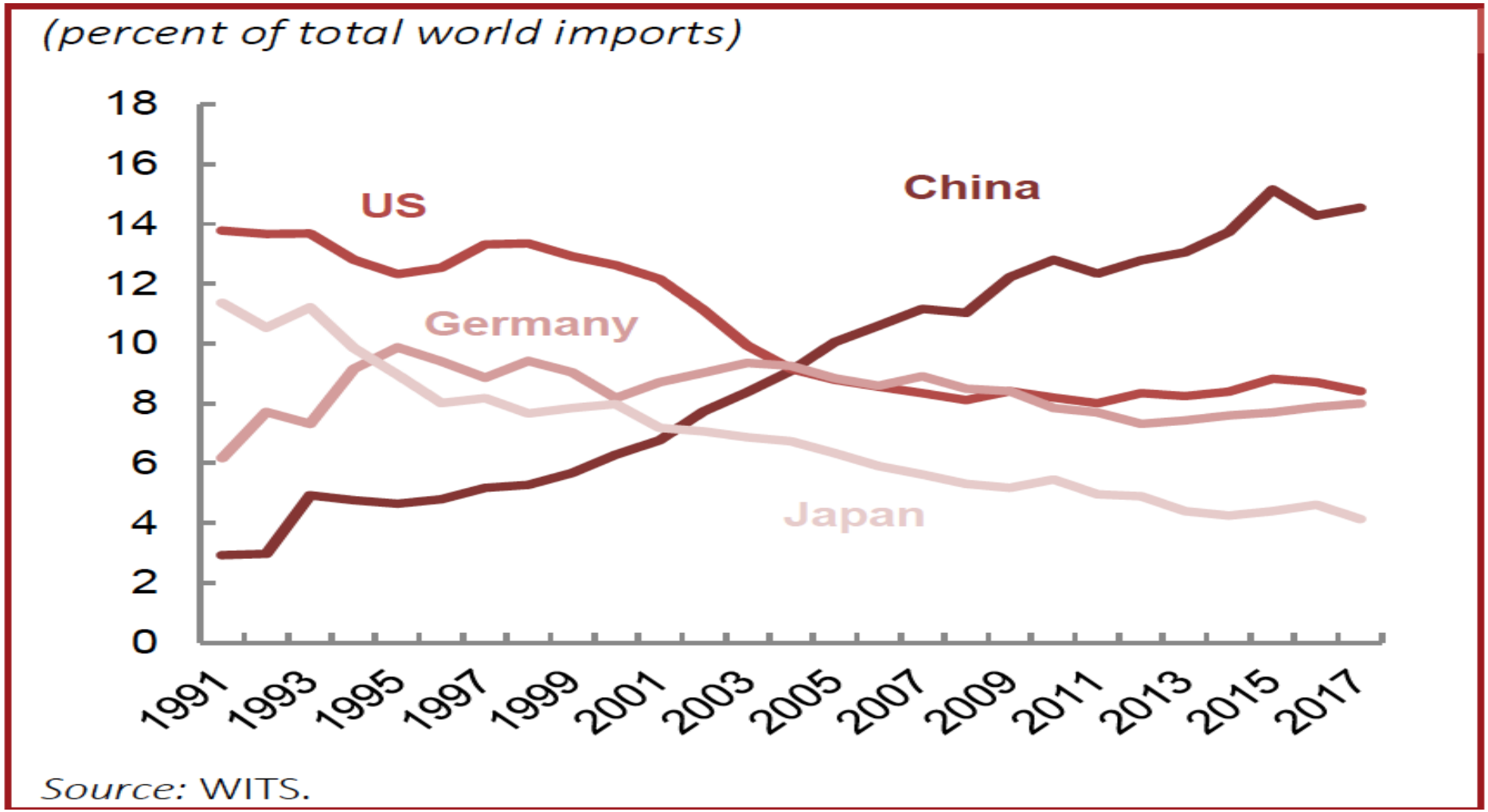


Source: Invest in China (http://www.fdi.gov.cn) and China's 2012 Statistical Yearbook.

Source: Wayne M. Morrison, *China's Economic Rise: History, Trends, Challenges, and Implications for the United States*, Congressional Research Service, Updated June 25, 2019, https://crsreports.congress.gov, RL33534, pp. 15.

Share of Global Trade in Goods by Country: 1991-2017

(Percent of World Imports)



Source: World Bank, *China Economic Update*, May 2015, p. 15.

US-China Trade in 2018

U.S. goods exports to China totaled $120.8 billion in 2018, a 7.3% ($9.4 billion) decrease from the 2017 level (see **Table 3**). The value of U.S. goods imports from China was $540.4 billion over the same period, up 6.8% ($34.4 billion) from 2017. The decrease in U.S. exports and increase in U.S. imports resulted in a $43.8 billion (11.7%) increase in the bilateral trade deficit, to $419.6 billion. Exports to China accounted for 7.2% of all U.S. goods exports, while imports from China accounted for 21.1% of all U.S. goods imports.

Table 3. U.S.-China Trade in 2018

	U.S.$ (billions)	% Change from 2017*
Total U.S. Exports to China	178.0	-4.5
Exports of Goods	120.8	-7.3
Exports of Services	57.1	2.0
Total U.S. Imports from China	558.8	6.7
Imports of Goods	540.4	6.8
Imports of Services	18.3	5.1
Total Balance (Deficit)	-380.8	12.9
Balance on Goods (Deficit)	-419.6	11.7
Balance on Services (Surplus)	38.8	0.6

Source: U.S. Bureau of Economic Analysis, Department of Commerce, June 20, 2019.

Note: *not adjusted for inflation.

Top U.S. goods exports to China in 2018 were capital goods, not including automotive products ($52.9 billion or 43.8% of U.S. goods exports to China), industrial supplies ($40 billion or 33.1%), and automotive vehicles and parts ($10.4 billion or 8.6%). Leading U.S. goods imports from China were consumer goods, not including food and automotive ($248.2 billion or 45.9% of U.S. goods imports from China), industrial supplies ($55.6 billion or 10.3%), and automotive vehicles and parts ($23.1 billion or 4.28%).

China has levied retaliatory tariffs on most U.S. agricultural and food products. The tariffs reportedly contributed to the sharp overall decline of these exports to China (particularly of U.S. soybeans) in 2018.[60] Total U.S. agricultural exports to China amounted to $9.1 billion, a decline of 53.0% from 2017, while the value of U.S. agricultural imports from China was $4.9 billion, up 8.9% from 2017.[61] China's share of total U.S. agricultural exports declined from 14.1% in 2017 to 6.6% in 2018.

Trade in Services

In 2018, U.S. services exports to China totaled $57.1 billion (up 2.0% or $1.1 billion), while U.S. imports of services from China grew 5.1% ($887 million) to $18.3 billion. The bilateral trade surplus in services stood at $38.8 billion (up 0.6% from 2017). Exports to China accounted for 6.9% of all U.S. services exports, while imports from China accounted for 3.2% of all U.S. services imports.

Travel represented the largest category of U.S. services exports to China, accounting for 56.1% ($32.1 billion). Other significant categories were charges for the use of IP rights (14.8% of all services exports to China or $8.5 billion) and transport (9.3% or $5.3 billion). Leading U.S. services imports from China were transport (27.4% of all services imports from China or $5.0 billion) and travel (24.7% or $4.5 billion).

Timeline, coordinated by Brock R. Williams; CRS Insight IN10971, *Escalating U.S. Tariffs: Affected Trade*, coordinated by Brock R. Williams; and CRS Insight IN11135, *U.S. Trade Friction with China Intensifies*, by Wayne M. Morrison.

[57] President Donald J. Trump on Twitter, August 1, 2019, https://twitter.com/realdonaldtrump/status/1156979446877962243.

[58] Donald J. Trump on Twitter, August 23, 2019, https://twitter.com/realdonaldtrump/status/1165005929831702529.

[59] The White House, "Remarks by President Trump Before Marine One Departure," August 1, 2019, https://www.whitehouse.gov/briefings-statements/remarks-president-trump-marine-one-departure-56/.

Source: Susan V. Lawrence, Coordinator Specialist in Asian Affairs, *U.S.-China Relations*, CRS RS-45898, 3.9.19, pp. 13-14

China versus U.S. Merchandise Trade Balance: 2001-2018

(billions of dollars)

Year	U.S. Trade Figures			Chinese Trade Figures		
	Exports to China (F.A.S.)	Imports from China (C.V.)	Trade Balance	Exports to United States (F.O.B.)	Imports from United States (C.I.F.)	Trade Balance
2001	19.396	102.570	-83.174	54.277	26.204	28.073
2002	22.317	125.498	-103.181	69.959	27.228	42.731
2003	28.646	152.974	-124.328	92.510	33.883	58.627
2004	34.833	197.456	-162.623	124.973	44.653	80.320
2005	41.874	244.699	-202.825	162.939	48.735	114.204
2006	54.813	289.246	-234.433	203.516	59.222	144.294
2007	64.313	322.975	-258.662	232.761	69.861	162.900
2008	71.346	339.581	-268.235	252.327	81.486	170.841
2009	70.636	297.872	-227.236	220.706	77.433	143.273
2010	93.059	366.126	-273.067	283.184	101.310	181.873
2011	105.445	400.632	-295.187	324.300	118.121	206.180
2012	111.855	426.792	-314.937	351.884	127.755	224.129
2013	122.827	441.621	-318.794	368.349	145.926	222.423
2014	124.747	467.940	-343.193	396.082	159.036	237.046
2015	116.817	484.371	-367.554	409.648	148.736	260.912
2016	115.775	462.813	-347.038	388.617	132.394	256.223
2017	130.370	505.597	-375.227	429.758	153.943	275.815
2018	120.341	539.503	-419.162	478.423	155.096	323.327

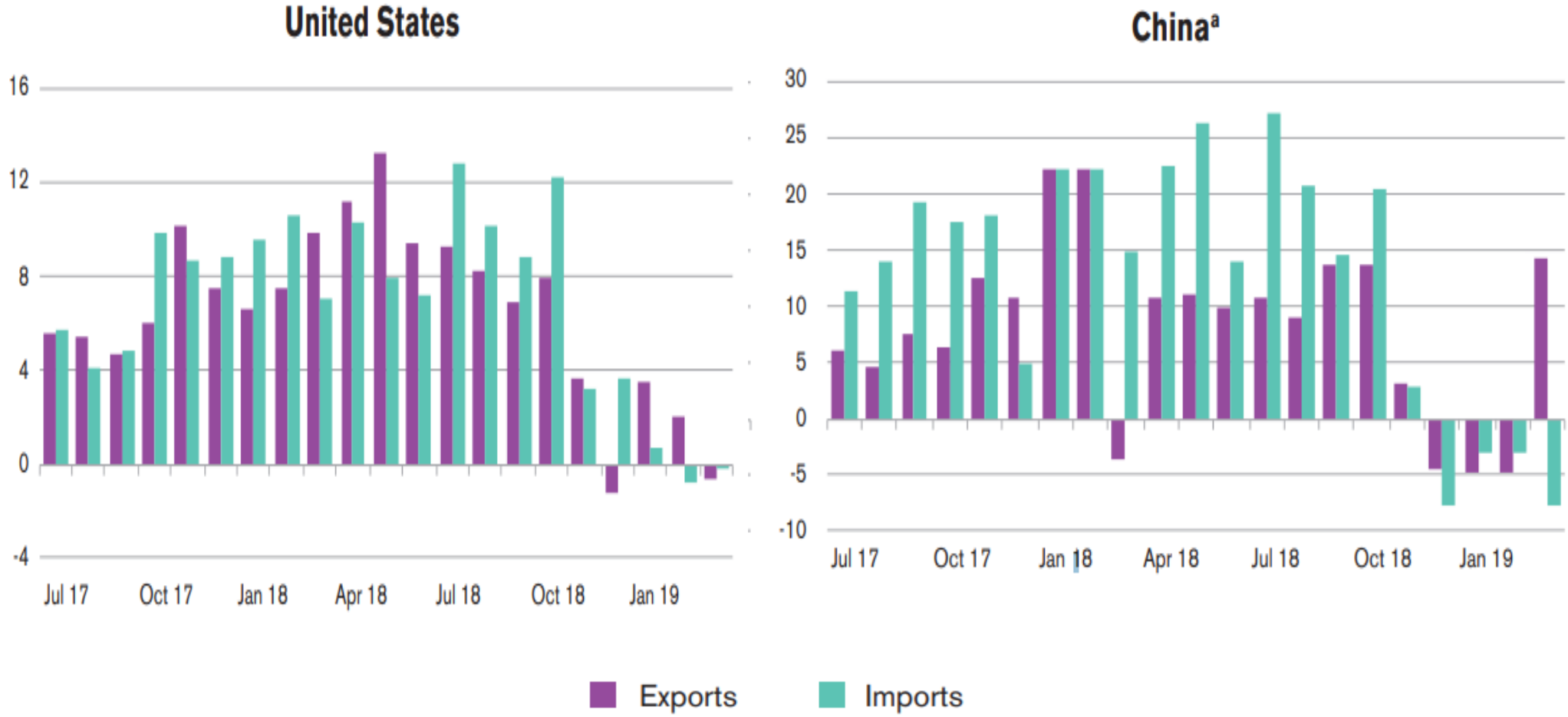
Source: China's General Administration of Customs, U.S. Bureau of Economic Analysis (BEA).

Note: China values its exports using the "free on board," or F.O.B. method and its imports using the "cost, insurance, and freight," or C.I.F. method. The United States values its exports using the "free alongside," or F.A.S. method and its imports using the "Customs value" (C.V.) method.

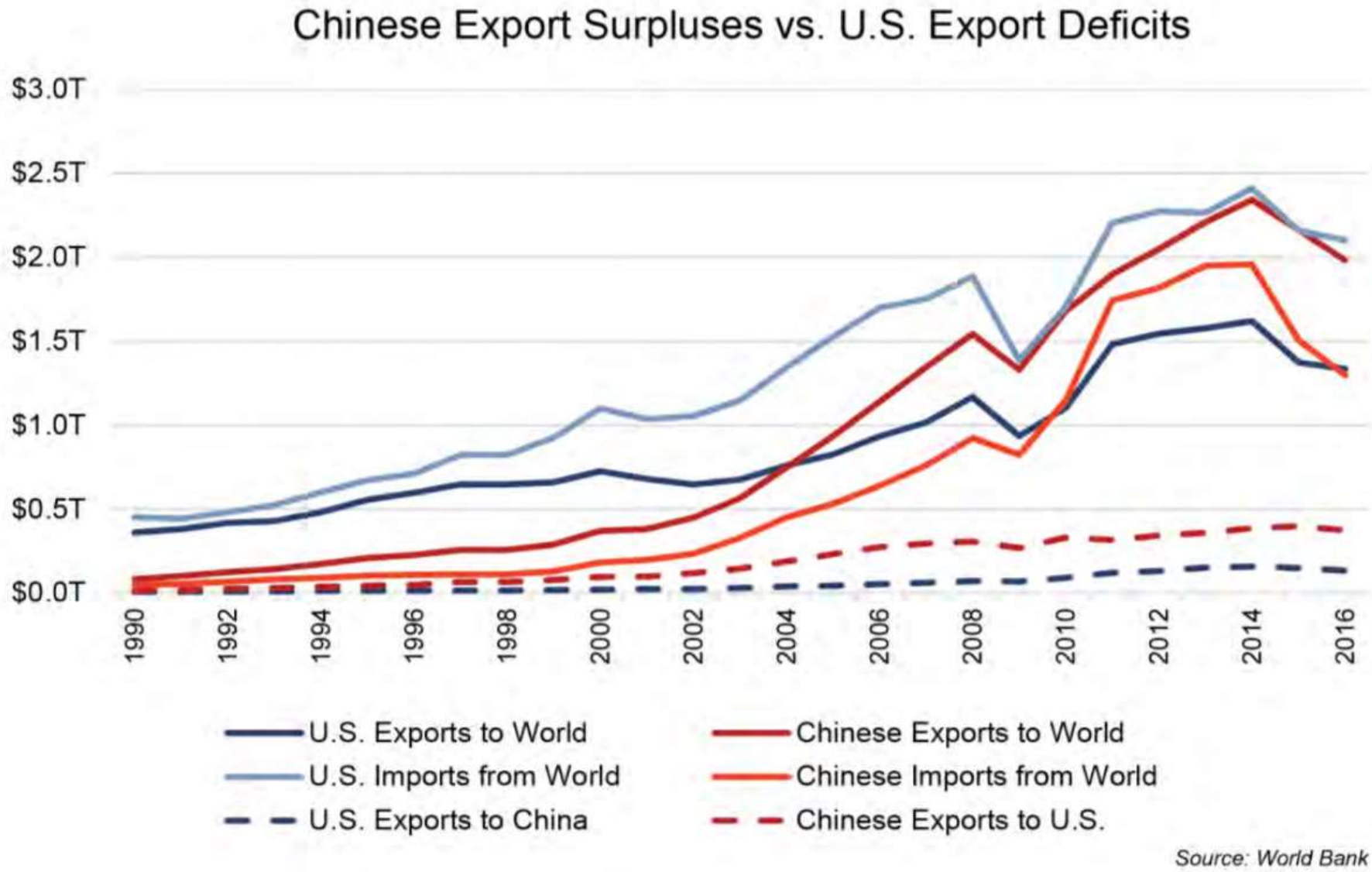
Michael F. Martin, *What's the Difference?—Comparing U.S. and Chinese Trade Data*, Congressional Research Service, RS22640, Updated March 20, 2019, https://crsreports.congress.gov , pp. 2-3.

Merchandise exports and imports of the U.S. and Chinese economies: July 2017-March 2019

(Year-on-year percentage change in US$ values)

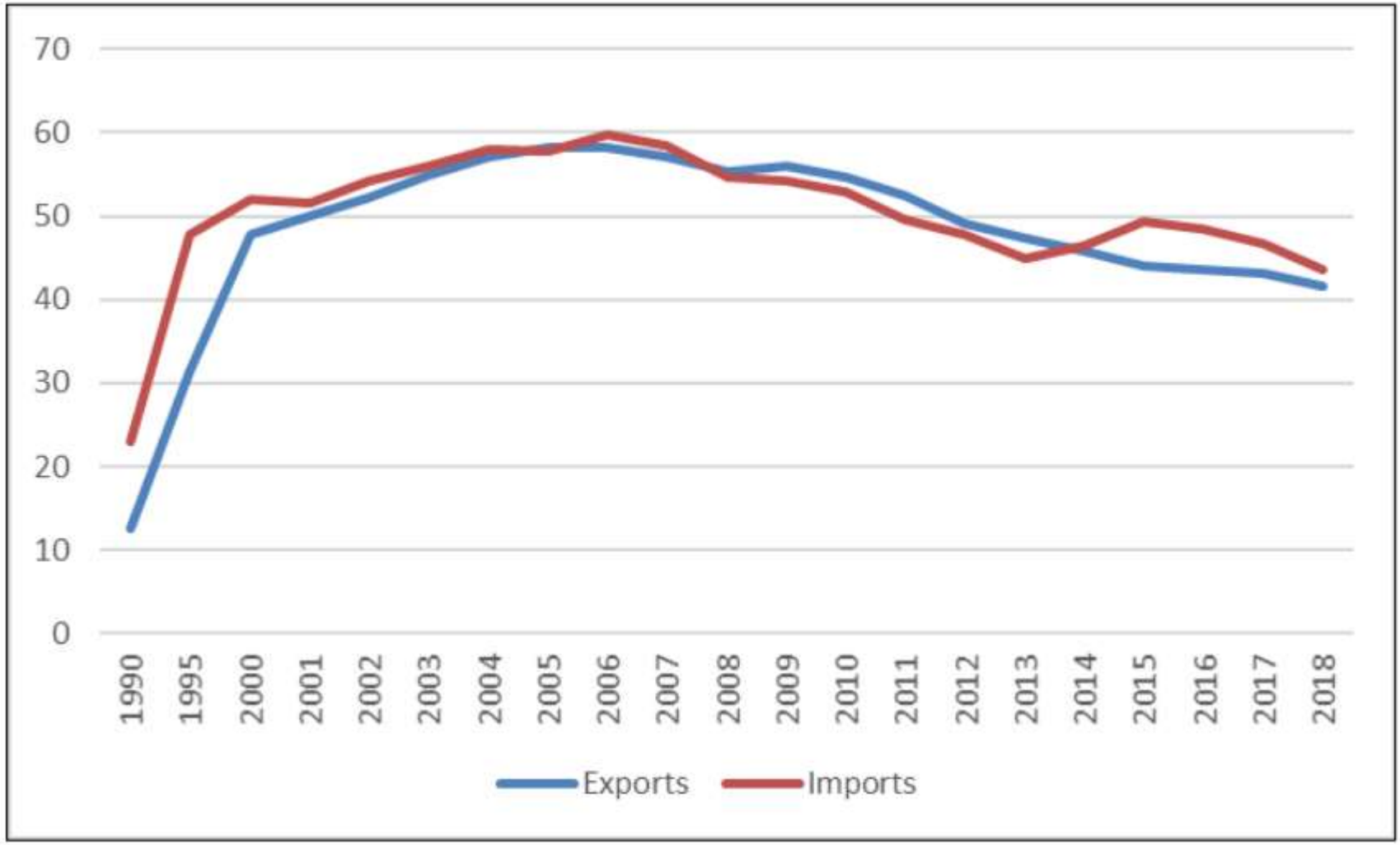


Source: World Trade Organization, *World Trade Statistical Review*, Updated May 31, 2019, https://www.wto.org/english/res_e/statis_e/wts2019_e/wts2019_e.pdf, pp. 22.



Source: *Assessing and Strengthening the Manufacturing and Defense Industrial Base and Supply Chain Resiliency of the United States*, Report to President Donald J. Trump by the Interagency Task Force in Fulfillment of Executive Order 13806, Department of Defense, September 2018, p. 35

Share of Chinese Merchandise Exports and Imports by Foreign-Invested Enterprises in China: 1990-2018

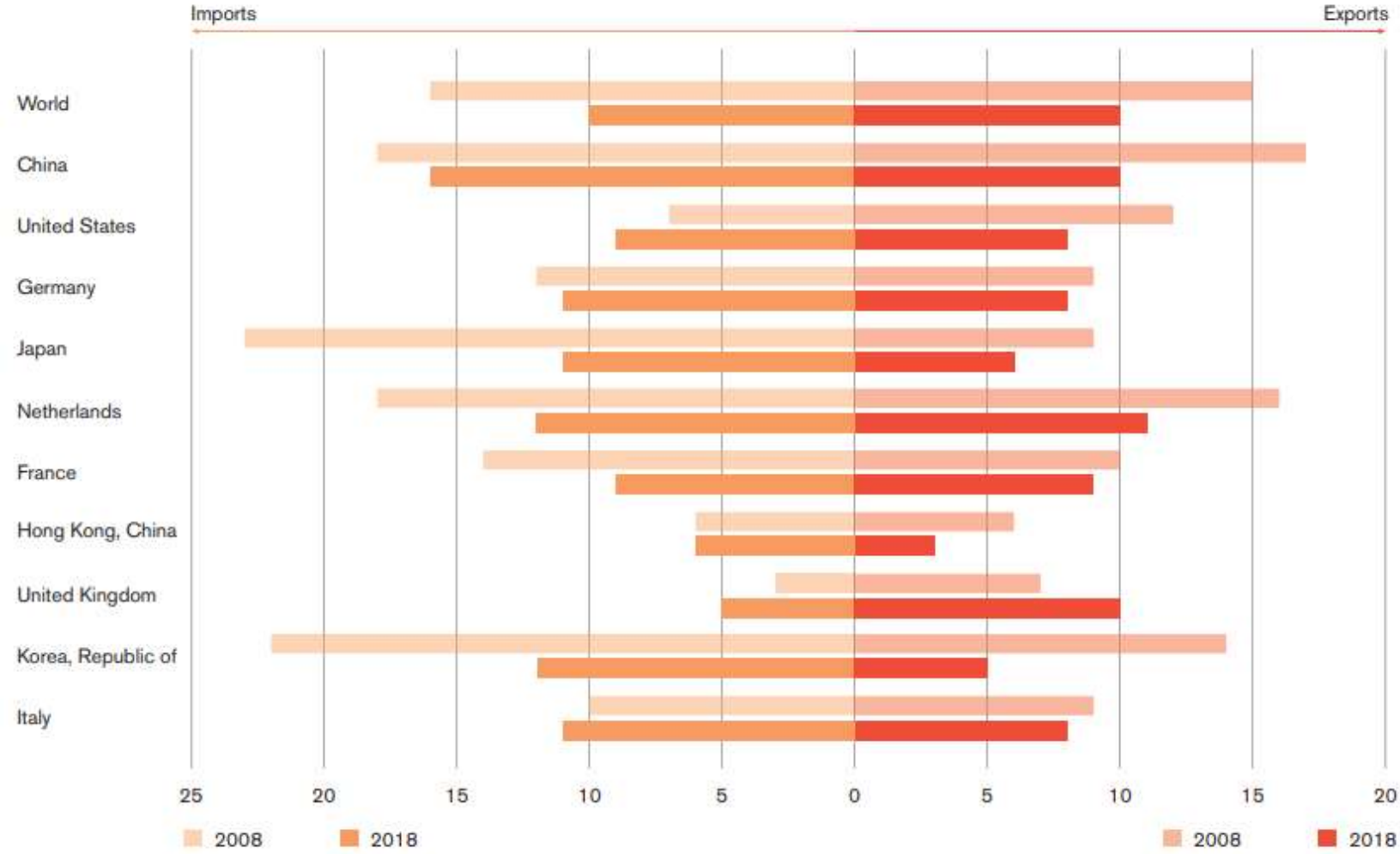


Source: Invest in China (http://www.fdi.gov.cn).

Source: Wayne M. Morrison, *China's Economic Rise: History, Trends, Challenges, and Implications for the United States*, Congressional Research Service, Updated June 25, 2019, https://crsreports.congress.gov, RL33534, pp. 15.

Leading Merchandise Traders: 2008 and 2018

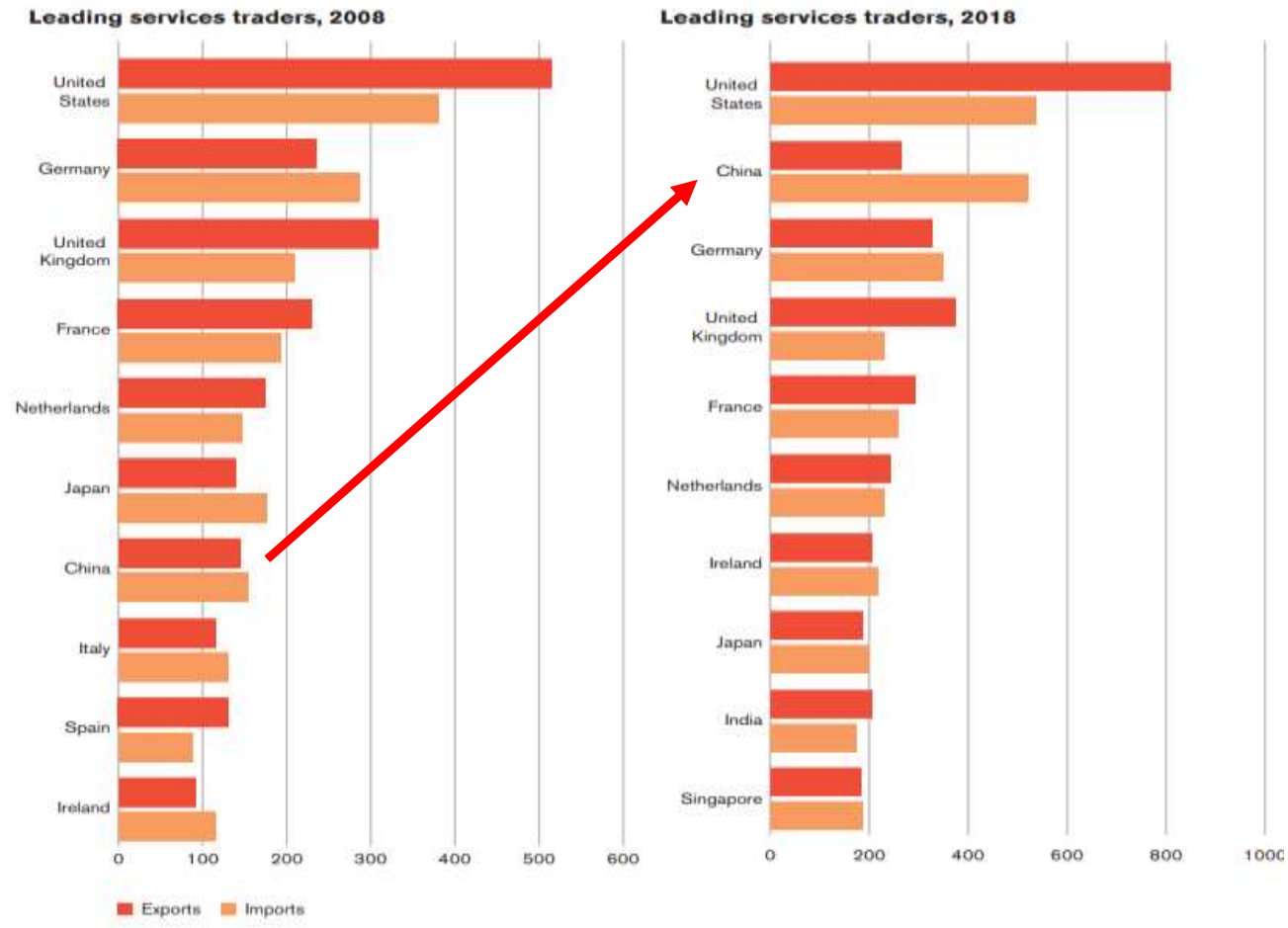
(Annual Percentage in Trade Growth)



Source: WTO-UNCTAD estimates.
Note: The traders are shown in the order of their world ranking in 2018. Ranking is based on total trade, calculated as the sum of exports and imports.

Source: World Trade Organization, *World Trade Statistical Review*, Updated May 31, 2019, https://www.wto.org/english/res_e/statis_e/wts2019_e/wts2019_e.pdf, pp. 48.

Growth in Chinese Commercial Services Trade: 2008-2018
(US$ billion)



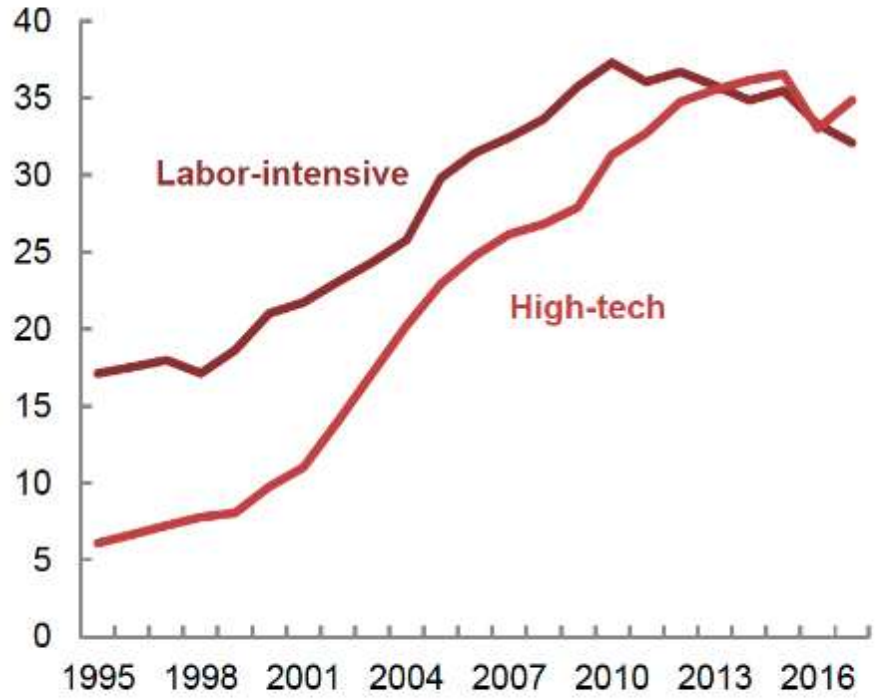
Source: WTO-UNCTAD-ITC estimates.
Note: The order in the chart reflects the economies' ranking in total trade in commercial services (exports plus imports) in the respective year.

Source: World Trade Organization, *World Trade Statistical Review*, Updated May 31, 2019, https://www.wto.org/english/res_e/statis_e/wts2019_e/wts2019_e.pdf, pp. 50.

Shift to Trade in Higher Technology Exports: 2005-2015

China's share in labor-intensive and high-tech in gross exports

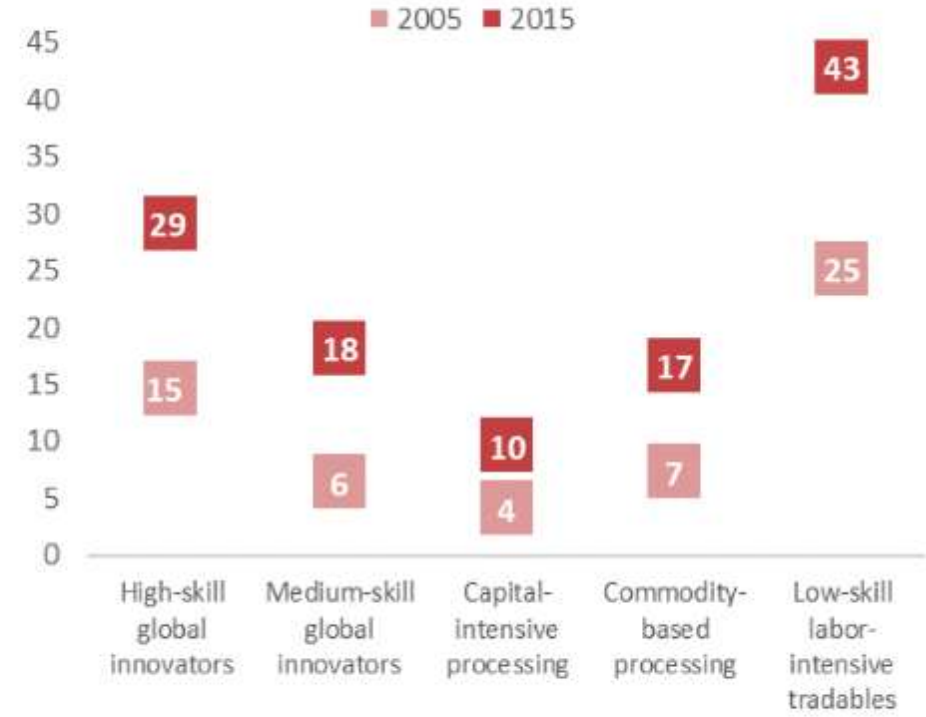
(percent of global market)



Note: Labor-intensive and high-tech are defined in the text.
Source: UN Comtrade and World Bank staff calculations.

China's share of manufacturing exports by domestic value added

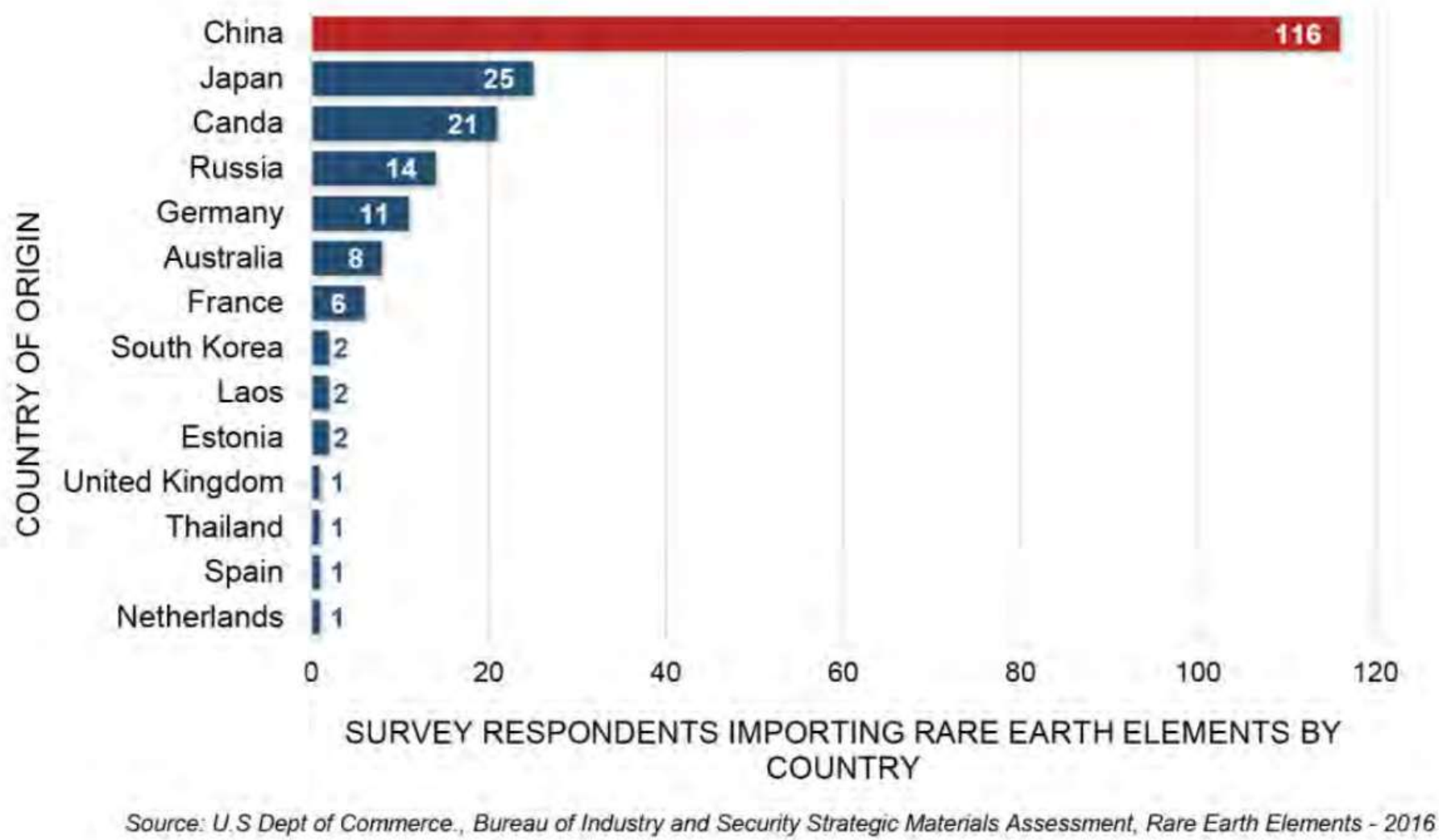
(percent of global market)



Source: OECD-WTO TiVA and World Bank staff calculations.

Source: World Bank, *China Economic Update*, May 2015, p. 7.

Rare Earth Supply by Import Source

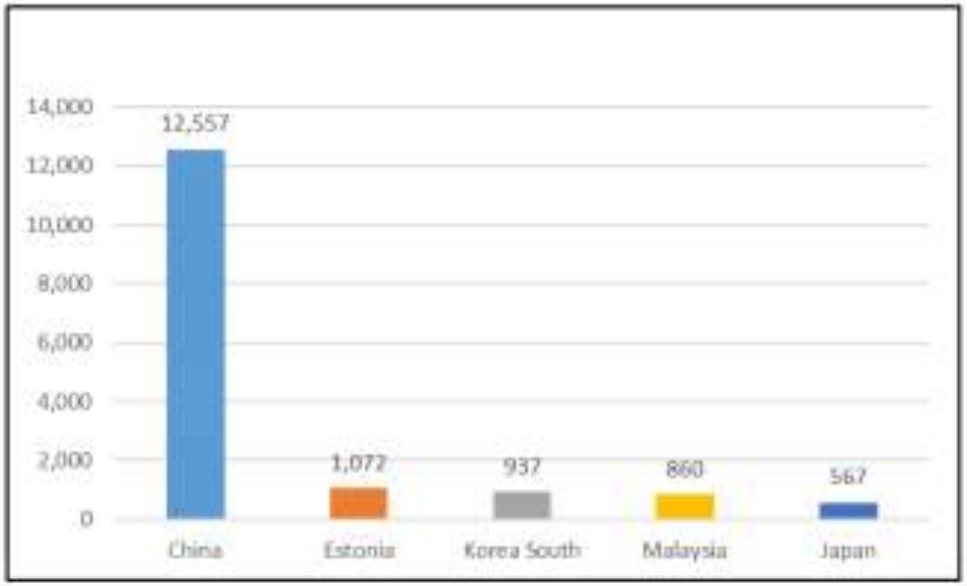


Source: *Assessing and Strengthening the Manufacturing and Defense Industrial Base and Supply Chain Resiliency of the United States*, Report to President Donald J. Trump by the Interagency Task Force in Fulfillment of Executive Order 13806, Department of Defense, September p. 16

U.S. Rare Earth Elements Dependence on China in 2018

Figure 1. Top Suppliers of U.S. REE: 2018

Metric Tons



Source: USITC Dataweb.

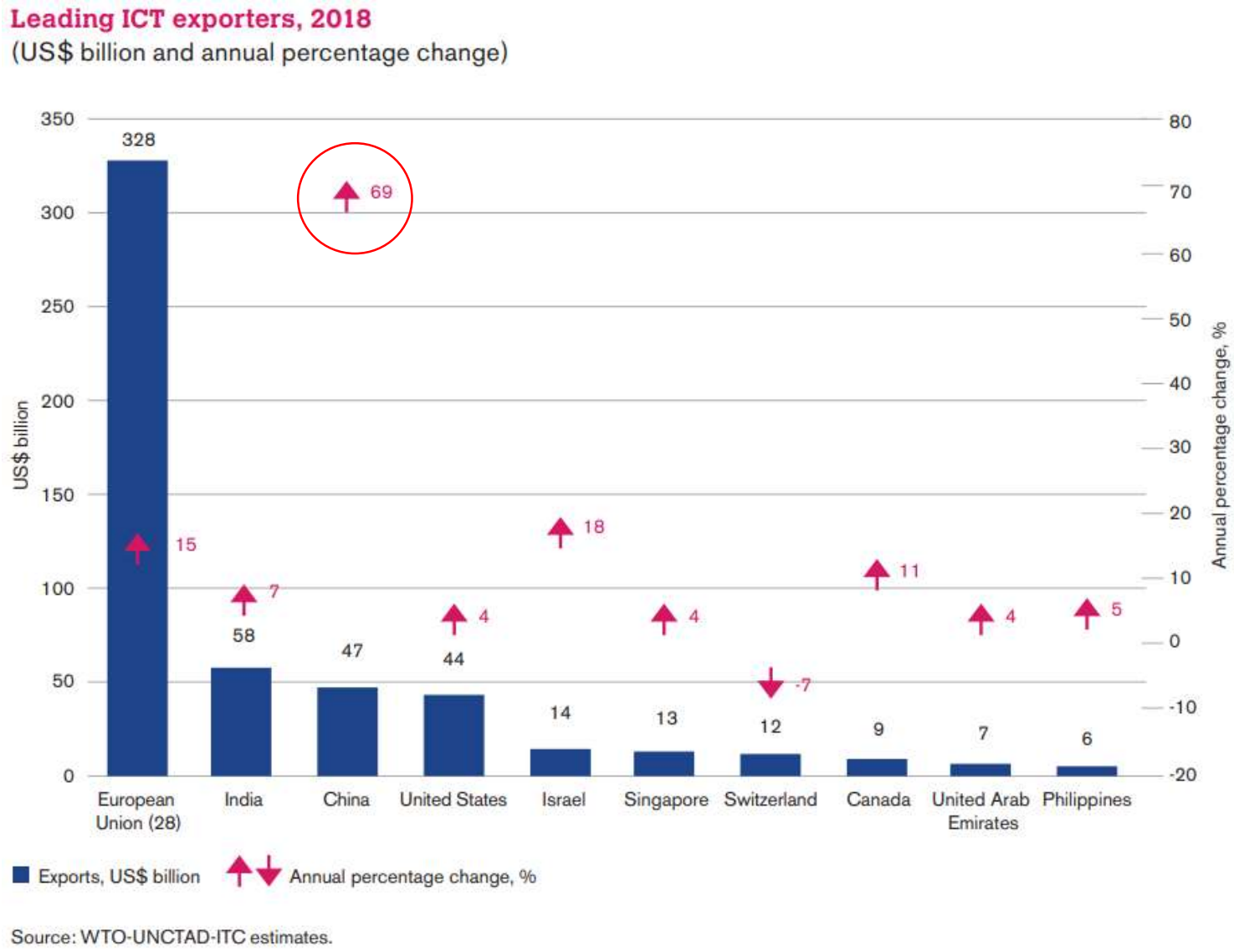
According to the U.S. Geological Survey (USGS), in 2018, China accounted for 71% (and possibly higher due to illegal mining, production, and smuggling in China) of global REE production in terms of quantity. Chinese data indicate that its REE exports totaled 53,518 metric tons, with a value of $517 million. China's top three REE exports markets by value were Japan (54% of total), the United States (14%), and the Netherlands (8%). China also exported $1.7 billion worth of magnets containing REEs (including $201 million to the United States), an indicator of the significance of Chinese downstream industries that utilize REEs.

As indicated in **Figure 1**, China was the largest source of U.S. REE imports in terms of quantity at 12,557 metric tons (or 74% of total). China was also the largest U.S. REE supplier in terms of dollar value, at $82 million (or 56%) of the total. (Some U.S. REE imports from non-Chinese sources may have originated in China.) The consulting firm Adamas Intelligence estimates that in 2018 China became the world's largest REE importer (in terms of quantity), including $79 million worth of REE imports (largely REE ores and fluorides).

According to the USGS, the largest U.S. industrial uses of REEs in 2018 were for catalysts (at 60% of total); ceramics and glass (15%); metals and alloys (10%); and polishing (10%) (see Figure 2). Examples of industries that utilize REEs in production include advanced electronics (which involve magnets, batteries, phosphors, polishing, and metal alloys); medical equipment (magnets, batteries, phosphors, and polishing); hybrid and conventional vehicles (magnets, catalysts, and batteries); energy efficient lighting (phosphors); steel (metal alloys); wind turbines (magnets); and chemicals (catalysts). REEs have numerous military applications as well. According to a June 11, 2019, article in Foreign Policy, "Every advanced weapon in the U.S. arsenal—from Tomahawk missiles to the F-35 fighter jet to Aegis-equipped destroyers and cruisers and everything in between—is absolutely reliant on components made using rare earth elements, including critical items such as permanent magnets and specialized alloys that are almost exclusively made in China."

Wayne M. Morrison, *Trade Dispute with China and Rare Earth Elements,* Congressional Research Service, IF11259, Updated June 28, 2019, https://crsreports.congress.gov, pp. 1-2.

Growth in Chinese Information and Communication Technology (ICT) Exports



Source: World Trade Organization, *World Trade Statistical Review*, Updated May 31, 2019, https://www.wto.org/english/res_e/statis_e/wts2019_e/wts2019_e.pdf, pp. 40.

Chinese Defense Industrial Base in 2019 - I

Defense Industry Reform

China's defense-industrial complex continues to adapt and reorganize in an effort to improve weapon system research, development, and production to compensate for an estimated lag of one to two generations behind its main competitors in the global arms industry. Over the past 2 years, China has undertaken organizational and policy measures to reenergize the military's work on defense research and innovation through cooperation with the market sector.

In 2016, the CMC established the Science and Technology Commission, a high-level defense research body, as an independent organization under the high command. It also emphasized the importance of "civil-military integration," a phrase used in part to refer to the leveraging of dual-use technologies, policies, and organizations for military benefit.

In March 2016, President Xi underscored this message by emphasizing defense innovation during a visit with the PLA's delegation to the National People's Congress. He urged "great attention to the development of strategic, cutting-edge technologies" for the military, among other subjects.

China's 13th Five-Year Plan (2016-2020) includes the establishment of focus areas for research, development, and innovation. Several of these have defense implications: aerospace engines—including turbofan technology—and gas turbines; quantum communications and computing; innovative electronics and software; automation and robotics; special materials and applications; nanotechnology; neuroscience, neural research, and artificial intelligence; and deep-space exploration and on-orbit servicing and maintenance systems. Other areas where China is concentrating significant R&D resources include nuclear fusion, hypersonic technology, and the deployment and "hardening" of an expanding constellation of multipurpose satellites. China's drive to expand civil-military integration and international economic activity supports these goals.

The National Natural Science Foundation of China (NSFC), the China Academy of Sciences, and the Ministry of Science and Technology fund and promote basic and applied research, scientific innovation, and high-technology integration throughout China's scientific, engineering, and civil-military industrial complex. The China Academy of Sciences, working closely with the NSFC, is the highest academic institution for comprehensive R&D in the natural and applied sciences in China and reports directly to the State Council in an advisory capacity, with much of its work ultimately funding disciplines and contributing to products for military use.

DIA, *China Military Power, Modernizing a Force to Win - 2019*, Department of Defense, 2019, pp. 105-106.

Chinese Defense Industrial Base in 2019 - II

Major Production-Sector Snapshots

Missile and Space. China's missile programs, including its ballistic and cruise missile systems, are comparable to those of other international top-tier producers. China's production of a wide range of ballistic, cruise, air-to-air, and surface-to-air missiles for the PLA and for export has probably been enhanced by upgrades to primary assembly and solid rocket motor production facilities. China has also purchased Russia's S-400 air defense system and received its first delivery in April 2018. China's space launch vehicle industry is expanding to support commercial and rapid satellite launch services and the manned space program.

Naval/Shipbuilding. China is the top ship-producing nation in the world and has increased its shipbuilding capacity and capability for all types of naval projects, including submarines, surface combatants, naval aviation, sealift, and amphibious assets. China's two largest state-owned shipbuilders—the China State Shipbuilding Corporation and China Shipbuilding Industry Corporation— collaborate in shared ship designs and construction information to increase shipbuilding efficiency. China continues to invest in foreign suppliers for some propulsion units but is becoming increasingly self-sufficient.

Armaments. China's production capacity continues to advance in almost every area of PLAA systems, including new versions of main battle tanks and new light tanks, armored personnel carriers, assault vehicles, air defense artillery systems, and artillery pieces. China is capable of producing ground weapon systems at or near world-class standards; however, quality deficiencies persist with some export equipment.

Aviation. China's aviation industry has advanced to produce a developmental large transport aircraft, modern fourth- to fifth-generation fighters incorporating low-observable technologies, modern reconnaissance and attack UAVs, and attack helicopters. China's commercial aircraft industry has invested in high-precision and technologically advanced machine tooling and production processes, avionics, and other components applicable to the production of military aircraft; however, China's aircraft industry remains reliant on foreign-sourced components for dependable, proven, high-performance aircraft engines. China's infrastructure and experience related to the production of commercial and military aircraft are improving because of the country's ongoing C919 commercial airliner and Y-20 large transport programs.

DIA, *China Military Power, Modernizing a Force to Win - 2019*, Department of Defense, 2019, pp. 105-106.

China's Evolving Precision Strike Capability

Short-Range Ballistic Missiles (300-1,000 km). The PLA Rocket Force has approximately 1,200 SRBMs. The force fields advanced variants with improved ranges and accuracy in addition to more sophisticated payloads, while gradually replacing earlier generations that do not possess true precision strike capability.

Medium-Range Ballistic Missiles (1,000-3,000 km). The PLA is fielding approximately 200-300 conventional MRBMs to increase the range at which it can conduct precision strikes against land targets and naval ships operating far from China's shores out to the first island chain.

Intermediate-Range Ballistic Missiles (3,000-5,500 km). The PLA is developing a nuclear and conventional road-mobile IRBM, which increases its capability for near-precision strike as far as the "second island chain." The PLAN also is improving its over-the-horizon (OTH) targeting capability with sky wave and surface wave OTH radars, which can be used in conjunction with reconnaissance satellites to locate targets at great distances from China, thereby supporting long-range precision strikes, including employment of ASBMs.

Land-Attack Cruise Missiles. The PLA continues to field approximately 200-300 air- and ground-launched LACMs for standoff precision strikes. Air-launched cruise missiles include the YJ-63, KD-88, and the CJ-20 (the air-launched version of the CJ-10 GLCM). China recently adapted the KD-88 LACM, which has an advertised range of more than 100 km, and may be testing a longer-range version. China also is developing the CM-802AKG LACM, an export system that can strike both land and ship targets from fighters or bombers.

Ground-Attack Munitions. The PLAAF has a small number of tactical air-to-surface missiles (ASM) as well as precision-guided munitions including all-weather, satellite-guided bombs, anti-radiation missiles, and laser-guided bombs. China is developing smaller-sized ASMs such as the AR-1, HJ-10 anti-tank, Blue Arrow 7 laser-guided, and KD-2 missiles in conjunction with its increasing development of UAVs. China is also adapting to UAV Global Positioning System-guided munitions such as the FT-5 and LS-6 that are similar to the U.S. Joint Direct Attack Munitions (JDAM).

Anti-Ship Cruise Missiles. China deploys a wide range of advanced ASCMs with the YJ-83 series as the most numerous, which are deployed on the majority of China's ships as well as multiple aircraft. China has also outfitted several ships with YJ-62 ASCMs and claims that the new LUYANG III class DDG and future Type 055 CG will be outfitted with a vertically launched variant of the YJ-18 ASCM. The YJ-18 is a long-range torpedo-tube-launched ASCM capable of supersonic terminal sprint which has likely replaced the older YJ-82 on SONG, YUAN, and SHANG class submarines. China has also developed the long range supersonic YJ-12 ASCM for the H-6 bomber. At China's military parade in September 2015, China displayed a ship-to-ship variant of the YJ-12 called the YJ-12A. China also carries the Russian SS-N-22 SUNBURN on four Russian built SOVREMENNYY-class DDGs and the Russian SS-N-27b SIZZLER on eight Russian built KILO-class submarines.

Anti-Radiation Weapons. China is starting to integrate an indigenous version of the Russian Kh-31P (AS-17), known as the YJ-91, into its fighter-bomber force. The PLA imported Israeli-made HARPY UAVs and Russian-made anti-radiation missiles during the 1990s.

Artillery-Delivered High Precision Munitions. The PLA is developing and deploying artillery systems with the range to strike targets within or even across the Taiwan Strait, including the PHL-03 300 mm multiple-rocket launcher (MRL) (greater than 100 km range) and the longer-range AR-3 dual-caliber MRL (out to 220 km range).

Source: Department of Defense, Chinese Military Power, 2017, p. 57.

China's Changing Technology Base and Search for Parity and Leadership

China's Changing Technology Base

China has set extremely ambitious goals for expanding and modernizing its overall technology base and reaching parity with the United States in virtually all of the critical areas affecting military technology. The slides in this section illustrate the scale of China's declared ambitions, and they set a goal of near parity in 2030 and taking the lead by 2050.

Once again, experts differ sharply about the levels of progress China has already made and can achieve over time, and these differences often involve areas where there are no precise metrics that clearly distinguish between the level of effort and the resulting quality of the result.

The World Bank analysis quoted in this section seems to provide an objective overview of both the progress made and the challenges still to come, but much will depend on what is actually deployed as distinguished from the potential of the technology base, and relative cost may well be as important a consideration as sheer performance.

The spending trends do seem to favor China, and so does the massive Chinese investment in technical education. What is less clear is the quality of the resulting education and investments in given areas of technology. Some data seem to favor China, while other data raise questions about the quality of the effort to date.

China's 70th Anniversary White Paper on Technology - I

In 2018, China's R&D spending accounted for 2.19 percent of GDP. According to the Global Innovation Index (GII) released by the World Intellectual Property Organization (WIPO) and other organizations, China continued its rise in 2019, moving from 17th in 2018 to 14th (see Box 5); it is the only middle-income economy in the top 20. In the field of high technology, China is catching up and getting ahead. Quantum communications, supercomputing, aerospace, artificial intelligence, fifth-generation mobile network technology (5G), mobile payment, new energy vehicles, high-speed rail, and financial technology are sectors in which China leads the world. (WIPO, Cornell University and INSEAD, "The Global Innovation Index 2019", July 2019.)

…According to the 2019 GII report issued by WIPO and others, the Bloomberg New Economy Forum Survey, and the KPMG Technology Industry Innovation Survey, China continues to improve its global ranking in innovation.

First, China's capability in innovation has continuously improved. China's GII has risen for four years in a row, moving to 14th this year and being the only middle-income economy in the top 20, according to the GII report.

Second, China's science and technology clusters are rising collectively. Eighteen science and technology clusters in China are among the top 100 in the world, an increase of two over last year. This is second only to the United States, which has 26 clusters in the top 100. Among them, the Shenzhen-Hong Kong cluster ranks second and the Beijing cluster ranks fourth. The rankings of almost all Chinese clusters are on the rise compared with last year. According to a Bloomberg survey of global business professionals, 39 percent of respondents believe that Beijing will become the world's top tech city by 2035, and 26 percent believe that Shanghai will become the world's center of technological innovation in the future.[1]

Third, the quality of innovation in China has further improved. The GII report points out that the focus of current global competition for innovation has shifted from quantity to quality. China ranks 15th in terms of innovation quality, and has ranked first among middle-income economies for the past seven years. It is also the only middle-income economy that has narrowed the gap with high-income economies in terms of the quality of universities, internationalization of local inventions, and the quality of scientific publications, measured by the number of citations that locally produced research documents receive abroad. The quality of Chinese universities ranks third only to the United States and the United Kingdom. China ranks first among the middle-income economies in international patents and the quality of scientific publications. Its innovation input-output performance is close to or higher than that of some high-income economies, and it is on a par with Germany, the UK, Finland, Israel and the US in terms of innovation output. China's industrial designs, trademark applications, and exports of high-tech and creative products are surging ahead. The number of patent applications for inventions in China has soared from 10,000 in 1990 to 1.38 million in 2017.

Fourth, China is more optimistic about technological innovation. The United States and China have the greatest potential to develop disruptive technology breakthroughs that will have a global impact, according to surveys by Bloomberg and KPMG. China is more optimistic about technological innovation, arguing that technology promotes the shaping of a better world, which is why China has been able to catch up with and surpass Western countries in some areas of technology.

China's communications technology bridges the global "digital gap". Chinese telecommunications enterprises actively "go global" and strive to promote global digitization, so as to benefit more people around the world. By 2018, Huawei was supporting more than 1,500 networks in more than 170 countries and regions, providing smooth communication to more than 3 billion people around the world.[1] It had provided communication solutions to remote mountain areas in dozens of countries, including Ghana, Nigeria, Kenya and Algeria, serving a rural population of 40 million. As of June 2019, Huawei had secured 50 5G commercial contracts worldwide and delivered more than 150,000 base stations.

*China and the World in the New Era***,** The State Council Information Office of the People's Republic of China, September 2019, pp. 15-16, 22

China's 70th Anniversary White Paper on Technology - II

…The ongoing fourth technological revolution will have immeasurable impact on a new wave of economic globalization and on the development of human society, bringing unprecedented opportunities for development as well as serious challenges. All countries should join together and take prompt action in building a new framework for global governance with the vision of a global community of shared future. We need to establish relevant rules and standards that facilitate technological innovation and development while ensuring the bottom line of human security. We should accommodate the interests of all countries and in particular those of the developing countries. It is unfair to apply the standards and security rules of developed countries or individual countries to all the other countries. It is essential to respect the sovereignty of every country. No country should seek technological hegemony, interfere in the domestic affairs of other countries, or engage in, connive in, or shield technological activities that undermine other countries' security. Based on multilateralism, mutual respect and mutual trust, all countries should conduct extensive dialogue and cooperation, and build a system of technological rules and a framework for international cooperation that ensure peace, security, democracy, transparency, inclusiveness and benefits for all. It is necessary for all countries to uphold social equity and justice, place technological innovation under the rule of law and internationally recognized norms, and ensure that innovation is by the people, for the people, and consistent with human values.

*China and the World in the New Era***,** The State Council Information Office of the People's Republic of China, September 2019, pp. 15-16, 22

Xi-Jinping's Innovation-Driven Strategy

In May 2016, nearly a decade after China's strategic push towards indigenous innovation, Xi Jinping re-emphasized the importance of S&T innovation at a National S&T Innovation Conference, stating, "if science and technology flourish, the nation will flourish, and if science and technology are strong, the country will be strong." Xi's speech extolled indigenous S&T innovation as key to modernizing China's military, ensuring its national security, and ushering in sustainable socioeconomic development. S&T advances in the commercial sector are increasingly influencing China's future military modernization, as Xi pushes greater military-civilian collaboration.

> In early 2017, the Ministry of Science and Technology (MOST) and the Central Military Commission Science and Technology Commission jointly announced the "13th Five-Year Plan–Military-Civilian Fusion S&T Developmental Guide," a roadmap for military-civilian fusion efforts in the next five years.

> In October 2017, Xi Jinping highlighted at the 19th Party Congress the importance of the strategy to revitalize the country through science, education and innovation-driven breakthroughs and the strategy of military-civilian integrated development – both key to complete building a well-off society with a great Chinese military and a modernized economic system.

The ultimate goal of S&T modernization is to rejuvenate China by 2050 as an S&T powerhouse. For the next 30 years, China's leaders have arranged its innovation-driven development strategy into the following four major milestones:

2020: Advance domestic competence for global innovation competition. The ability to rank side-by-side with other innovation-driven countries remains a top priority under Xi Jinping. These development goals center on upgrading the industrial economy (including modern agriculture, clean and efficient energy, and 5th generation mobile telecommunications networks), building science innovation parks, and attracting top-tier researchers. China intends these projects to further advance China's global ranking and to strengthen defense technology development between the military and civilian sectors.

2025: Reduce reliance on foreign technology. In October 2015, China's State Council published the *Made in China 2025* plan, outlining development trajectories to establish and promote China-made components, create well-known Chinese brands, and increase the domestic and international market share in 10 strategic industries. The plan aims to develop internationally competitive leading enterprises; improve technical, equipment, and quality standards to international levels; and create a long-term industrial supply chain and perfect mass production. To achieve core technology breakthroughs, the plan incentivizes accumulating patents, increasing Chinese intellectual property, and establishing engineering platforms and collaborative innovation centers for S&T. The 10 strategic industries are:

1) New generation information technology;
2) High-grade machine tooling and robotics;
3) Aerospace equipment;
4) Marine engineering equipment;
5) Advanced rail transportation equipment;
6) New-energy automobiles;
7) Electric power equipment;
8) Agricultural equipment;
9) New materials; and,
10) Biomedicine.

2030: Make milestone contributions to the global scientific community. Striving to take the lead on breakthroughs in important S&T areas, China's 13th Five-Year Program outlines major S&T Innovation Projects for 2030 to benefit both the Chinese economy and its military. Projects include AI 2.0, national cyberspace security, aircraft engines and combustion turbines, quantum computing and quantum communication, advanced manufacturing, clean and efficient energy production, green technologies and environmental solutions, agriculture advances, biology and health, resource management in both space and ocean, and deep-earth exploration.

> China's AI 2.0 project moves beyond its focus with AI 1.0, which centered solely on discovering AI, to focus on the networking and intelligentization of the entire industry chain. In July 2017, China published a national AI blueprint that lays out its R&D trajectory to achieve major breakthroughs in the AI field and become the world's primary AI innovation center by 2030.

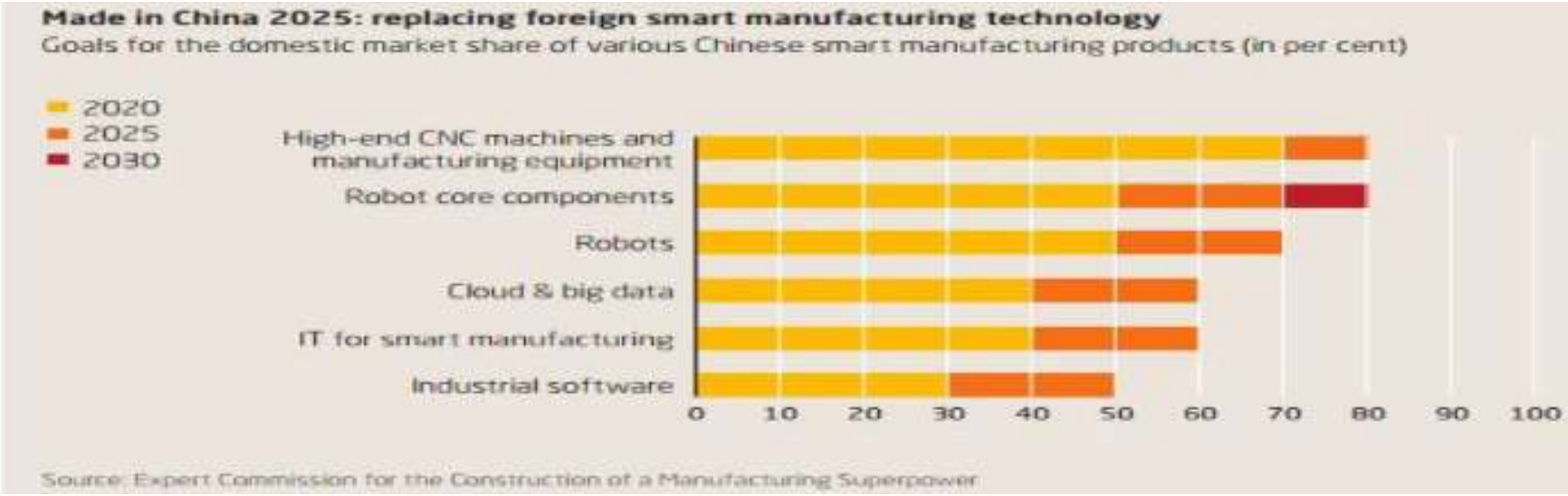
2050: Lead and dominate as the S&T powerhouse. China's long-term objective remains to become the global leader in innovative scientific development. Major milestones focus on S&T popularization by training S&T personnel, fostering a favorably education environment for cultivating S&T talent, and strengthening intellectual property protection. As Xi stated, "without generally raising the scientific quality of all the people, it will be difficult to establish a huge high-quality innovation army."

China's push for leadership in global S&T development comes at a time in which dual-use technology advances, applicable for both commercial and military purposes, increasingly occur in the commercial sector. This means that efforts by China to cultivate a broad base of S&T talent, particularly given its stated focus on dual-use sectors, will be relevant to China's military power in coming decades. Specific examples include advanced computing, essential for weapons design and testing, industrial robotics, potentially useful for improving weapons manufacturing; new materials and electric power equipment, which could contribute to improved weapon systems; next generation information technology, which could enable improved C4ISR and cyber capabilities; commercial directed energy equipment, which could contribute to the development of directed energy weapons; and artificial intelligence, which could contribute to next-generation autonomous systems such as missiles, swarming technology, or cyber capabilities.

Office of the Secretary of Defense, *Military and Security Developments Involving the Republic of China*, Annual Report to Congress, May 16, 2018, Department of Defense. China Military Power 2018, p.121-22.

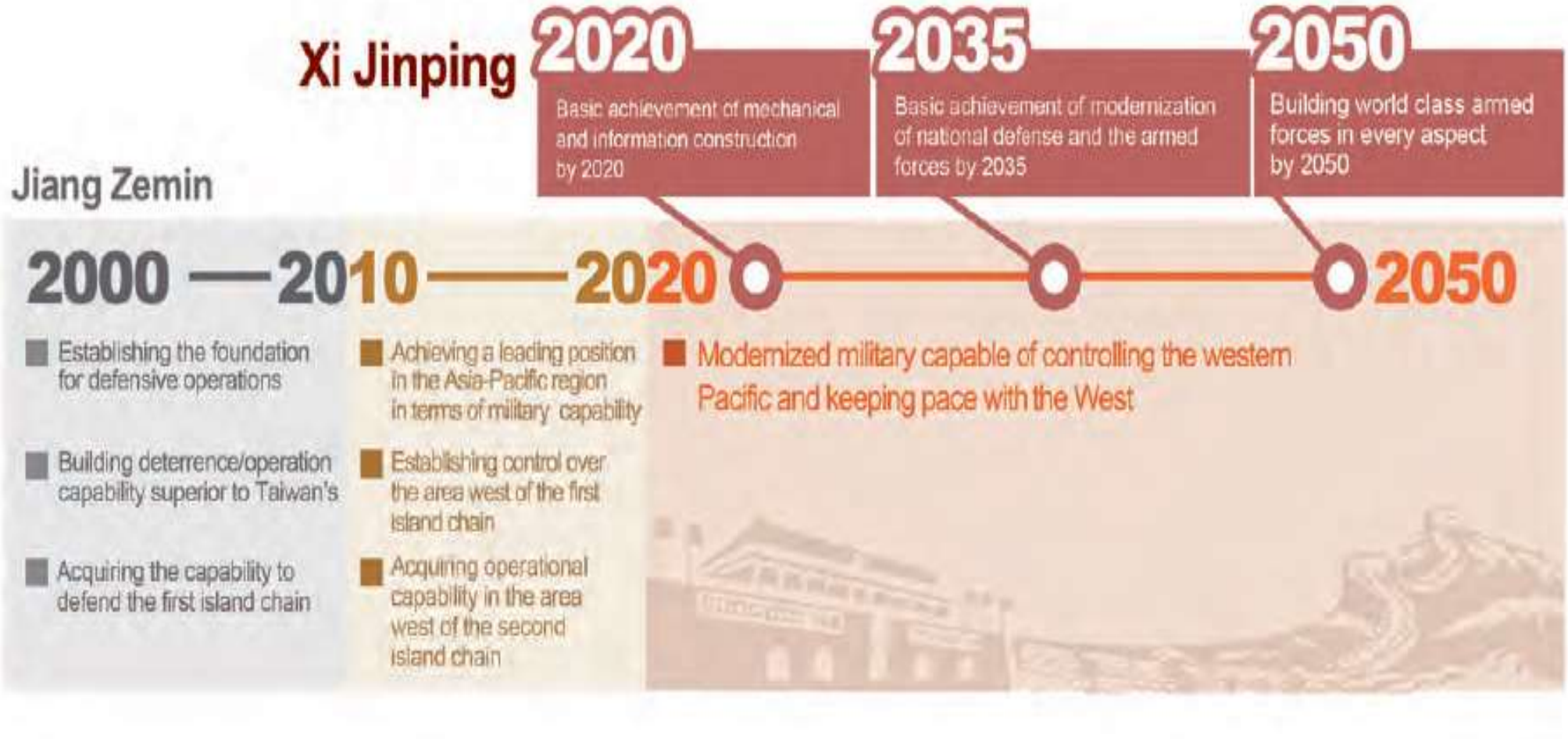
Chinese Technology Goals: 2020? 2025? 2030?

- **2018 - April 26: China's president urges China to speed up its semiconductor strategy in the face of foreign pressure and growing tech demands.**
- **2017 – July, December: Ministry of Industry and Information Technology issues document on goals for development of artificial intelligence from 2018 to 2020, and the top leadership's vision for a new Chinese economy in the age of AI. China will be able to mass-produce neural-network processing chips.**
- **2016 – March: Draft outline of the 13th Five-Year Plan (2016-2020) on national economy and social development presented on Saturday to the Fourth Session of the 12th National People's Congress with more than 21 goals for civilian and military development of technology along with the "Made in China technology plan."**
- **1978 - March 18 to March 31, 6,000 scientific and technical workers from all over China took part in a National Science Conference in Peking.**



Made in China 2025: Global Ambitions Built on Local Protections, U.S. Chamber of Commerce, Beijing, https://www.uschamber.com/sites/default/files/final_made_in_china_2025_report_full.pdf

Taiwan Diagram of Chinese Military Modernization Goals



Taiwan Ministry of Defense, *National Defense Report, 2017*, p. 37

Chinese Technology Goals: 2020? 2025? 2030?

China now has the ability to develop advanced fighters, aircraft carriers, new-generation intercontinental ballistic missiles, drones and other advanced platforms. Another indicator of this progress is China's booming arms exports, which rose 74 percent from a global share of 3.8 percent in 2007–11 to 6.2 percent in 2012–16. While China is still far behind the world's leading arms exporters (the United States and Russia), it is catching up fast.

13th defense Science and Technology and Industry Five-Year Plan (2016–2020). **It calls for streamlining and targeting investment across core areas, accelerating weapons development, raising arms exports and promoting collaboration between military and civilian organizations.**

Another key initiative is the *2025 defense Science and Technology Industry Plan*, which calls for the upgrade of China's defense science and technology base. This is in line with the *Made in China 2025* strategy — a sweeping initiative to overhaul China's manufacturing industry.

Moreover, China outlined a list of sixteen megaprojects in the *Medium- and Long-term Science and Technology Development Plan (2006-2020).* These include advanced numeric-controlled machinery, high-end generic chips, integrated circuit manufacturing and techniques, high-definition earth observation systems, advanced nuclear reactors, manned aerospace and moon exploration, and large aircraft. These projects involve numerous companies and research institutions from China's sprawling defense industry. Technologies developed for every one of these megaprojects would have important military applications in addition to civilian uses.

But despite maturing rapidly over the last two decades, China's defense industry continues to be plagued by notable weaknesses such as outdated management models, weak governance, corruption, inflexibility and monopoly power. These weaknesses will need to be addressed if the industry is to better support PLA modernization in the years ahead.

Adam Ni, Superweaponising China's defense industry, East Asia Forum,
24 February 2018, http://www.eastasiaforum.org/2018/02/24/superweaponising-chinas-defense-industry/

ODNI on China's Development Strategy In 2019

We assess that China's intelligence services will exploit the openness of American society, especially academia and the scientific community, using a variety of means.

Daniel R. Coats, **STATEMENT FOR THE RECORD** WORLDWIDE THREAT ASSESSMENT **of the US INTELLIGENCE COMMUNITY, ODNI** January 29, 2019 p. 14

World Bank Assessment of China's Technology Progress - I

China is still in the technology catching-up phase, and its innovation capabilities and the underlying learning and creative culture may take some time to mature. This assessment is based on various assessments of China's innovation capacity by the INSEAD/World Intellectual Property Organization (WIPO)/Cornell University, the World Economic Forum (WEF), and the Information Technology and Innovation Foundation (ITIF). The Global Innovation Index by INSEAD/WIPO/Cornell University has shown steady improvements for China since 2011: China was ranked 29th in 2011 and improved to 25th in 2016 and 22nd in 2017. According to the WEF, since 2010–11 China's ranking has held steady at around 27th to 28th in overall competitiveness (28th in 2015–16) and 74th in terms of technological readiness, out of 144 countries. China is also the highest ranking developing country according to the WEF assessment. In earlier ITIF reports, China was in 33rd place in a group of 40 countries; in 2016, it was 44th in a sample of 56 countries.[28]

Over the past decade China significantly increased research & development (R&D) spending and patent applications. China spends 2.07 percent of its GDP on R&D (2015). Its total spending on R&D is the second highest in the world after the United States and accounts for over 14.4 percent of the total global spending on R&D. [29] R&D expenditures as a share of GDP is multiples above what is common for a country at China's level of development (Figure 1.9). Industry expenditures on R&D have been increasing and make up the majority of R&D. In line with increased spending on R&D, China's patenting activities have increased rapidly over the last decade. In 2016, the number of applications for patents for invention accepted by the State Intellectual Property Office totaled more than 1.3 million, and according to WIPO, since 2011 China has had the world's largest number of patent applications. Concerns have been expressed regarding the quality of the patents, but there are also indications, such as number of citations, that quality is improving. Increased patenting activities could have been due to multiple factors, including greater investments in R&D and possibly improved intellectual property rights (IPRs) protection, but they may also reflect government incentives to encourage patent registration.

Increased R&D spending has to be complemented by institutional reforms in order for it to improve innovation and productivity. Goni and Maloney [30] showed that returns to R&D is higher in countries that are further away from the global technology frontier, as one would expect given that those countries have more potential to catch-up growth. However, their research also indicated that returns to R&D peak at around higher middle-income countries, and the returns decline for countries that are further away from this peak. This arises because countries that are distant from the frontier lack critical complementary policy and institutional factors, such as research institutes and a private sector of sufficient quality and capacity. Without those factors, simply increasing R&D spending may not result in the desired impact on innovation and productivity.

Source: World Bank Group, *China Systematic Diagnostic, Report 113092-CN, 2017, ,pp. 12-14*

World Bank Assessment of China's Technology Progress - II

The government recognizes the importance of strengthening IPRs for promoting indigenous innovation. Enforcement of IPRs will be critical to creating the incentives to invest in innovation activities. The Action Plan for Carrying Out National Strategy on Intellectual Property Rights (2014–20) specifies that China will "endeavor to build an intellectual property right power to provide powerful support for building an innovation-oriented country and a moderately prosperous society in all respects." It sets a target of 14 patent applications per 10,000 persons by 2020. Chinese government has announced that China will step up enforcement of IPRs and increase the scale of punishment. In August 2014, the Chinese legislature approved a resolution to establish specialized intellectual property (IP) courts in Beijing, Shanghai, and Guangzhou. The establishment of the specialized IP courts is a step in the right direction, but more needs to be done to fundamentally address the issues surrounding IPRs, including strengthening of IPR enforcement. Complementary reforms could include developing more effective platforms for IP valuation and transactions and building the capacity of intermediaries such as technology transfer offices.

The innovation system in China focuses heavily on R&D to generate new innovation and technology, but the vast majority of firms have yet to absorb and adopt existing technology. Most of the firms are far from the technology frontier, and therefore they may benefit the most by focusing on absorbing available technologies rather than creating new and innovative technologies. Hence, in China, large scope may exist for upgrading and strengthening existing low- and medium-technology industries, including through organizational and process innovations. A core underpinning capability of this upgrading is management quality. As industries move up the value chain, they will need to learn to compete on the basis of their intangible assets, such as information and communication technologies (ICTs), organizational structures, design, brand equity, education and training, and sophisticated management. Chinese firms may be exceptionally good with short-run targets, but appear to be relatively weak in the areas of long-run planning and human resource management that are necessary for innovation. [31] Some have argued that, for East Asia's New Industrialized Economies, the firms' organizational capacity for acquiring and learning technology was more important than the conventional R&D.[32] Indications suggest that a good 30 percent of the differences in TFP among countries can be explained by variations in the quality of management.[33]

The government can continue to play a critical role in promoting innovation. Public research institutes and grant financing can play a complementary role to private sector R&D, in particular by carrying out and supporting basic research. Because the focus is on quick returns, too much of the funding for R&D is devoted to development and too little to basic and upstream applied research. Whereas the United States allocates 18 percent of its R&D to basic research and the OECD average is 20 percent, until recently only 5 percent of China's research funding was being used to build a base of scientific knowledge. [34] Project financing could be made more effective by strengthening the project selection process. Improving access to finance for innovation and increasing government procurement for innovative products could also promote investments in innovation. Public research institutes can be strengthened, including with respect to the commercialization of research and collaboration with industry. Fiscal policies (tax credits and subsidies) as well as other financial instruments such as vouchers and grants, technology extension and business advisory services, incubators/accelerators, public procurement, and relaxing of regulatory requirements can encourage greater private sector investments in innovation.

Source: World Bank Group, *China Systematic Diagnostic, Report 113092-CN, 2017, ,pp. 12-14*

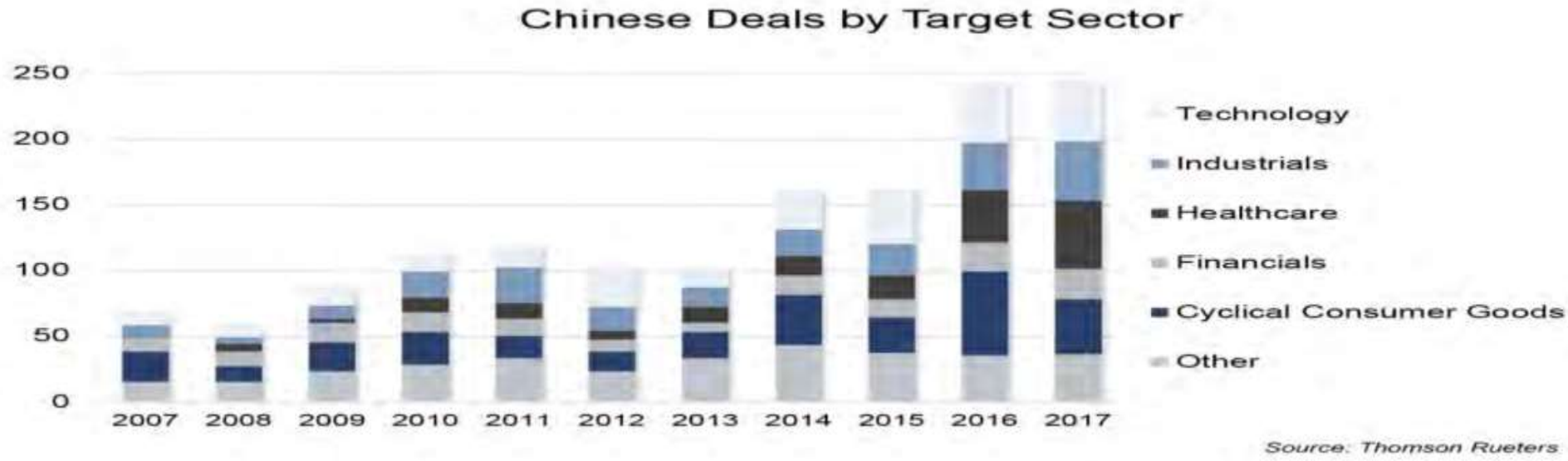
World Bank Assessment of China's Technology Progress - III

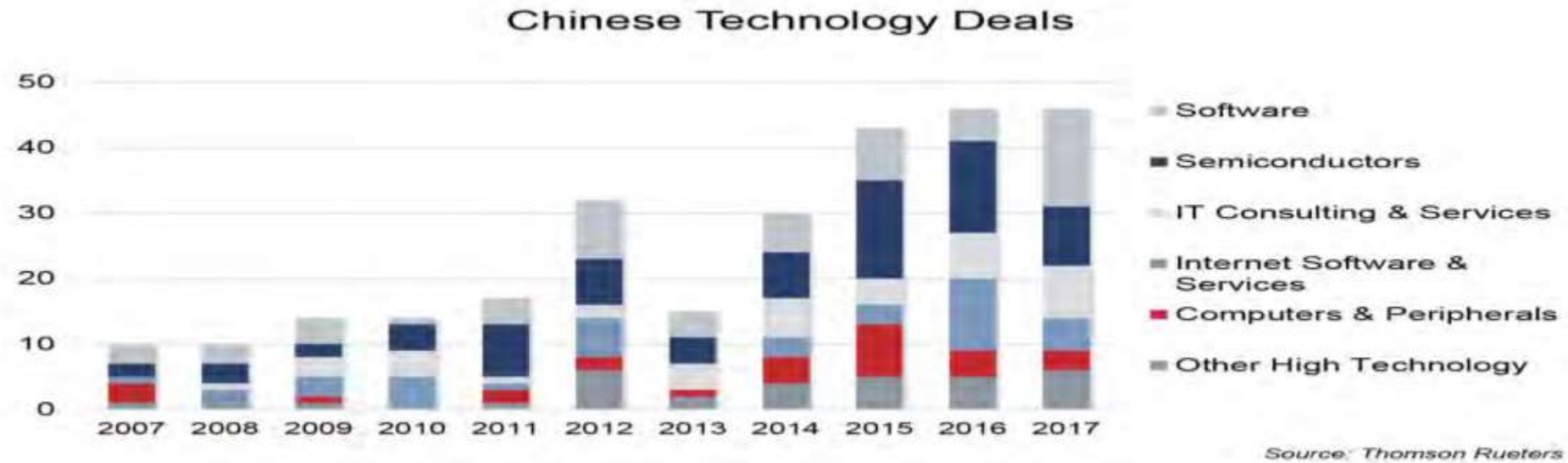
Improving and enlarging the innovation talent pool is pivotal to appropriating gains from innovation. China has many science and engineering (S&E) graduates and Ph.D.'s. The total number of S&E researchers exceeded 3.53 million in 2014, which is greater than in the United States and the European Union (EU) combined. China recognizes the importance of human resources for innovation and is devising various policies to nurture and attract talent. In addition to the previously launched 100 Talents, 1,000 Talents, and 10,000 Talents programs, the government aims to reform parts of the education system to nurture more innovative minds and support innovative research. Mass entrepreneurship is also seen as part of the solution to reduce the unemployment rate of new graduates. This could be complemented with reforms in the technical and vocational educational system.

The success of China's indigenous innovation agenda will ultimately depend on broader market-oriented reforms. The "Decisions on Important Issues Concerning Comprehensive and Far Reaching Reform" issued at the Third Plenum of the 18th Central Committee of the Communist Party of China (November 2013) emphasized that markets will play a decisive role in allocating resources, which represents a significant departure from the previous model of government-led innovation. Private sector development and increased competition, reforms in factor markets, human capital deepening, and the effective harnessing of urban agglomeration economies to advance ideas and technologies are ways to stimulate markets that reward innovation. More targeted interventions could support commercialization of intellectual property by local high-technology industries as well as low- and medium-technology industries increasingly using indigenous innovation.

Source: World Bank Group, *China Systematic Diagnostic, Report 113092-CN, 2017, ,pp. 12-14*

China Targets U.S. Technology with Its Outbound Foreign Direct Investment





Source: *Assessing and Strengthening the Manufacturing and Defense Industrial Base and Supply Chain Resiliency of the United States*, Report to President Donald J. Trump by the Interagency Task Force in Fulfillment of Executive Order 13806, Department of Defense, September 2018, p. 16

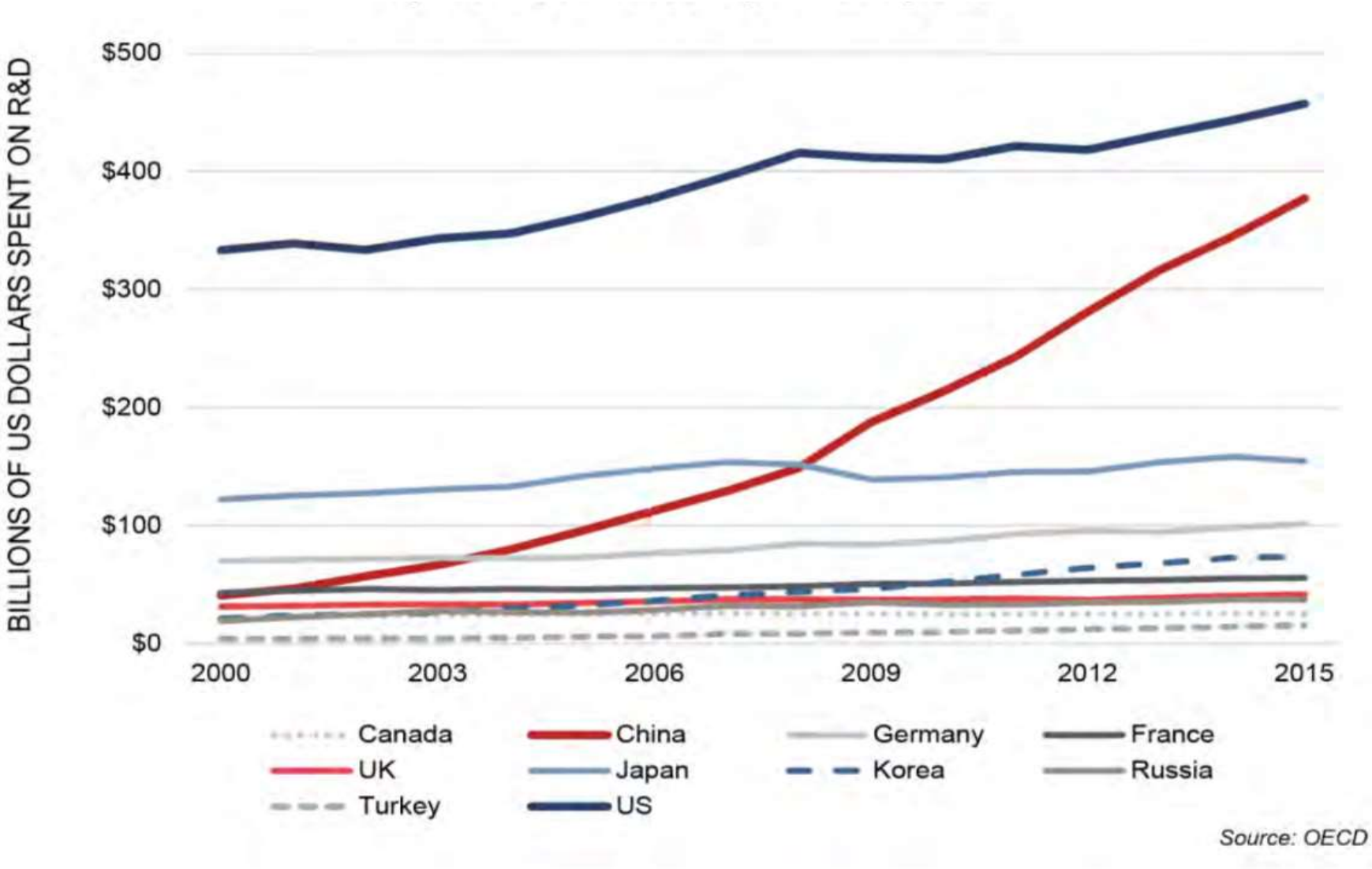
U.S. Responds to Foreign Direct Investment U.S. in "Critical Technologies"

Foreign Direct Investment (FDI). U.S.-China FDI flows are relatively small given the high level of bilateral trade, although estimates of such flows differ. The U.S. Bureau of Economic Analysis (BEA) is the official U.S. agency that collects and reports FDI data. BEA estimates the stock of Chinese FDI in the United States through 2017 at $40 billion and the stock of U.S. FDI in China at $108 billion. Some analysts contend BEA's methodology for measuring FDI significantly undercounts the level of actual U.S.- China FDI, in large part because it does not capture all FDI that is made through other countries, territories, or tax havens, as well as acquisitions made by U.S. affiliates of foreign firms. The Rhodium Group (RG), a private advisory firm, attempts to identify FDI by Chinese firms in the United States, regardless of where they are based or where the money for investment comes from. RG's data on U.S.- China FDI are much higher than BEA's data. For example, RG estimates the stock of China's FDI in the United States through 2017 at $140 billion and the stock of U.S. FDI in China at $256 billion. RG estimates that China's FDI flows to the United States rose from $14.9 billion in 2015 to $45.6 billion in 2016, but fell to $29.4 billion in 2017 and to $4.8 billion in 2018. The decline in Chinese FDI flows to the United States may reflect Beijing's efforts to rein in "irrational" capital outflows, as well as enhanced scrutiny by the Trump Administration, which contends that the Chinese government seeks to obtain U.S. cutting-edge technologies and IP in order to further its industrial policy goals. For example, in September 2017, President Trump prohibited a group of investors with alleged links to the Chinese government from acquiring U.S. firm Lattice Semiconductor Corporation.

Congressional concerns over the ability of the Committee on Foreign Investment in the United States (CFIUS) to adequately screen foreign investment in terms of U.S. national security led to the enactment of the Foreign Investment Risk Review Modernization Act of 2018 (FIRRMA) (P.L. 115-232) in August 2018. The act seeks to modernize CFIUS and expand the types of investment subject to review, including certain non-controlling investments in "critical technology." In November 2018, the U.S. Commerce Department issued a notice requesting public comment on criteria for identifying emerging and foundational technologies deemed essential to U.S. national security that could be subject to new export controls.

Wayne M. Morrison, U.S.-China Trade Issues, Congressional Research Service**, u**pdated June 23, 2019, https://crsreports.congress.gov, IF10030, pp. 1-2**.**

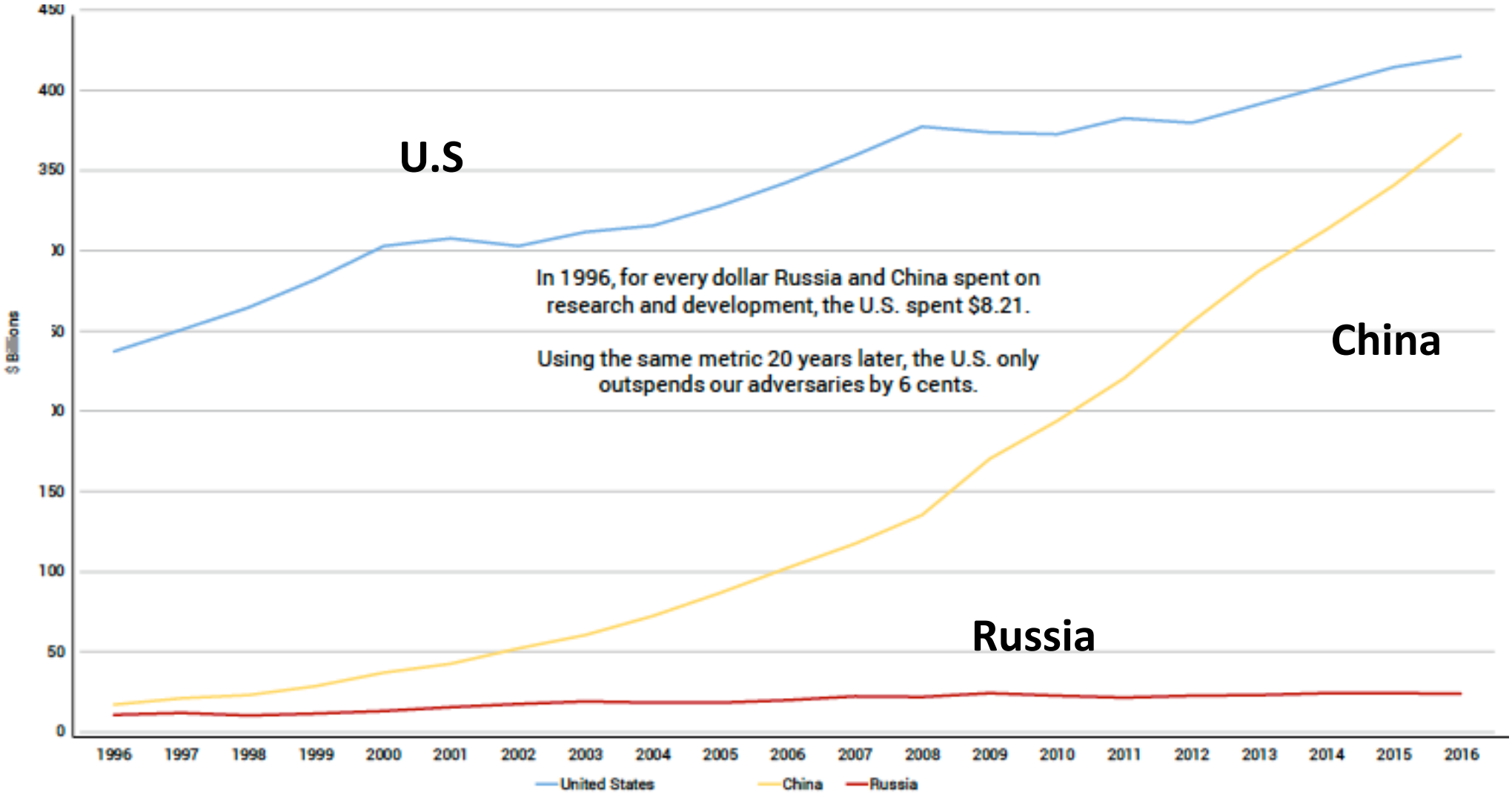
Ten Top Countries in R&D Spending: 2000-2015



Source: *Assessing and Strengthening the Manufacturing and Defense Industrial Base and Supply Chain Resiliency of the United States*, Report to President Donald J. Trump by the Interagency Task Force in Fulfillment of Executive Order 13806, Department of Defense, September 2018, p. 39

Chinese vs. U.S. vs. Russian Spending on Research and Development: 1996-2016

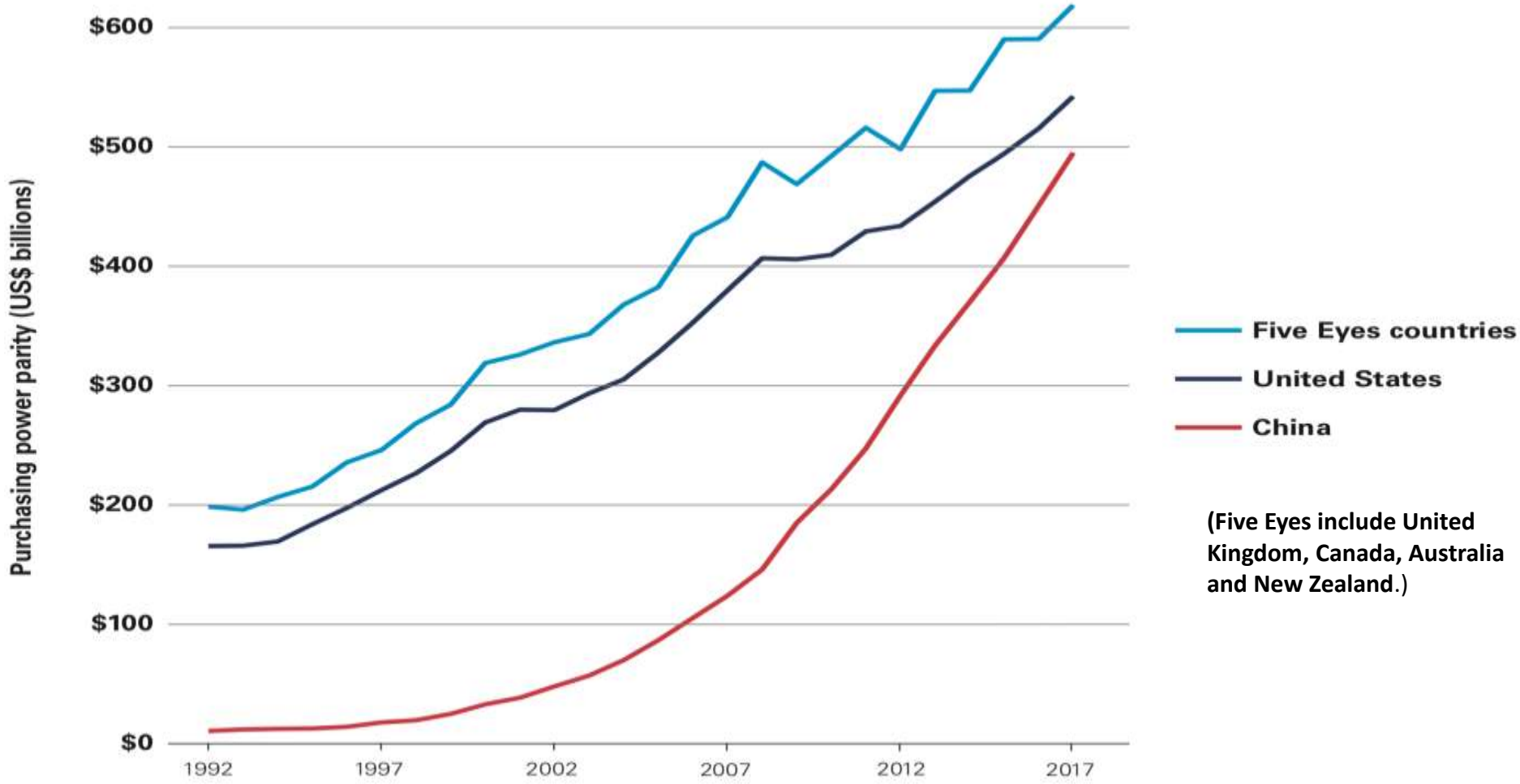
(Annual Expenditure on Research and Development (Adjusted For Purchasing Power Parity))



Source: United Nations Educational, Scientific and Cultural Organization R&D Database, IISS Military Balance and World Bank (for gross domestic product, Providing for the Common Defense, 2018, p.29.

Chinese vs. U.S. vs. Five Eyes National Spending on Research and Development: 1992-2017

($US Billions, Purchasing Power Parity)



(Five Eyes include United Kingdom, Canada, Australia and New Zealand.)

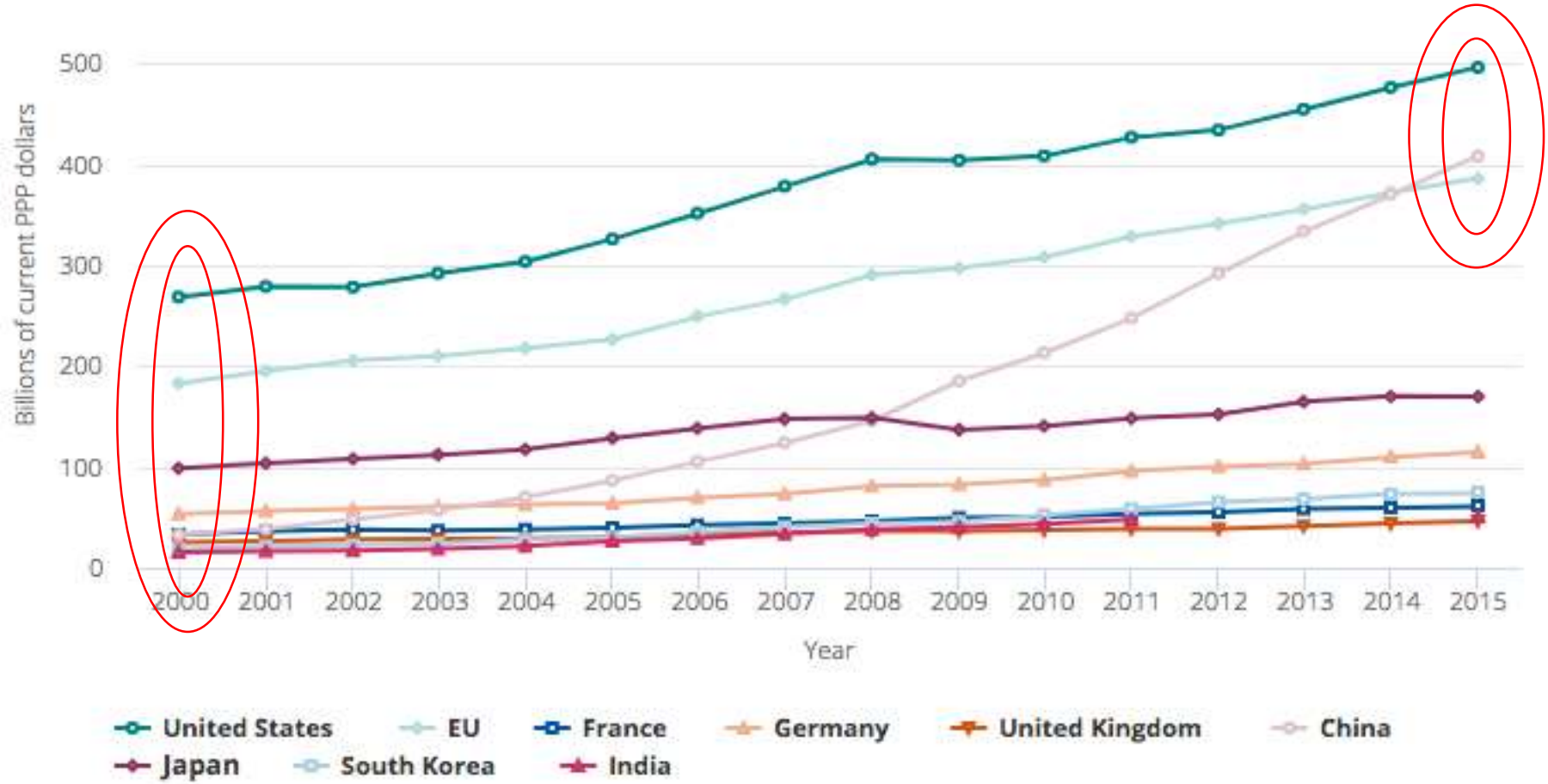
Source: Organisation for Economic Co-operation and Development.[D]

Source: Ashley Townshend and Brendan Thomas-Noone and Matilda Steward with Matilda Steward, *Averting Crisis: American Strategy*, United States Studies Centre, University of Sydney, August 2019, p. 71

Gross Regional Shifts in R&D Spending

National Science Foundation, National Center for Science and Engineering Statistics estimates, August 2017. Based on data from the Organization for Economic Co-operation and Development, Main Science and Technology Indicators (2017/1), and the United Nations Educational, Scientific and Cultural Organization (UNESCO), Institute for Statistics database, data.uis.unesco.org.National science Board, Science& Engineering Indicators, 2018, https://nsf.gov/statistics/2018/nsb20181/report/sections/overview/research-publications.

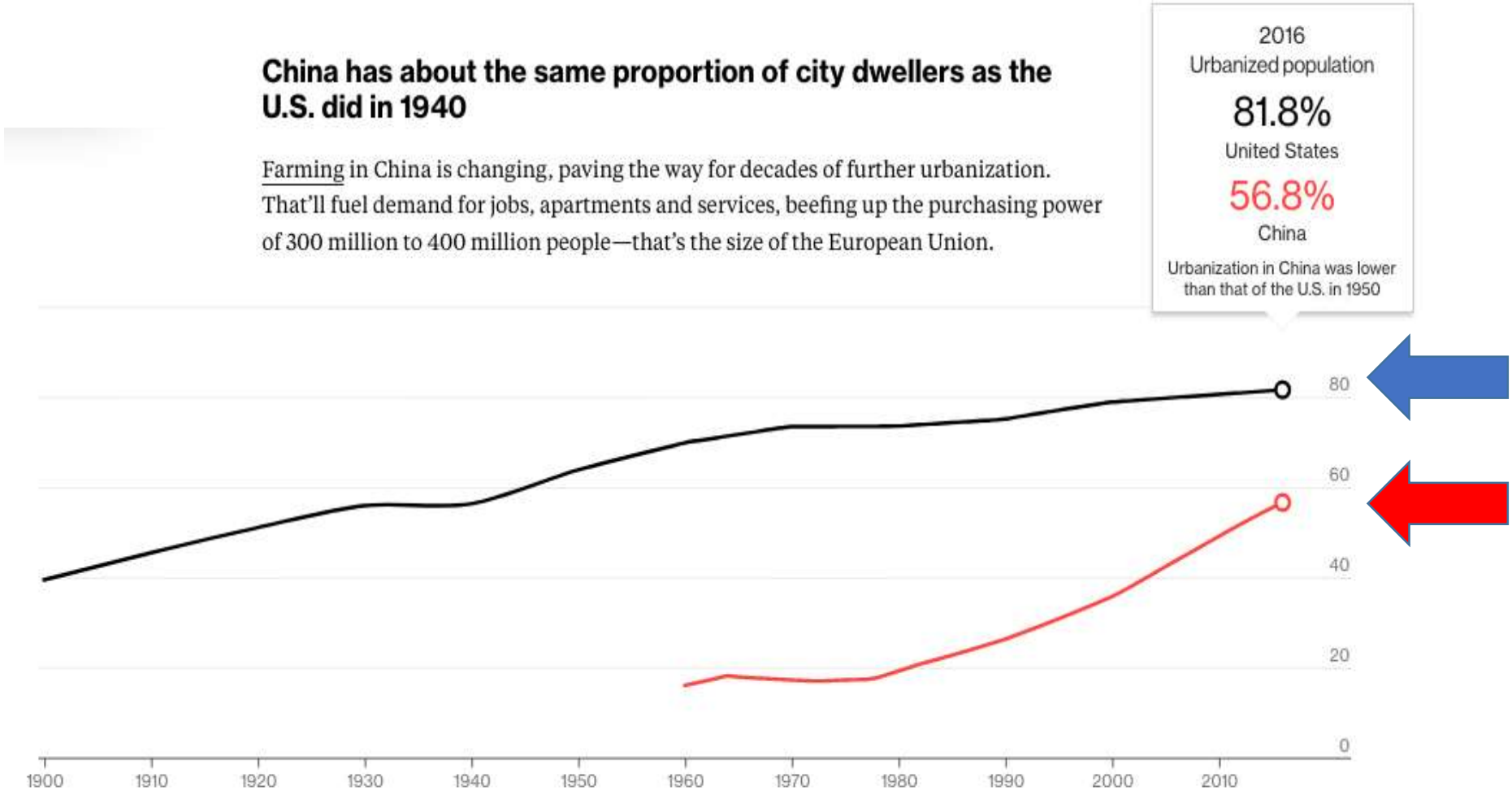
Chinese R&D Spending Rises Above EU, Challenges U.S.



United States and Europe experienced substantial declines in their shares of global R&D (from 37% to 26% in the United States and from 27% to 22% in Europe between 2000 and 2015). During the same period, the economies of East and Southeast Asia—including China, Japan, Malaysia, Singapore, South Korea, Taiwan, and India—saw an increase in their combined global share from 25% to 40%, thus exceeding the respective U.S. and the European R&D shares in 2015.

National Science Foundation, National Center for Science and Engineering Statistics estimates, August 2017. Based on data from the Organization for Economic Co-operation and Development, Main Science and Technology Indicators (2017/1), and the United Nations Educational, Scientific and Cultural Organization (UNESCO), Institute for Statistics database, data.uis.unesco.org.National science Board, Science& Engineering Indicators, 2018, https://nsf.gov/statistics/2018/nsb20181/report/sections/overview/research-publications.

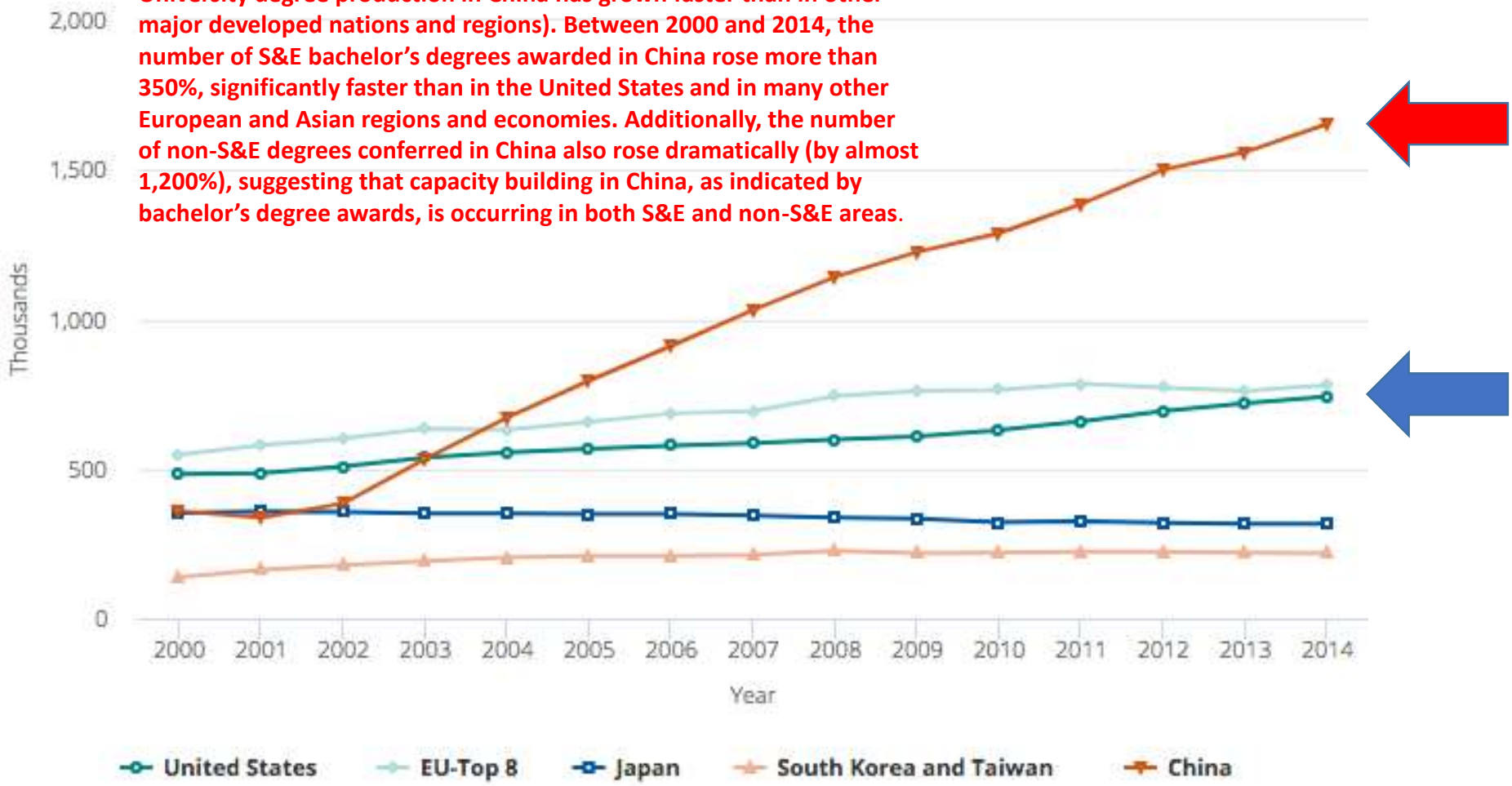
Shifts Towards Higher Technology Demographics: Chinese vs. US Urbanization: 1900-2005



Malcolm Scott, Cedric Sam: *Here's How Fast China's Economy Is Catching Up to the U.S.*, Bloomberg May 12, 2016 | Updated: November 06, 2017, Sources: World Bank for urbanization data for 1960 and after, U.S. Census Bureau for urbanization data before 1960. Additional work by: Christopher Cannon, Michael Keller and Ailing Tan.

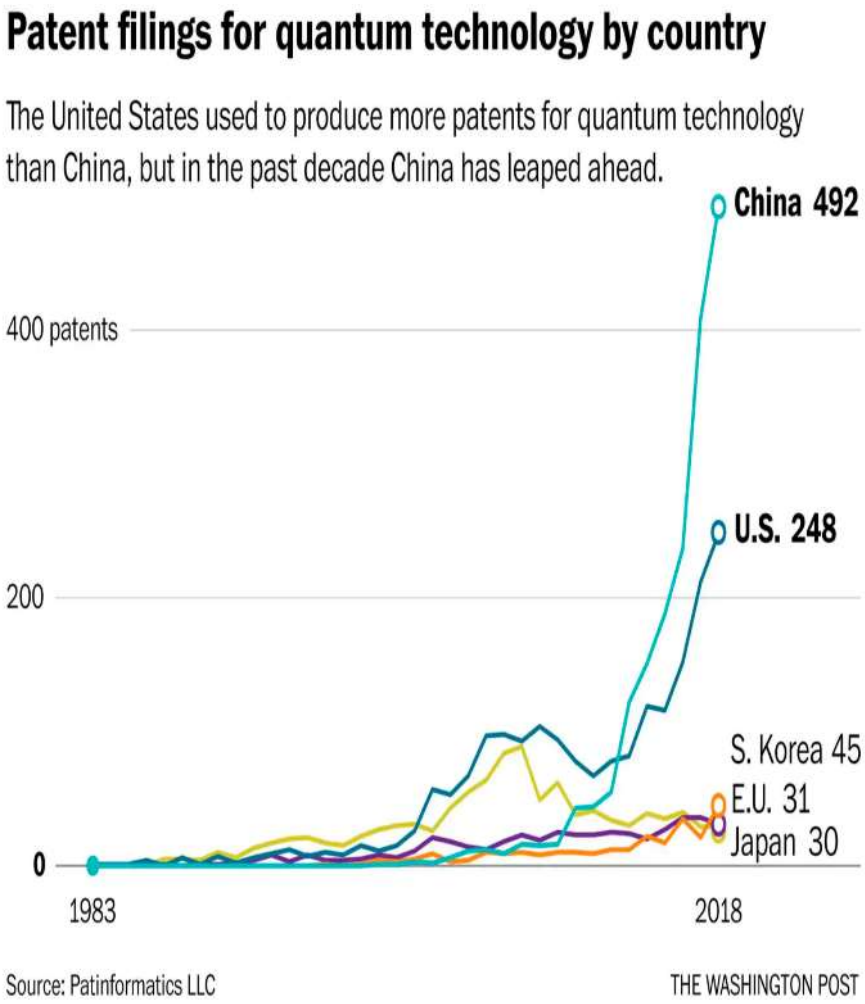
Underlying Educational Base: Bachelor's degree awards in S&E fields, by selected region, country, or economy: 2000–14

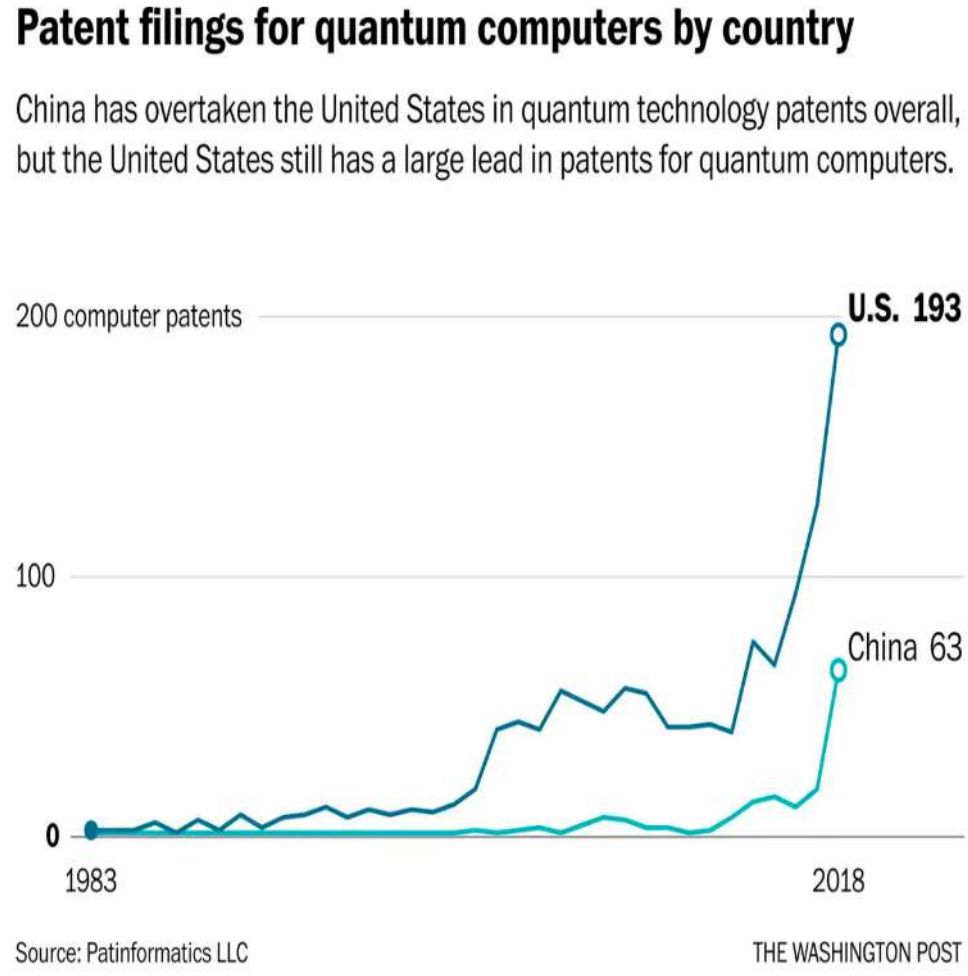
University degree production in China has grown faster than in other major developed nations and regions). Between 2000 and 2014, the number of S&E bachelor's degrees awarded in China rose more than 350%, significantly faster than in the United States and in many other European and Asian regions and economies. Additionally, the number of non-S&E degrees conferred in China also rose dramatically (by almost 1,200%), suggesting that capacity building in China, as indicated by bachelor's degree awards, is occurring in both S&E and non-S&E areas.



National Science Foundation, National Center for Science and Engineering Statistics estimates, August 2017. Based on data from the Organization for Economic Co-operation and Development, Main Science and Technology Indicators (2017/1), and the United Nations Educational, Scientific and Cultural Organization (UNESCO), Institute for Statistics database, data.uis.unesco.org.National science Board, Science& Engineering Indicators, 2018, https://nsf.gov/statistics/2018/nsb20181/report/sections/overview/research-publications.

Trends in Quantum Computing Research





Adapted from Jeanne Whalen, Washington Post, **"The quantum revolution is coming, and Chinese scientists are at the forefront,**:
August 18, 2019, https://www.washingtonpost.com/business/2019/08/18/quantum-revolution-is-coming-chinese-scientists-are-forefront/.

ODNI Estimate in 2019 of Chinese Rise in Relative S&T Citations: 1996-2016

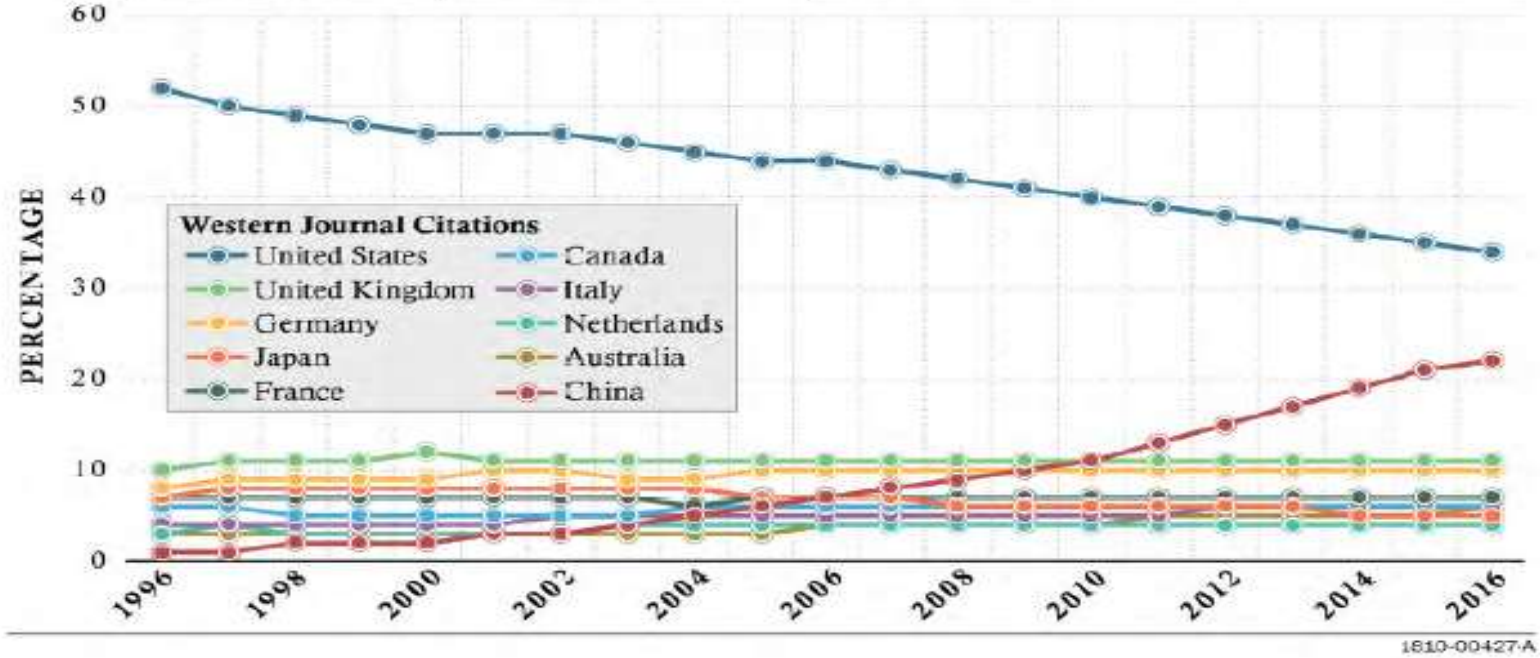
Strategic Outlook

For 2019 and beyond, the innovations that drive military and economic competitiveness will increasingly originate outside the United States, as the overall US lead in science and technology (S&T) shrinks; the capability gap between commercial and military technologies evaporates; and foreign actors increase their efforts to acquire top talent, companies, data, and intellectual property via licit and illicit means. Many foreign leaders, including Chinese President Xi Jinping and Russian President Vladimir Putin, view strong indigenous science and technology capabilities as key to their country's sovereignty, economic outlook, and national power.

Researchers Worldwide Citing More Foreign and Less US Research

During the past two decades, the US lead in S&T fields has been significantly eroded, most predominantly by China, which is well ahead in several areas, according to an analysis of Western journal publications.

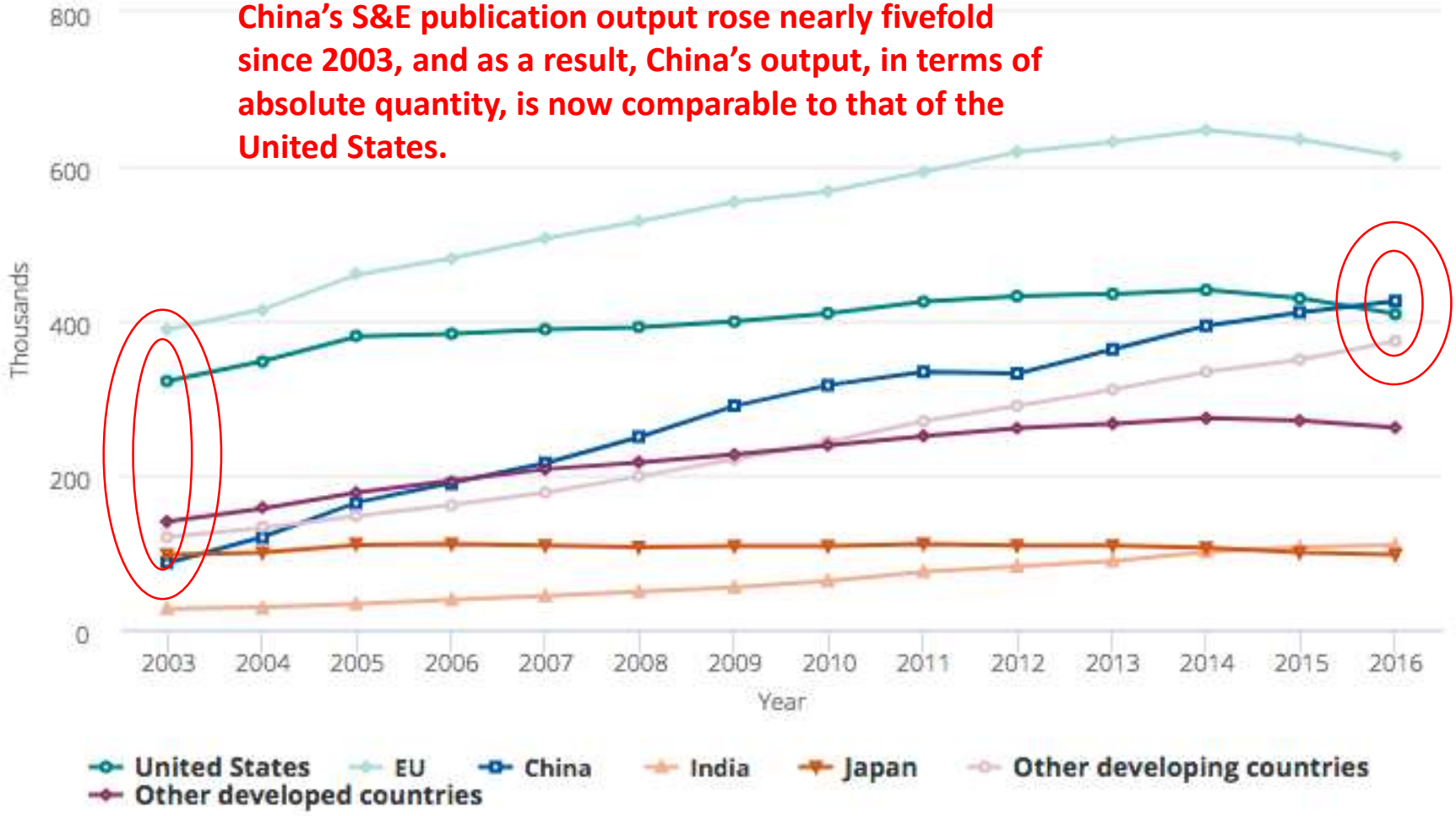
However, the United States maintains an overall lead largely because we are at the forefront of the medical sciences, which account for almost a third of S&T publications worldwide.



Daniel R.Coats, **STATEMENT FOR THE RECORD**WORLDWIDE THREAT ASSESSMENT **of the US INTELLIGENCE COMMUNITY, ODNI** January 29, 2019 p. 15

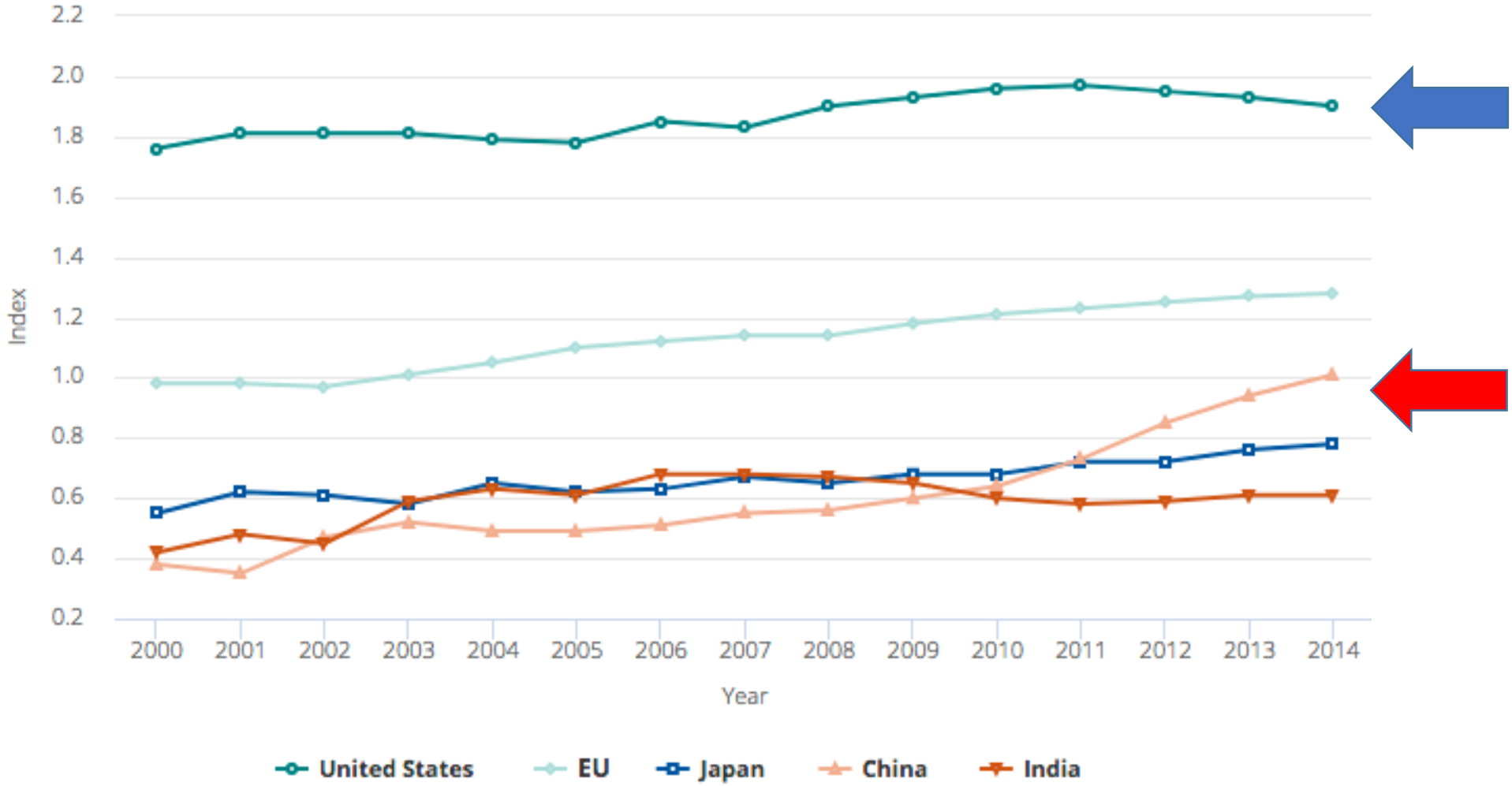
Chinese Science & Engineering Publications Overtake Those in the U.S. for First Time in 2016

China's S&E publication output rose nearly fivefold since 2003, and as a result, China's output, in terms of absolute quantity, is now comparable to that of the United States.



National Science Board, Science& Engineering Indicators, 2018, https://nsf.gov/statistics/2018/nsb20181/report/sections/overview/research-publications.

But Quality Matters: S&E publication output in the top 1% of cited publications, by selected region, country, or economy: 2000–14



National science Board, Science& Engineering Indicators, 2018, https://nsf.gov/statistics/2018/nsb20181/report/sections/overview/research-publications.

Trees Don't Grow to the Sky?
Possible Limits to China's Success

Possible Limits to China's Success

Serious questions do arise as to how much of its past success China can sustain in the future, and its ability to meet a new range of challenges as its economy matures. The World Bank governance indicators, for example, show relatively low ratings for corruption and rule of law — issues China's leadership has also flagged. The ability to grant a public voice and provide accountability is rated as extremely low, and performance in maintaining political stability and limiting violence is only rated as moderate – along with government effectiveness.

It is clear that China has made far more progress in its coastal areas than in the rest of the country, and questions emerge at to the extent China's state planning systems will pose a limit to future growth. China's growth rates have already declined in recent years and may remain lower in the future. Questions also arise over China's domestic consumption ability to lower the barriers to private sector business efforts, trends in labor costs, and improvements in human development.

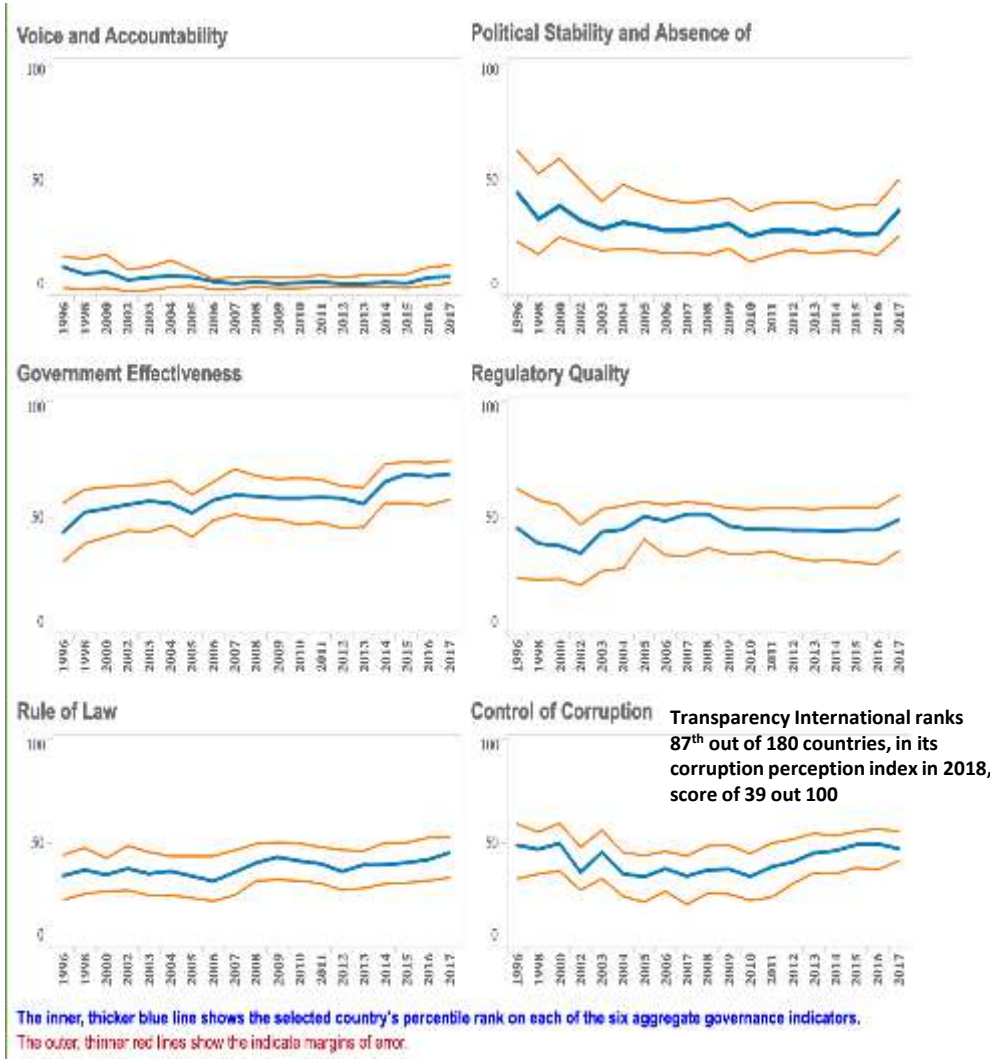
While the UN and most other sources estimate that China will end its population growth, serious questions still arise about the imbalance between its number of males and females, its ability to counter poverty in rural areas and in central and western China, and its ability to deal with an aging population that is increasing its dependency ratio.

More generally, history is filled with examples of cases where the comparative trends in political and military power, and economics, were altered by variables that were not predictable even at the time, and seem almost random in character. Some decades ago, serious think tanks like the Hudson Institute examined the possibility that Japan would emerge as the world dominant manufacturing and exporting state – only to see Japan's economic boom collapse in less than a year. Only handful of analysts predicted the eventual collapse of the former Soviet Union, and it is unclear that any major analyst came close to the timing and actual causes of the event.

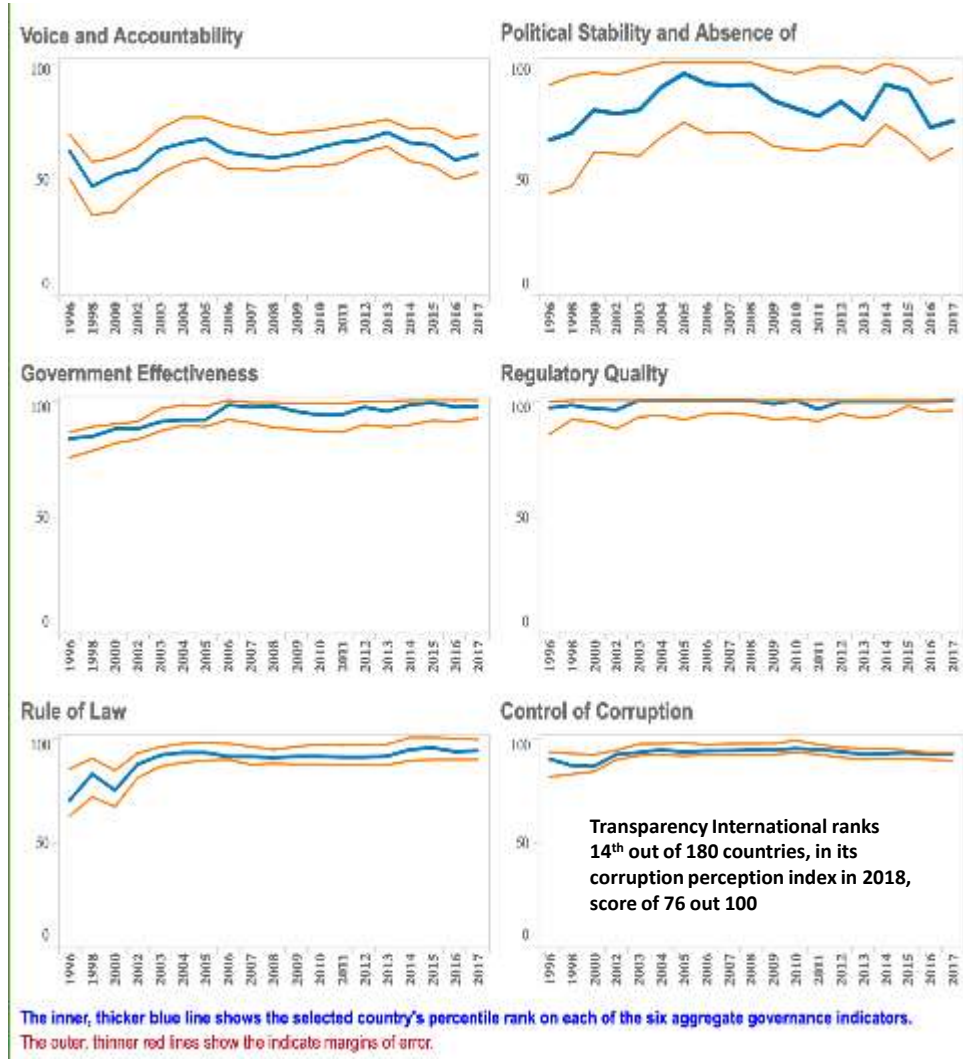
Even at a purely mathematical level, "chaos" or "complexity" theory raises serious questions about the ability to understand the number of critical variables that can shape China a decade or more in the future, and no clear method of suboptimization analysis offers a convincing substitute. The trends in this study do as much to warn about the risks of turning "futurism" into false prophecy as to provide a picture of where China may be in 2030 or 2050, and its ability to cooperate, compete, or engage in conflict with the United States – a warning that applies just as much to efforts in predicting the future and status of the United States or any other major power.

The Chinese Governance Challenge: Mainland vs. Hong Kong

China



Hong Kong SAR



Source: World Bank, Governance Indicators, 2018, http://info.worldbank.org/governance/wgi/#reports .

World Bank Economic Overview: April 2019

Since initiating market reforms in 1978, China has shifted from a centrally-planned to a more market-based economy and has experienced rapid economic and social development. GDP growth has averaged nearly 10% a year—the fastest sustained expansion by a major economy in history—and more than 850 million people have lifted themselves out of poverty. China reached all the Millennium Development Goals (MDGs) by 2015 and made a major contribution to the achievement of the MDGs globally. Although China's GDP growth has gradually slowed since 2012, as needed for a transition to more balanced and sustainable growth, it is still relatively high by current global standards.

With a population of 1.3 billion, China is the world's second largest economy and the largest if measured in purchasing price parity terms. China has been the largest single contributor to world growth since the global financial crisis of 2008.

Although China has made impressive economic and social development gains, its market reforms are incomplete, and its per capita income remains that of a developing country and less than one quarter of the average of OECD countries. The country is on track to eliminate absolute poverty by 2020 according to China's current poverty standard (per capita rural net income of RMB 2,300 per year in 2010 constant prices). However, there are still an estimated 373.1 million people below the "upper middle income" international poverty line of $5.50 a day.
Rapid economic ascendance has brought on many challenges as well, including high inequality (especially between rural and urban areas), challenges to environmental sustainability, and external imbalances. China also faces demographic pressures related to an aging population and the internal labor migration.

China's rapid economic growth exceeded the pace of institutional development, and there are important institutional and reform gaps that it needs to address to ensure a sustainable growth path. Significant policy adjustments are required for China's growth to be sustainable. Managing structural reforms and related risks will not be straightforward given the complexity, size, and global importance of China's economy.
China's 13th Five-Year Plan (2016-2020) addresses these issues. It highlights the development of services and measures to address environmental and social imbalances, setting targets to reduce pollution, to increase energy efficiency, to improve access to education and healthcare, and to expand social protection. The 13th Five-Year Plan's annual growth target is 6.5%, reflecting the rebalancing of the economy and the focus on the quality of growth while maintaining the objective of achieving a "moderately prosperous society" by 2020 (doubling GDP for 2010-2020).

World Bank Group, *April 8, 2019, https://www.worldbank.org/en/country/china/overview*

CIA Economic Overview: April 2019

Since the late 1970s, China has moved from a closed, centrally planned system to a more market-oriented one that plays a major global role. China has implemented reforms in a gradualist fashion, resulting in efficiency gains that have contributed to a more than tenfold increase in GDP since 1978. Reforms began with the phaseout of collectivized agriculture, and expanded to include the gradual liberalization of prices, fiscal decentralization, increased autonomy for state enterprises, growth of the private sector, development of stock markets and a modern banking system, and opening to foreign trade and investment. China continues to pursue an industrial policy, state support of key sectors, and a restrictive investment regime. From 2013 to 2017, China had one of the fastest growing economies in the world, averaging slightly more than 7% real growth per year. Measured on a purchasing power parity (PPP) basis that adjusts for price differences, China in 2017 stood as the largest economy in the world, surpassing the US in 2014 for the first time in modern history. China became the world's largest exporter in 2010, and the largest trading nation in 2013. Still, China's per capita income is below the world average.

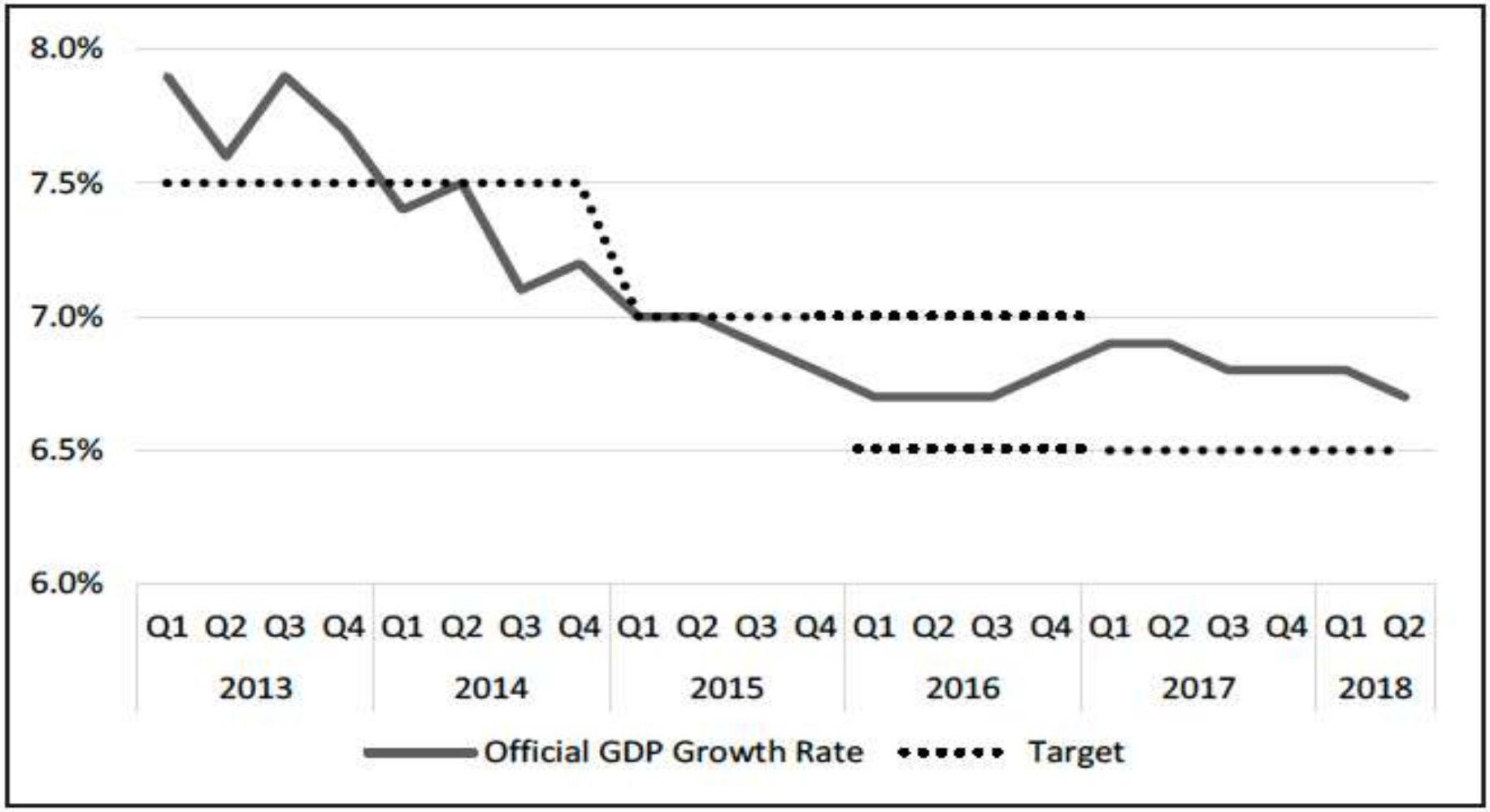
In July 2005 moved to an exchange rate system that references a basket of currencies. From mid-2005 to late 2008, the renminbi (RMB) appreciated more than 20% against the US dollar, but the exchange rate remained virtually pegged to the dollar from the onset of the global financial crisis until June 2010, when Beijing announced it would resume a gradual appreciation. From 2013 until early 2015, the renminbi held steady against the dollar, but it depreciated 13% from mid-2015 until end-2016 amid strong capital outflows; in 2017 the RMB resumed appreciating against the dollar – roughly 7% from end-of-2016 to end-of-2017. In 2015, the People's Bank of China announced it would continue to carefully push for full convertibility of the renminbi, after the currency was accepted as part of the IMF's special drawing rights basket. However, since late 2015 the Chinese Government has strengthened capital controls and oversight of overseas investments to better manage the exchange rate and maintain financial stability.

The Chinese Government faces numerous economic challenges including: (a) reducing its high domestic savings rate and correspondingly low domestic household consumption; (b) managing its high corporate debt burden to maintain financial stability; (c) controlling off-balance sheet local government debt used to finance infrastructure stimulus; (d) facilitating higher-wage job opportunities for the aspiring middle class, including rural migrants and college graduates, while maintaining competitiveness; (e) dampening speculative investment in the real estate sector without sharply slowing the economy; (f) reducing industrial overcapacity; and (g) raising productivity growth rates through the more efficient allocation of capital and state-support for innovation. Economic development has progressed further in coastal provinces than in the interior, and by 2016 more than 169.3 million migrant workers and their dependents had relocated to urban areas to find work. One consequence of China's population control policy known as the "one-child policy" - which was relaxed in 2016 to permit all families to have two children - is that China is now one of the most rapidly aging countries in the world. Deterioration in the environment - notably air pollution, soil erosion, and the steady fall of the water table, especially in the North - is another long-term problem. China continues to lose arable land because of erosion and urbanization. The Chinese Government is seeking to add energy production capacity from sources other than coal and oil, focusing on natural gas, nuclear, and clean energy development. In 2016, China ratified the Paris Agreement, a multilateral agreement to combat climate change, and committed to peak its carbon dioxide emissions between 2025 and 2030.

The government's 13th Five-Year Plan, unveiled in March 2016, emphasizes the need to increase innovation and boost domestic consumption to make the economy less dependent on government investment, exports, and heavy industry. However, China has made more progress on subsidizing innovation than rebalancing the economy. Beijing has committed to giving the market a more decisive role in allocating resources, but the Chinese Government's policies continue to favor state-owned enterprises and emphasize stability. Chinese leaders in 2010 pledged to double China's GDP by 2020, and the 13th Five Year Plan includes annual economic growth targets of at least 6.5% through 2020 to achieve that goal. In recent years, China has renewed its support for state-owned enterprises in sectors considered important to "economic security," explicitly looking to foster globally competitive industries. Chinese leaders also have undermined some market-oriented reforms by reaffirming the "dominant" role of the state in the economy, a stance that threatens to discourage private initiative and make the economy less efficient over time. The slight acceleration in economic growth in 2017—the first such uptick since 2010—gives Beijing more latitude to pursue its economic reforms, focusing on financial sector deleveraging and its Supply-Side Structural Reform agenda, first announced in late 2015.

CIA World Factbook, "China," accessed 2.7.19

Declining Chinese GDP Growth: 2013-2018



Note: In 2016, the GDP growth target was set at a range of 6.5–7.0 percent.
Source: China's National Bureau of Statistics via CEIC database; Li Keqiang, *Report on the Work of the Government*, First Session of the 13th National People's Congress, Beijing, China, March 5, 2018, 20.

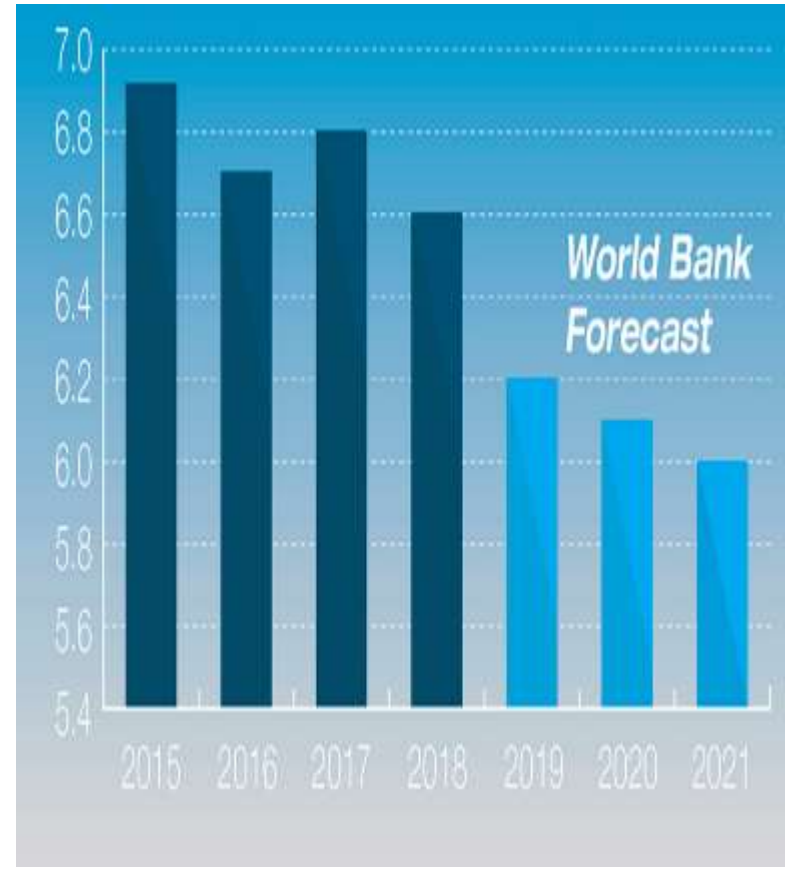
2018 Report to Congress of the U.S. and China Security Review Commission 115th Congress, 2nd Session, November 2018, p. 58

World Bank, Limited Drop in GDP Growth: 2016-2021?

Table 2: Macroeconomic indicators and outlook	2016	2017	2018	2019f	2020f	2021f
Real GDP growth, at constant market prices (percent)	6.7	6.8	6.6	6.2	6.1	6.0
Contributions to growth (pp):						
Final consumption	4.5	3.9	5.0	4.4	4.3	4.3
Gross fixed capital investment	2.9	2.3	2.1	2.1	2.1	2.0
Net exports	0.6	0.6	0.6	-0.3	-0.3	-0.3
Real GDP growth, at constant factor prices (percent)	6.7	6.8	6.6	6.2	6.1	6.0
Contributions to growth (pp):						
Agriculture	0.3	0.3	0.3	0.3	0.3	0.3
Industry	2.6	2.4	2.4	2.2	2.1	2.0
Services	3.9	4.0	3.9	3.7	3.7	3.7
Inflation (average percent change in Consumer Price Index)	2.0	1.6	2.1	2.2	2.0	2.0
Current account balance (% of GDP)	1.8	1.6	0.4	-0.1	0.3	0.5
Financial and capital account (excl. reserves) (% of GDP)	-3.7	0.9	1.0	0.2	0.6	0.7
Net foreign direct investment (% of GDP)	0.4	0.2	0.8	0.5	0.5	0.5
Consolidated fiscal balance (% of GDP) *	-3.0	-2.5	-3.9	-5.9	-4.0	-3.7

Note: f-forecast. * The consolidated fiscal balance = Public Finance Budget balance + Government Fund Budget balance + Social security and SOE fund net revenues - Net withdrawal from Stabilization Fund. Numbers may not add up due to rounding.

Source: Ministry of Finance, NBS, SAFE, World Bank staff calculations and projections.



Source: World Bank, *China Economic Update*, May 2015, , p. 10, and http://www.worldbank.org/en/news/infographic/2019/05/31/infographic-china-economic-update-may-2019.

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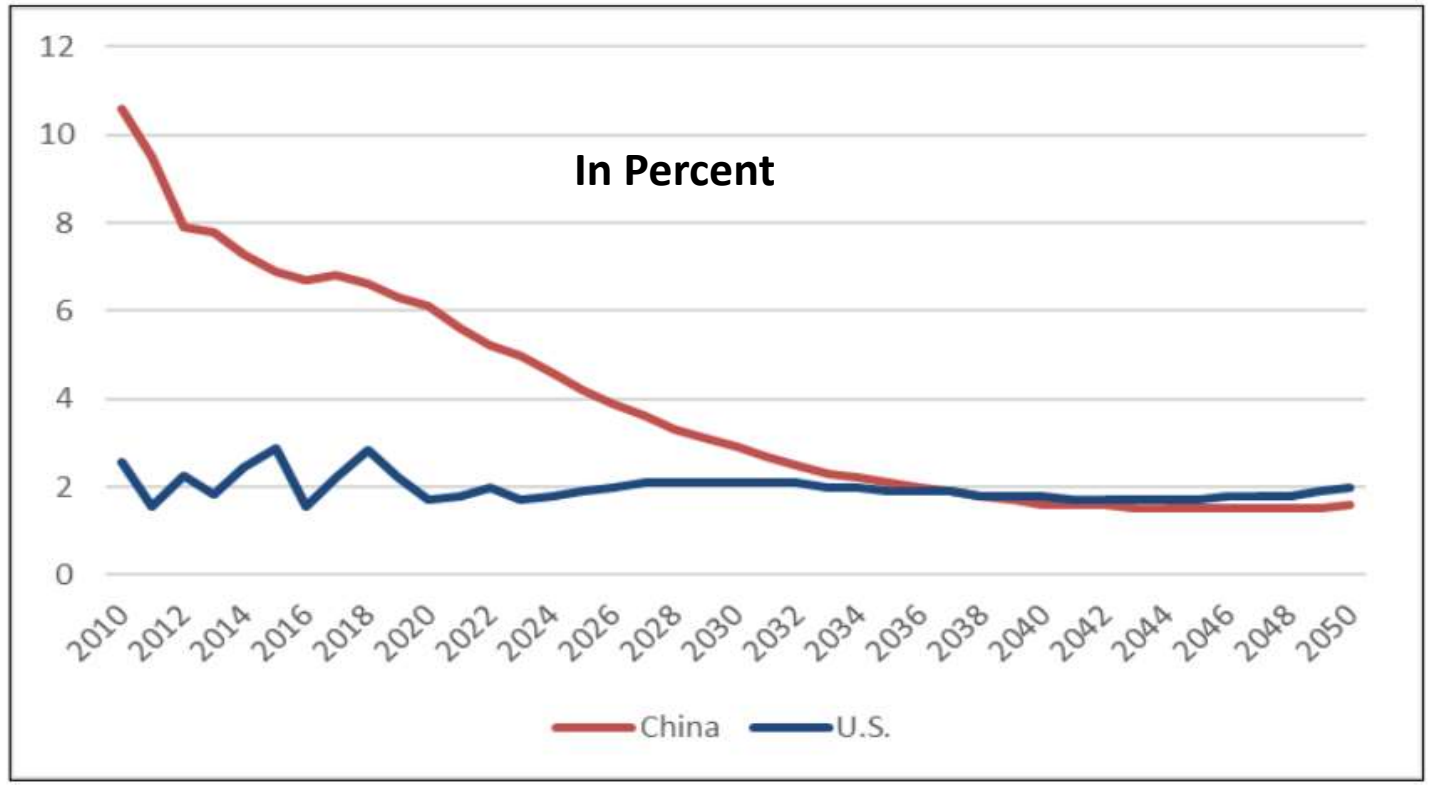
Declining Chinese GDP Growth Relative to U.S.: 2010-2050 - I



Source: EIU Database (accessed on June 24, 2019).

….as China's technological development begins to converge with major developed countries (i.e., through its adoption of foreign technology), its level of productivity gains, and thus, real GDP growth, could slow significantly from its historic levels unless China becomes a major center for new technology and innovation and/or implements new comprehensive economic reforms. Several developing economies (notably several in Asia and Latin America) experienced rapid economic development and growth during the 1960s and 1970s by implementing some of the same policies that China has utilized to date to develop its economy, such as measures to boost exports and to promote and protect certain industries. However, at some point in their development, some of these countries began to experience economic stagnation (or much slower growth compared to previous levels) over a sustained period of time, a phenomenon described by economists as the "middle-income trap."

Wayne M. Morrison, *China's Economic Rise: History, Trends, Challenges, and Implications for the United States*, Congressional Research Service, Updated June 25, 2019, https://crsreports.congress.gov, RL33534, pp. 9.

Declining Chinese GDP Growth Relative to U.S.: 2010-2050 -II

This means that several developing (low-income) economies were able to transition to a middle-income economy, but because they were unable to sustain high levels of productivity gains (in part because they could not address structural inefficiencies in the economy), they were unable to transition to a high-income economy. China may be at a similar crossroads now.
The Economist Intelligence Unit (EIU) projects that China's real GDP growth will slow considerably in the years ahead, eventually converging on U.S. growth rates by the year 2036 (U.S. and Chinese real GDP growth are both projected at 1.6%); for some years thereafter, U.S. GDP growth is projected to be greater than China's.

The Chinese government has indicated its desire to move away from its current economic model of fast growth at any cost to more "smart" economic growth, which seeks to reduce reliance on energy-intensive and high-polluting industries and rely more on high technology, green energy, and services. China also has indicated it wants to obtain more balanced economic growth. (These issues are discussed in more detail later in the report.)

2018 Report to Congress of the U.S. and China Security Review Commission 115th Congress, 2nd Session, November 2018, p. 34.

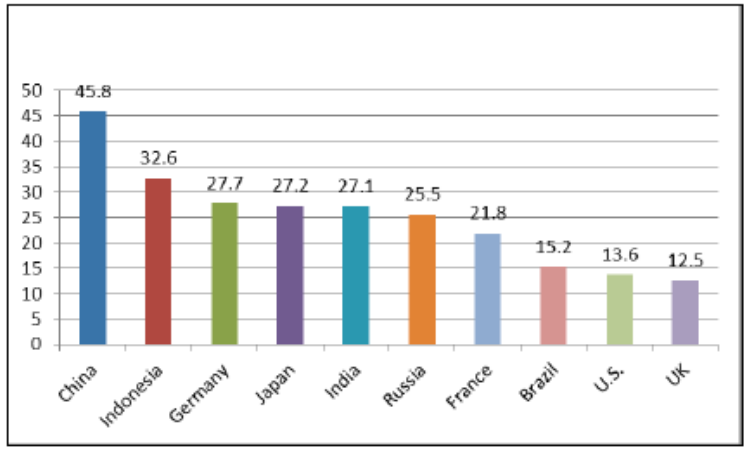
Medium World Bank Chinese Doing Business Ranking: 2019

Country	Ease of Doing Business Ranking	Ease of Doing Business Score	= Global Ranking in: Starting a Business	Construction Permits	Getting Electricity	Registering Property	Getting Credit	Protecting Minority Investors	Paying Taxes	Trading Across Borders	Enforcing Contracts	Resolving Insolvancy *
China	46	71.81	72	33	36	61	85	64	76	71	49	51
Hong Kong SAR	4	84.22	5	1	3	53	32	11	1	27	30	44
Singapore	2	85.24	3	8	16	21	32	7	8	45	1	27
United States	8	82.65	19	17	7	42	32	15	23	30	32	14
Japan	39	75.65	93	44	22	48	85	64	97	56	52	1
South Korea	5	84.14	11	10	2	40	60	23	24	33	2	11
Vietnam	69	68.36	104	21	27	60	32	89	131	100	62	133
India	77	67.23	137	52	74	166	22	7	121	80	163	108
North Korea	-	-	-	-	-	-	-	-	-	-	-	-
Malaysia	15	80.60	122	3	4	29	32	2	72	48	33	41
Pakistan	136	55.31	130	166	167	161	112	26	173	142	156	53
Afghanistan	167	42.77	49	184	168	186	99	26	177	177	181	174

Source: World Bank, http://www.doingbusiness.org/en/rankings.

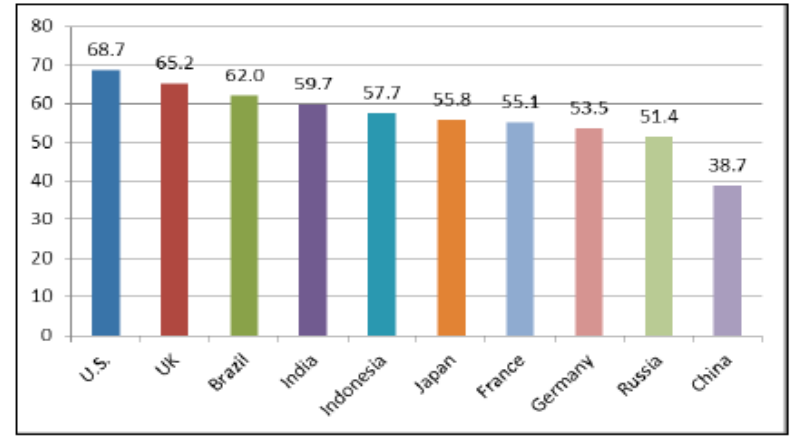
Comparative Savings, Investment and Spending Rates

Comparison of Gross Savings Rates for Major Global Economies in 2016
(percentage of GDP)



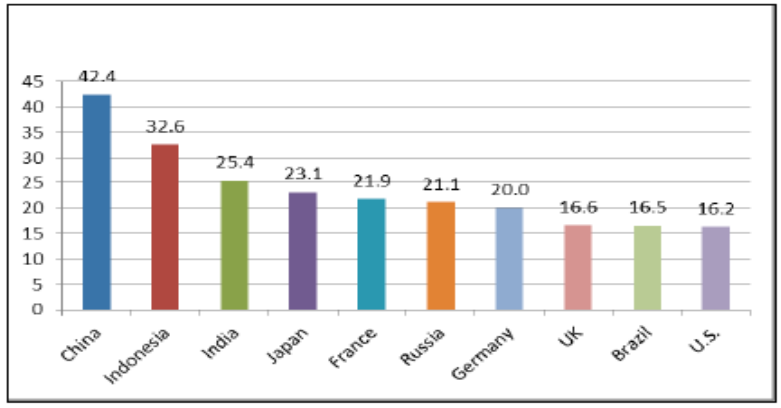
Source: Economist Intelligence Unit.

Comparison of Private Consumption of Major Global Economies in 2016
(percentage of GDP)



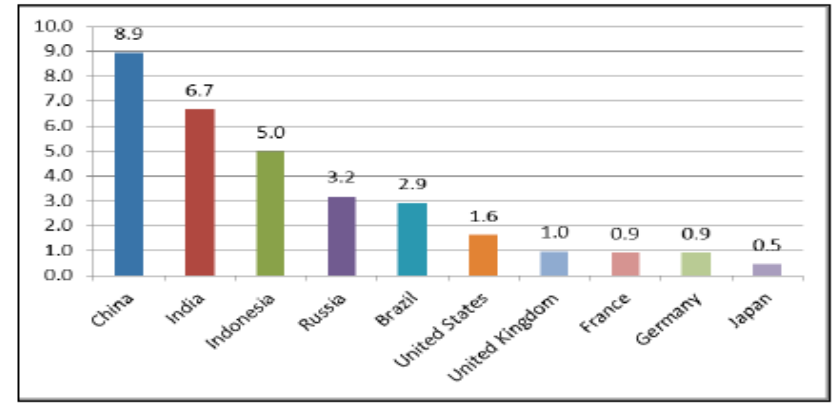
Source: Economist Intelligence Unit.

Comparison of Gross Fixed Investment for Major Global Economies in 2016
(percentage of GDP)



Source: Economist Intelligence Unit.

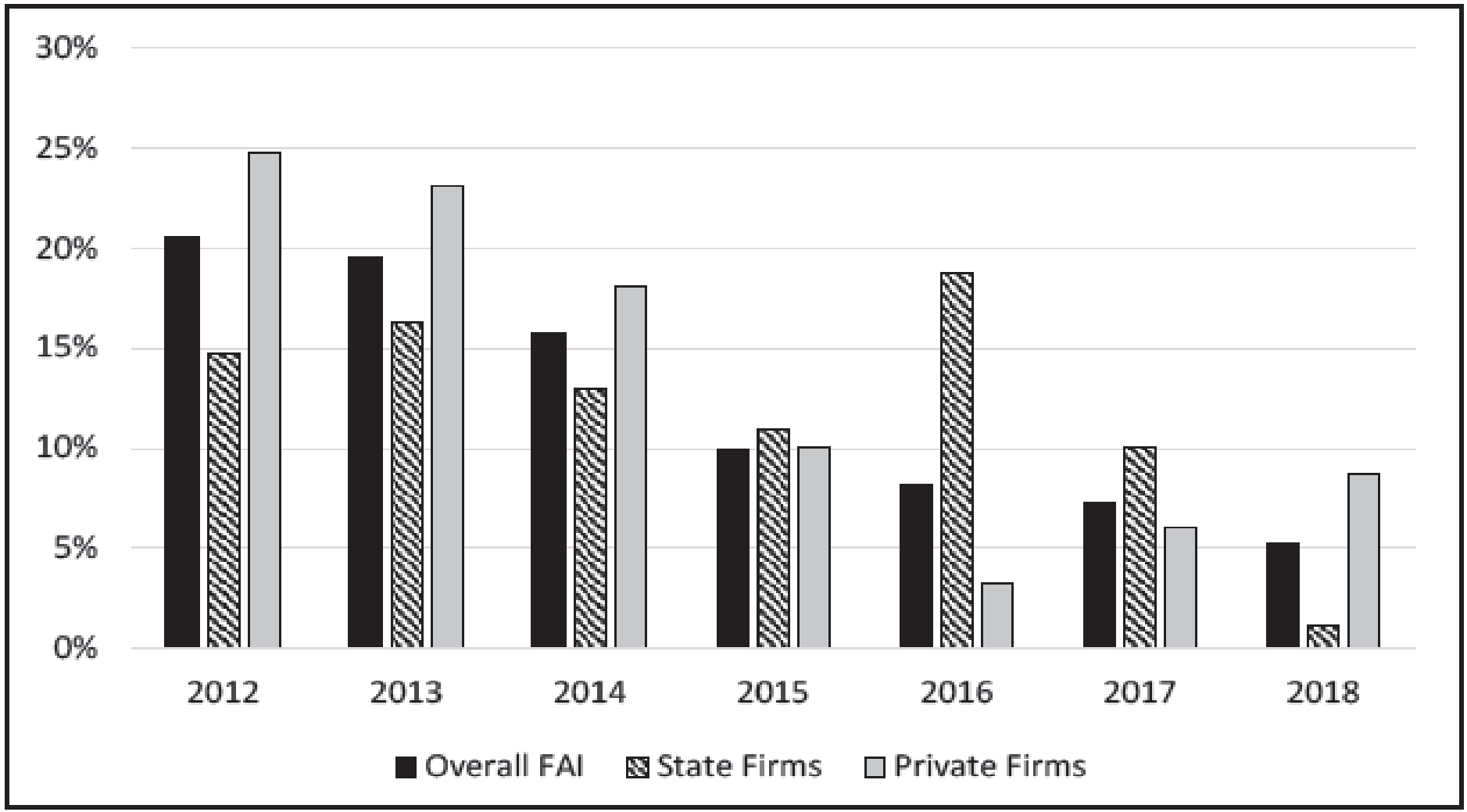
Average Annual Growth in Private Consumption: 2007-2016
(percent)



Source: Economist Intelligence Unit.

Wayne M. Morrison, *China's Economic Rise: History, Trends, Challenges, and Implications for the United States*, Congressional Research Service, Updated February 5, 2018, https://crsreports.congress.gov, RL33534, pp. 10.

Decline in Chinese Fixed Asset Investment: 2012-8/2018

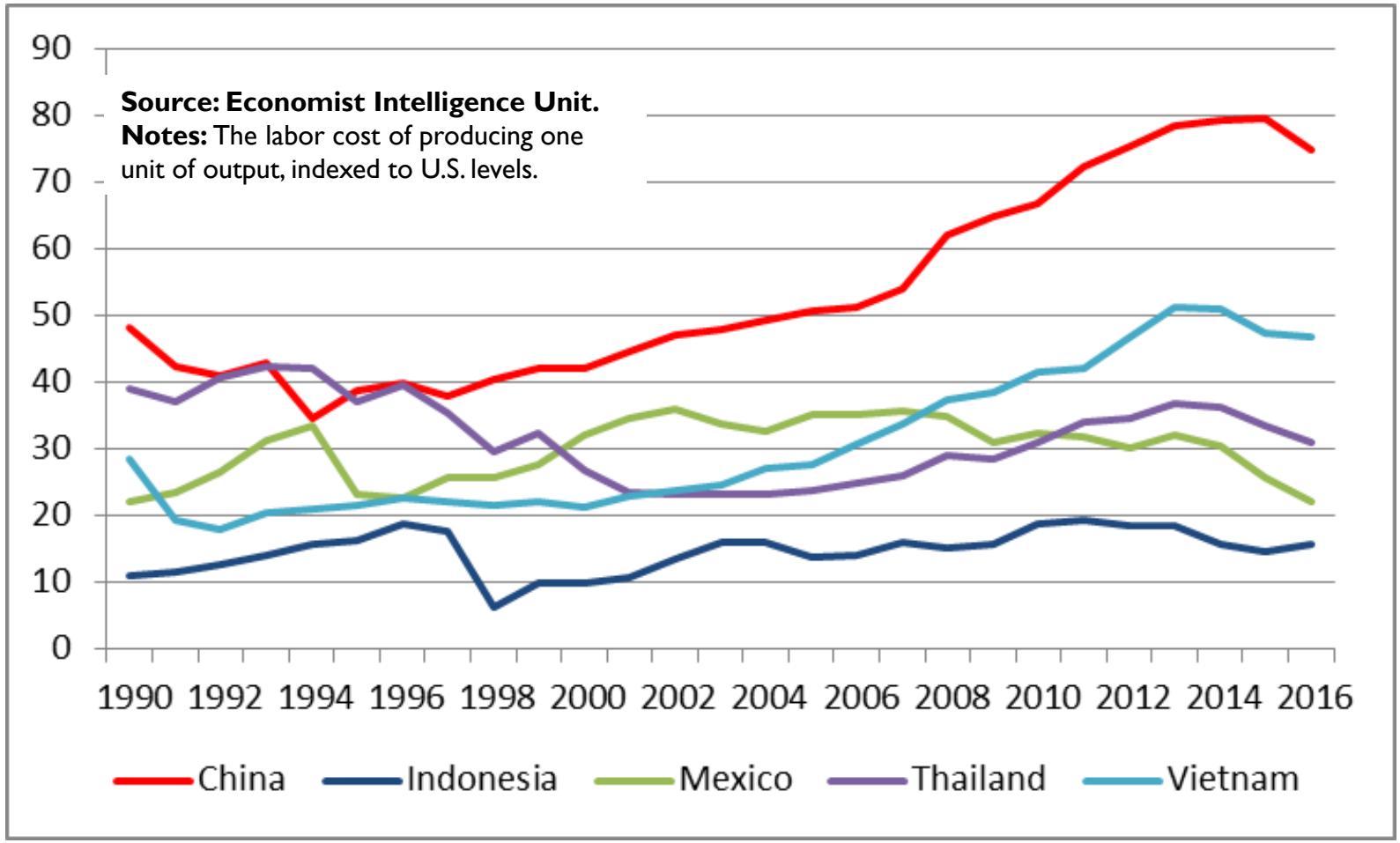


Note: Data for 2018 are for the first eight months of the year.
Source: China's National Bureau of Statistics via CEIC database.

2018 Report to Congress of the U.S. and China Security Review Commiss115th Congress, 2nd Session, November 2018, p. 34

Chinese Labor Costs are Becoming Less Favorable

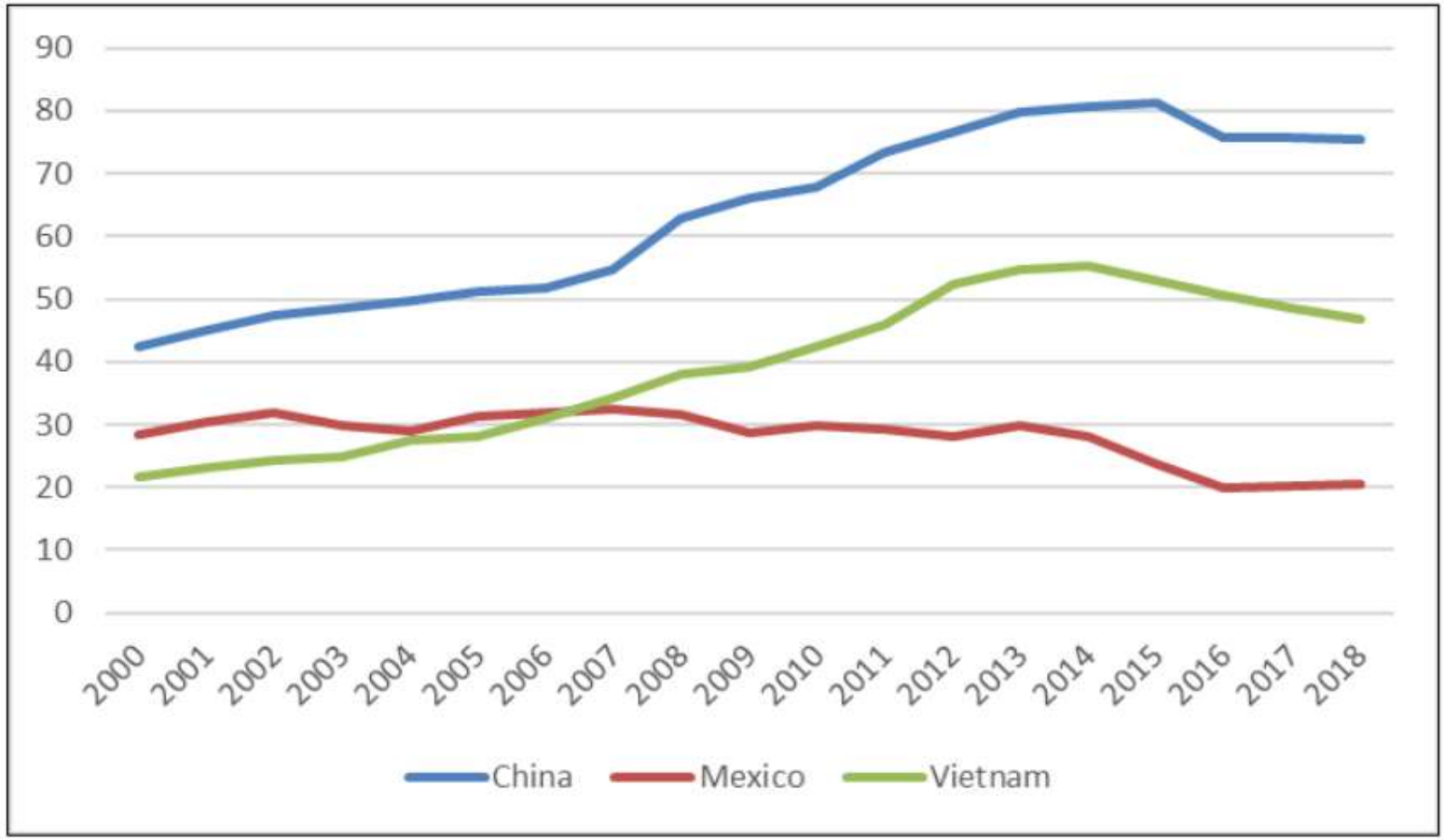
Labor Cost Index for China and Selected Countries Relative to the United States:1990-2016
(U.S. level =100)



Wayne M. Morrison, *China's Economic Rise: History, Trends, Challenges, and Implications for the United States*, Congressional Research Service, Updated February 5, 2018, https://crsreports.congress.gov, RL33534, pp. 10.

Chinese Labor Costs are Becoming Less Favorable

Labor Cost Index for China and Selected Countries Relative to the United States:2000-2018
(U.S. level =100)

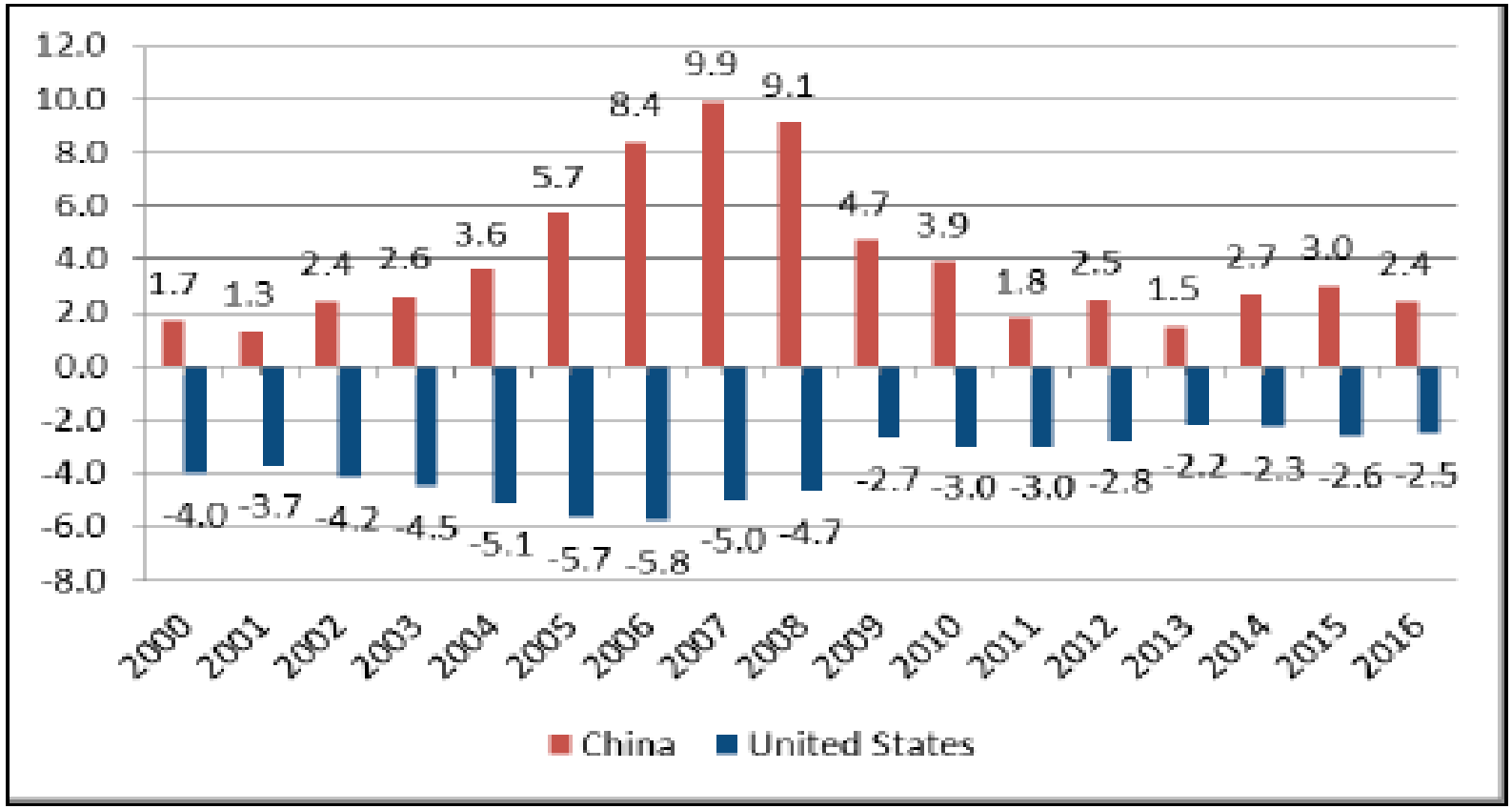


Source: Economist Intelligence Unit.

Notes: The labor cost of producing one unit of output, indexed to U.S. levels.

Source: Wayne M. Morrison, *China's Economic Rise: History, Trends, Challenges, and Implications for the United States*, Congressional Research Service, Updated June 25, 2019, https://crsreports.congress.gov, RL33534, pp. 14.

Shifts in Current Account Balances as a Percentage of GDP for China and the United States: 2000-2016



Source: International Monetary Fund, *World Economic Outlook Database*, October 2016.
Note: Data for 2016 are IMF estimates.

China's Economic Rise: History, Trends, Challenges, and Implications for the United States, Congressional Research Service, Updated February 5, 2018, https://crsreports.congress.gov, RL33534, p. 39

Medium UN Human Development Index Ranking: 2018

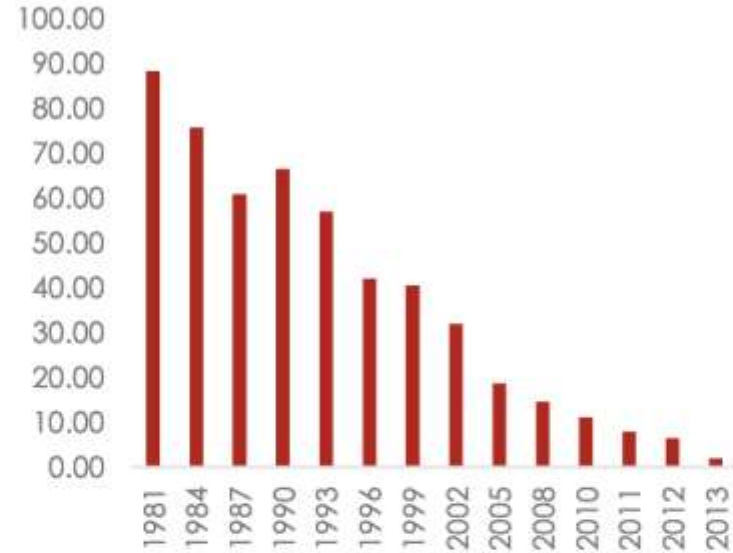
Country	Human Development Index	Ranking	Life Expectancy at Birth (yrs)	Expected Years of Schooling	Mean Years of Actual Schooling	Gross National Per Capita Income (2011 PPP)	CIA Per Capita Income (2017 PPP)
China	86	0.752	76.4	13.8	7.8	$15.270	$16,700
Hong Kong SAR	7	0.933	84.1	16.3	12.0	$58.420	$61,500
Singapore	9	0.932	83.2	16.2	11.5	$82,503	$94,100
United States	13	0.924	79.5	16.5	13.4	$54,941	$59,800
Japan	19	0.909	83.4	15.2	12.8	$38,986	$42,900
South Korea	22	0.903	82.4	16.5	12.1	$35,945	$39,500
Vietnam	116	0.694	76.5	12.7	8.2	$5,859	$6,900
India	130	0.640	68.8	12.3	6.4	$6,353	$7,200
North Korea	NA	NA	71.9	12.0	NA	NA	$1,700 (2015)
High Development	-	0.757	76.0	14.1	8.2	$14,999	NA
Medium Development	-	0.645	69.1	12.0	6.7	$6,849	NA

Source: World Bank, Human Development Report, Statistical Annex, http://www.doingbusiness.org/en/rankings, http://report.hdr.undp.org/, CIA World Factbook, accessed 18..6.2019.

Mixed Progress in Dealing with Poverty

The World Bank forecasts that China is on its way to eliminating extreme poverty, but the population vulnerable to poverty in China will remain relatively large. China is expected to continue to make strong progress toward eliminating extreme poverty, despite the slowdown of economic growth. The World Bank projects extreme poverty, based on the international PPP US$1.90 per day poverty line, to decline to 0.5 percent by 2018. [42] This assumes a deceleration of annual GDP growth from 6.9 to 6.5 percent between 2015 and 2018. Slower growth rates of up to a percentage point do not render significant differences in poverty forecasts. But despite the progress made in eliminating extreme poverty, the population vulnerable to poverty, as defined by the higher international poverty line of PPP US$3.10, will remain relatively large. The higher poverty line characterizes those in moderate poverty and vulnerable to falling below the poverty line. According to this higher poverty line, China is projected to have a poverty rate of 3.9 percent or 54.6 million people by 2018.

Figure 2. 1: China's Poverty Head Count Ratio [41]
(International PPP US$1.90 Per Day Poverty Line)



Sources: China NBS household surveys and staff calculations.

Source: World Bank Group, *China Systematic Diagnostic, Report 113092-CN, 2017, p. 20*

The Remaining Chinese Poverty Challenge in Rural Areas

Poverty Head Count Ratio in China, National and by Urban and Rural Areas: Percentage of Population That Consume Less than US$1.90 Per Day in 2011 PPP

	National	Rural	Urban
1981	88.32	95.59	59.43
1984	75.75	85.21	42.60
1985	—	83.62	#N/A
1987	60.84	72.55	24.27
1990	66.58	78.95	32.16
1992	—	60.64	9.01
1993	57.00	71.83	20.86
1994	—	52.50	9.46
1995	—	46.55	6.84
1996	42.05	55.26	13.85
1997	—	33.35	5.91
1998	—	31.10	12.25
1999	40.54	56.38	10.96
2002	31.95	48.80	4.95
2005	18.75	30.63	2.69
2008	14.76	26.25	1.33
2010	11.18	21.30	0.74
2011	7.9	15.44	0.54
2012	6.47	12.98	0.42
2013	1.85	3.38	0.51

Source: PovcalNet, Shaohua Chen prepared data for this study.

Note: See note to Table 2A.1. — = not available.

Impact by Region, and On Migration to East

		2000	2005	2015
Rural impoverished population (millions)	National	9,422	6,432	5,575
	Eastern	962	545	653
	Middle	2,729	2,091	2,007
	Western	5,731	3,805	2,914
Poor incidence (%)	National	10.2	6.8	5.7
	Eastern	2.9	1.6	1.8
	Middle	8.8	6.6	6.2
	Western	20.6	13.3	10
Share of rural poor (%)	National	100.0	100.0	100
	Eastern	10.2	8.5	11.7
	Middle	29.0	32.3	36.0
	Western	60.8	59.2	52.3

Source: China Rural Poverty Monitoring Report 2015.

Source: World Bank, , China-Systemic Country Diagnostic, Report No. 113092-CN, 2017, p. 46. See pages 30-46 for analysis.

US Census Bureau Estimate of Diminishing Post-2030 Population Pressure

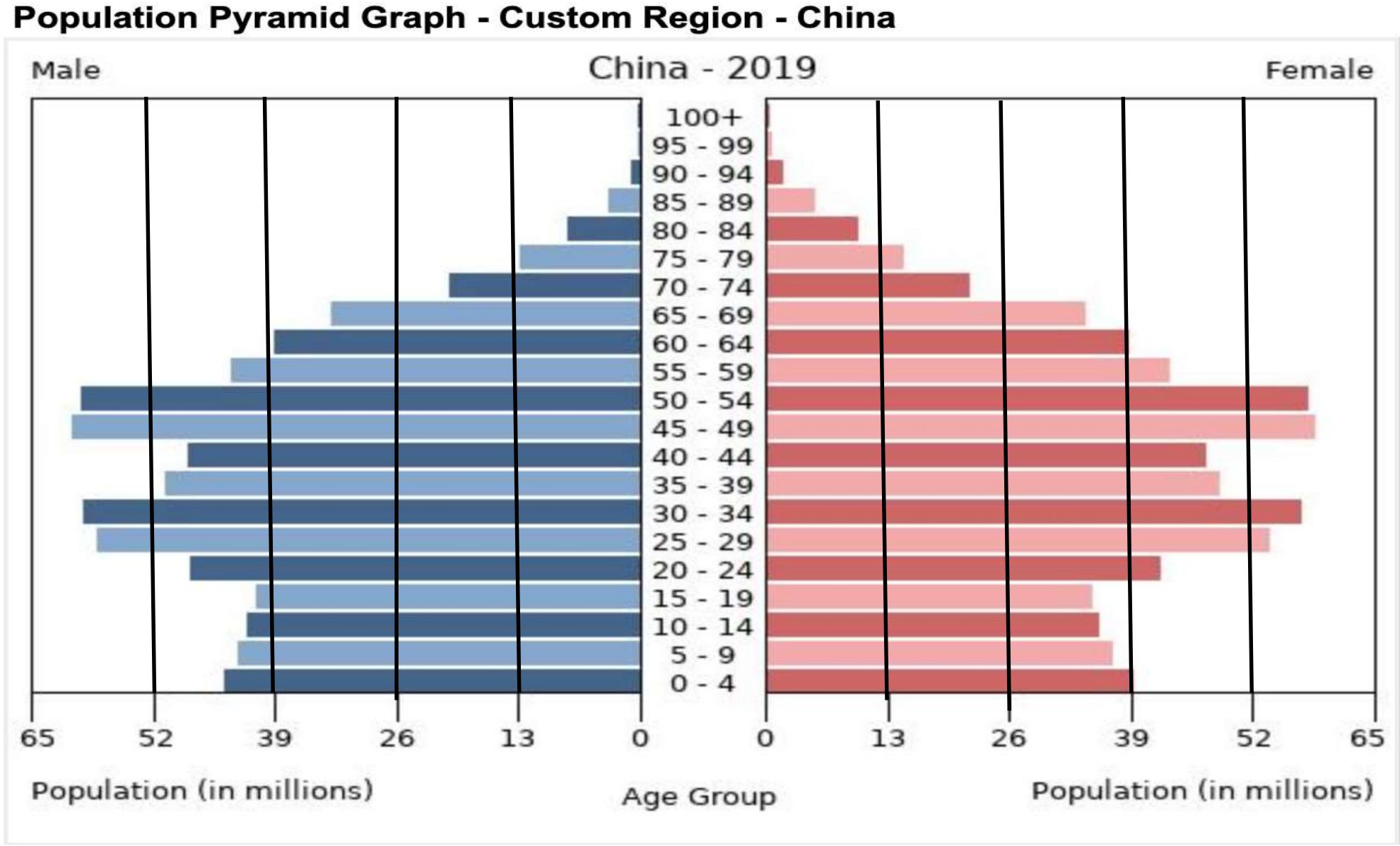
Demographic Overview - Custom Region - China

Demographic Indicators	1950	1960	1970	1980	1990	1995	2000	2005	2010	2015	2019	2025	2030	2040	2050
Population															
Midyear population (in thousands)	562,580	651,339	822,116	987,822	1,153,164	1,221,055	1,268,302	1,302,285	1,336,681	1,367,485	1,389,619	1,407,007	1,403,893	1,364,679	1,301,627
Growth rate (percent)	(NA)	(NA)	(NA)	(NA)	1.4	1.0	0.6	0.5	0.5	0.5	0.3	0.1	-0.1	-0.4	-0.6
Fertility															
Total fertility rate (births per woman)	(NA)	(NA)	(NA)	(NA)	2.2	1.8	1.6	1.5	1.5	1.6	1.6	1.6	1.6	1.6	1.6
Crude birth rate (per 1,000 population)	(NA)	(NA)	(NA)	(NA)	21	17	13	12	12	12	12	10	9	8	9
Births (in thousands)	(NA)	(NA)	(NA)	(NA)	24,216	20,843	16,298	15,523	15,907	17,080	16,523	13,958	12,144	11,532	11,103
Mortality															
Life expectancy at birth (years)	(NA)	(NA)	(NA)	(NA)	68	69	71	74	75	75	76	77	78	79	81
Infant mortality rate (per 1,000 births)	(NA)	(NA)	(NA)	(NA)	43	36	30	19	14	12	12	10	9	7	5
Under 5 mortality rate (per 1,000 births)	(NA)	(NA)	(NA)	(NA)	52	44	37	23	17	15	14	12	10	8	6
Crude death rate (per 1,000 population)	(NA)	(NA)	(NA)	(NA)	7	7	7	6	7	8	8	9	10	12	14
Deaths (in thousands)	(NA)	(NA)	(NA)	(NA)	8,384	8,315	8,701	8,074	9,130	10,297	11,242	12,396	13,604	16,212	18,015
Migration															
Net migration rate (per 1,000 population)	(NA)	(NA)	(NA)	(NA)	-0	-0	-0	-0	-0	-0	-0	-0	-0	-0	-0
Net number of migrants (in thousands)	(NA)	(NA)	(NA)	(NA)	-161	-220	-330	-391	-454	-602	-598	-605	-604	-600	-599

Source Information: China

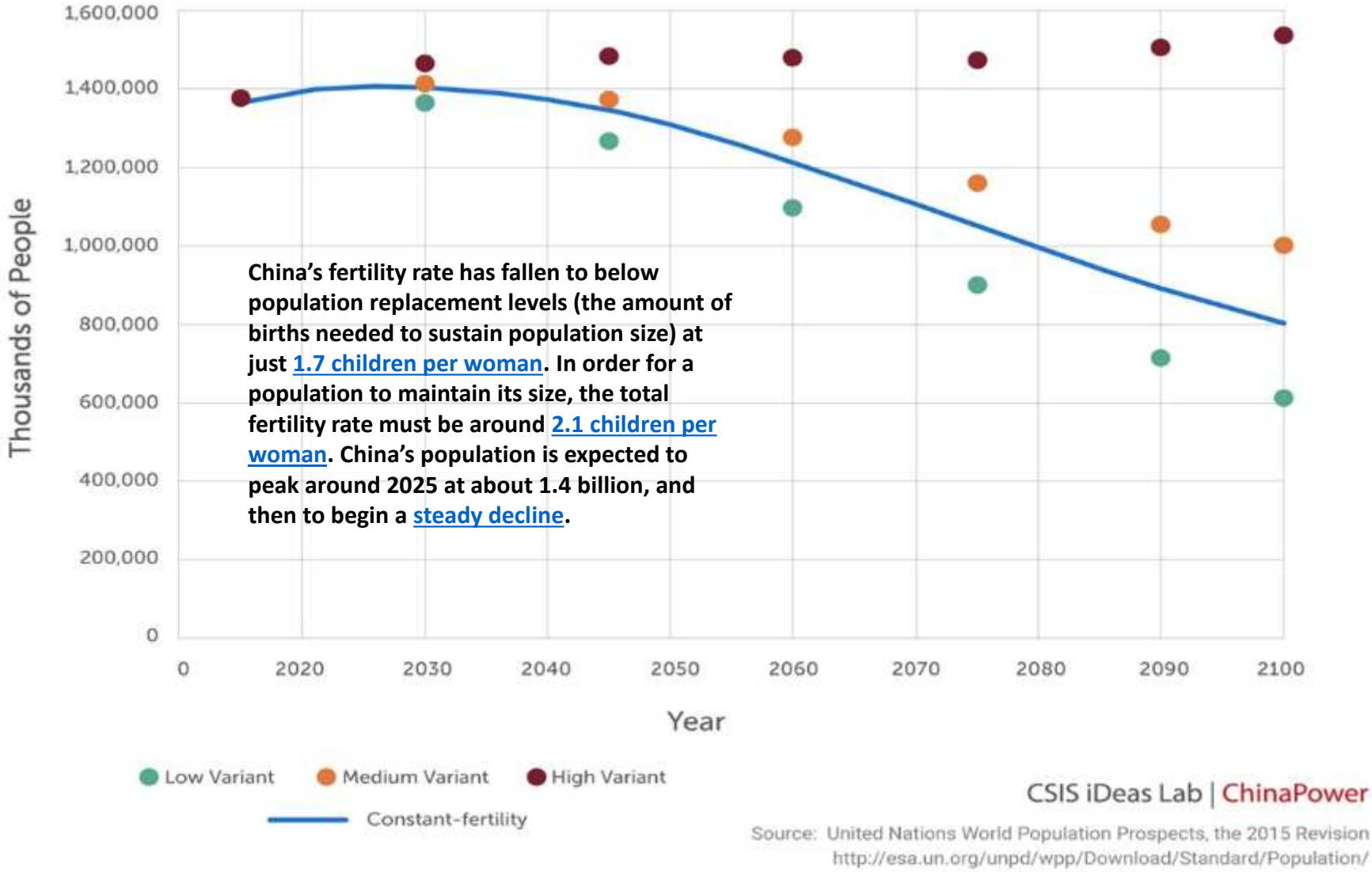
Source: US Census Bureau, International Data Base, https://www.census.gov/data-tools/demo/idb/region.php?N=%20Results%20&T=13&A=separate&RT=0&Y=1951,1953,1960,1970,1980,1990,2000,2010,2019,2030,2040,2050&R=-1&C=CH, Accessed August 21, 2019.

US Census Bureau Estimate of Population Pyramid



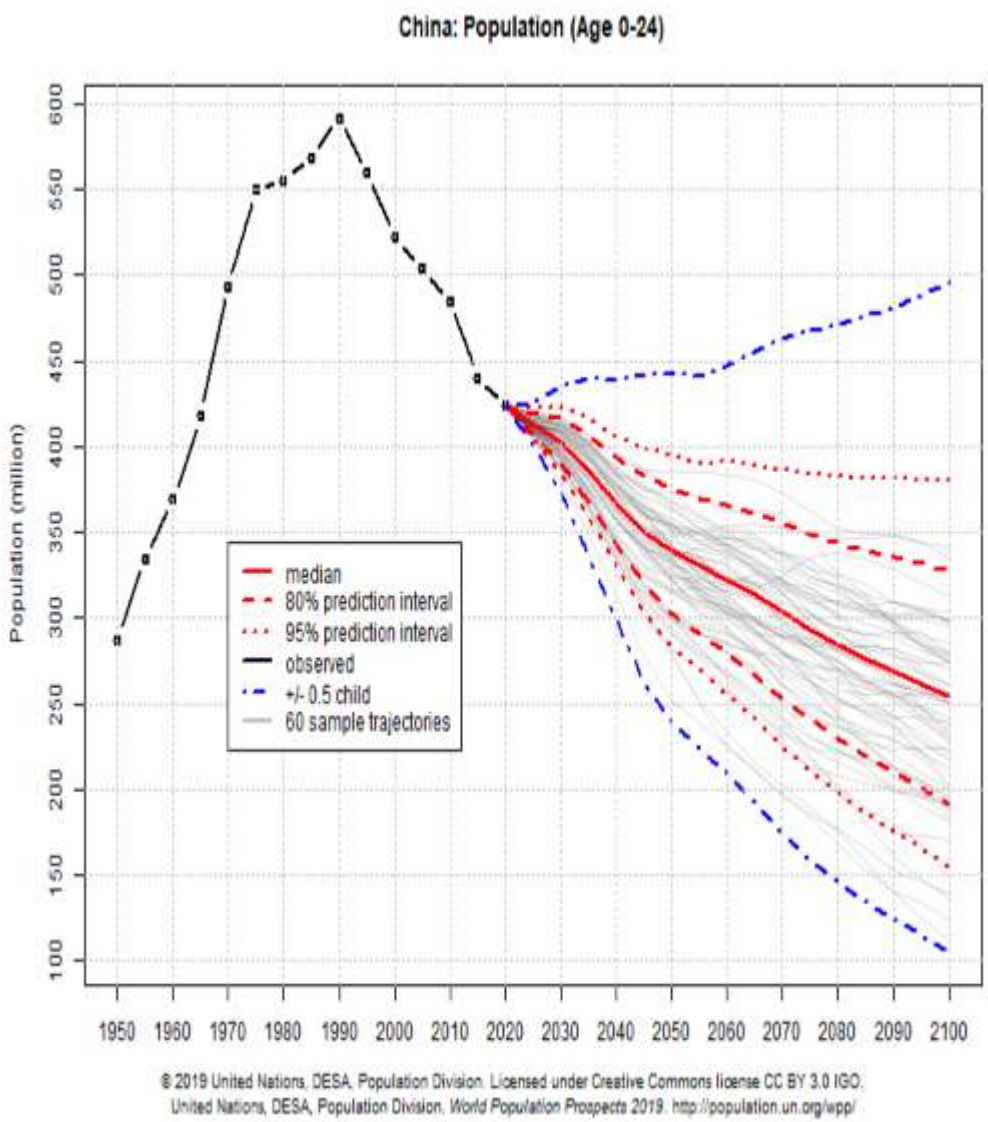
Source: US Census Bureau, International Data Base, https://www.census.gov/data-tools/demo/idb/region.php?N=%20Results%20&T=13&A=separate&RT=0&Y=1951,1953,1960,1970,1980,1990,2000,2010,2019,2030,2040,2050&R=-1&C=CH, Accessed August 21, 2019.

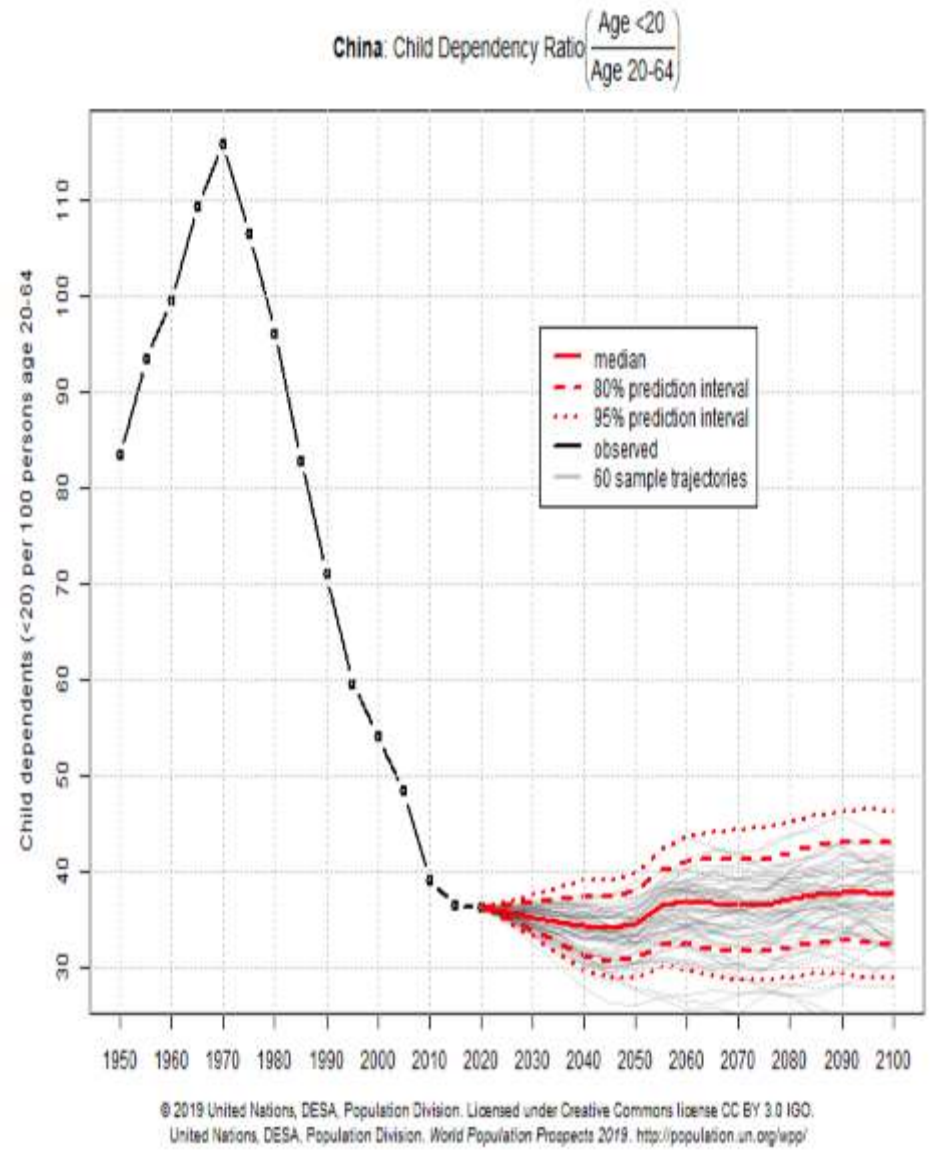
China's Uncertain Demographics: Population 2000-2100



CSIS, China Power Project, https://chinapower.csis.org/aging-problem/.

UN Estimate of Ongoing Drop in "Youth Bulge," Employment, and Child Dependency Needs





Source: UN, World Population Prospect, 2019, https://population.un.org/wpp/Graphs/Probabilistic/POP/TOT/156. .

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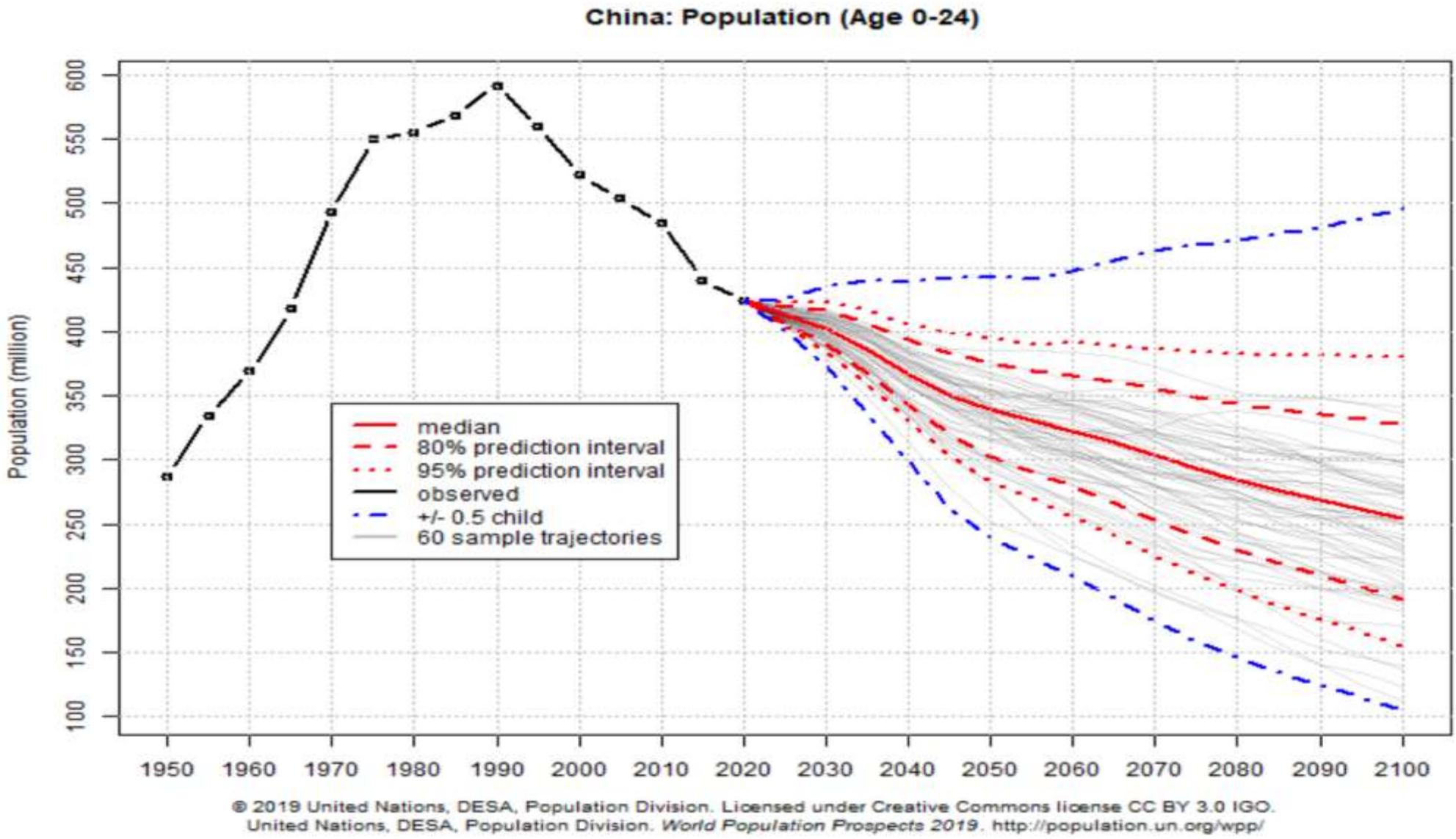
UN Estimate of Ongoing Drop in "Youth Bulge" and Employment and Dependency Ratio Needs



Source: UN, World Population Prospect, 2019, https://population.un.org/wpp/Graphs/Probabilistic/POP/TOT/156.

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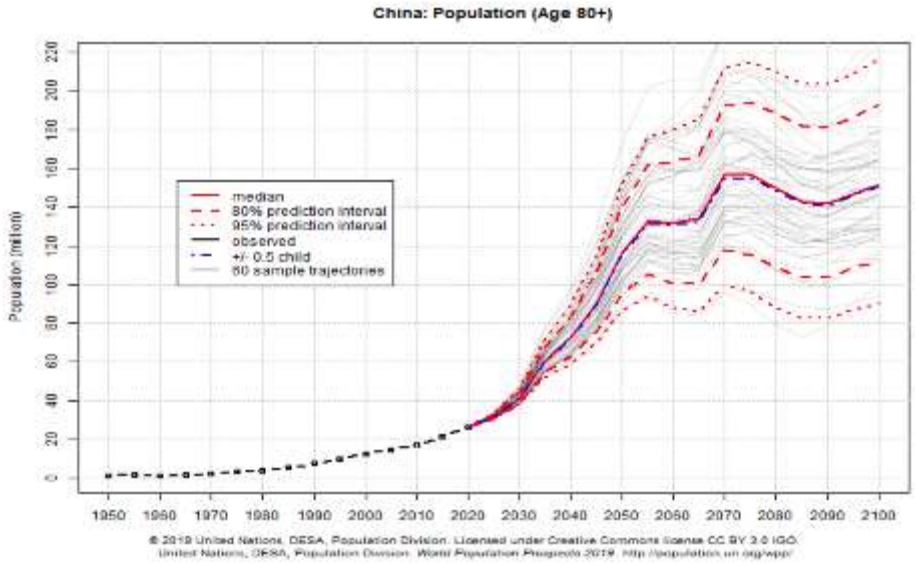
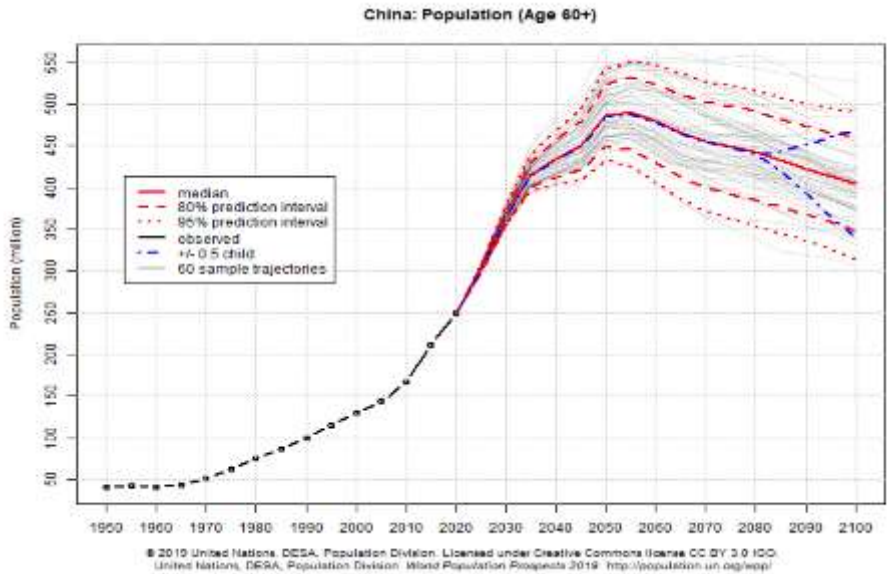
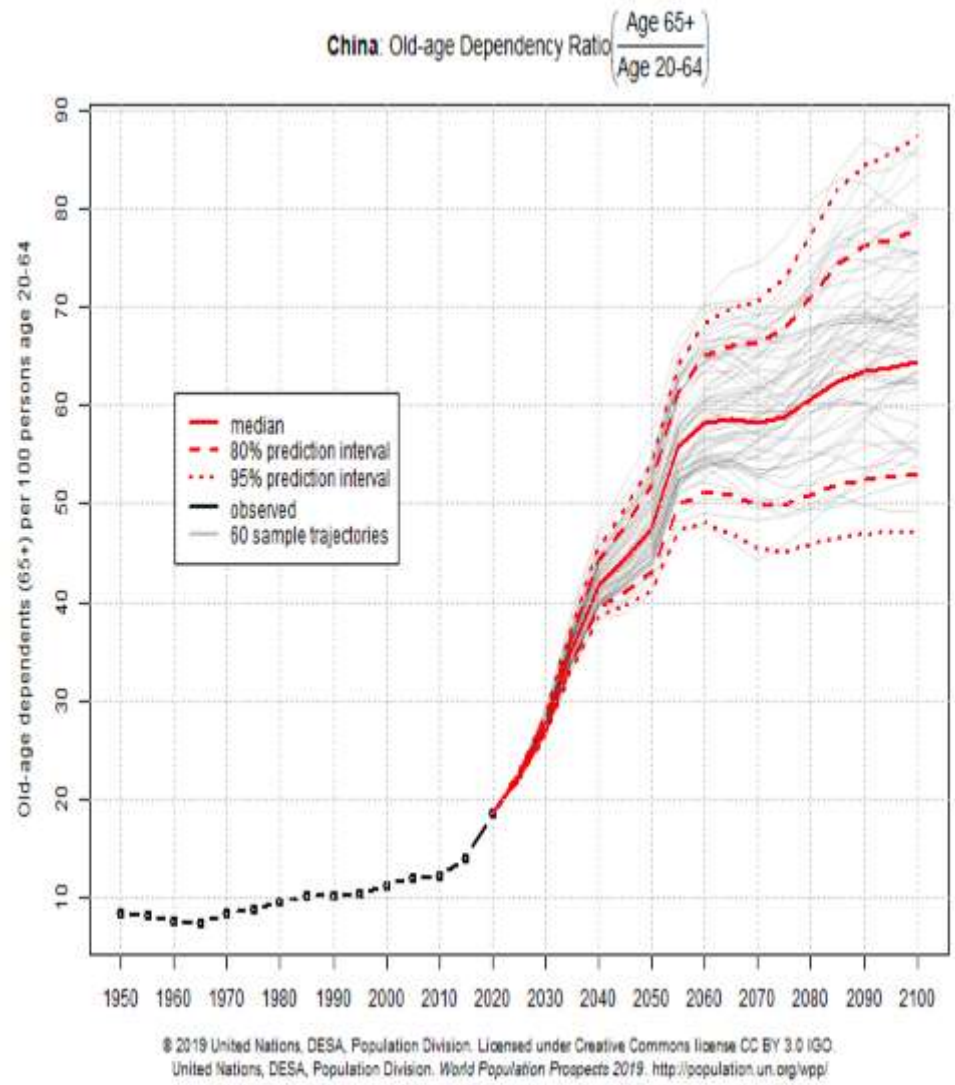
UN Estimate of Ongoing Rise in Aging Population and, and Old Age Dependency Needs







Source: UN, World Population Prospect, 2019, https://population.un.org/wpp/Graphs/Probabilistic/POP/TOT/156.

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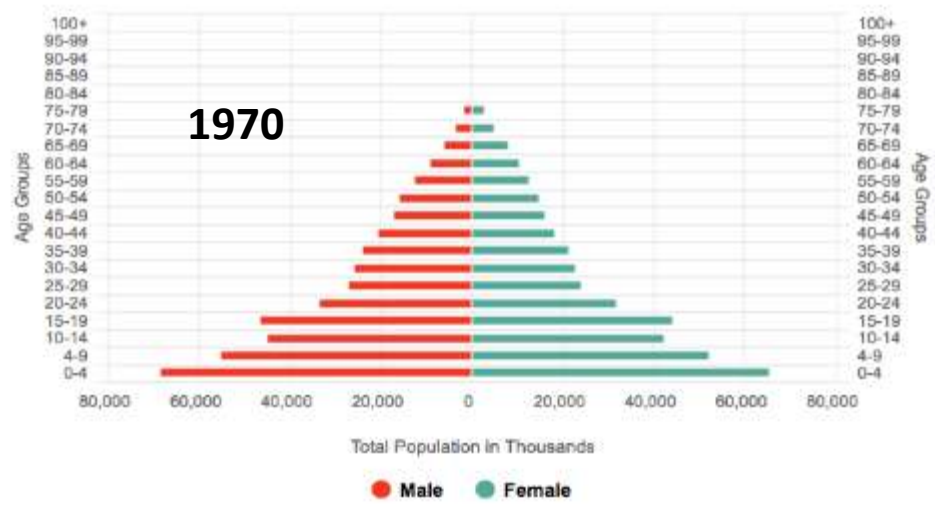
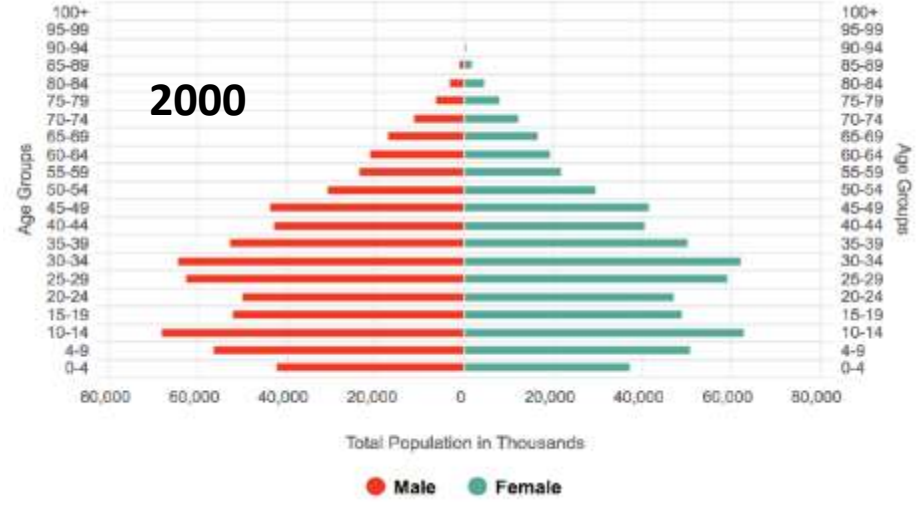
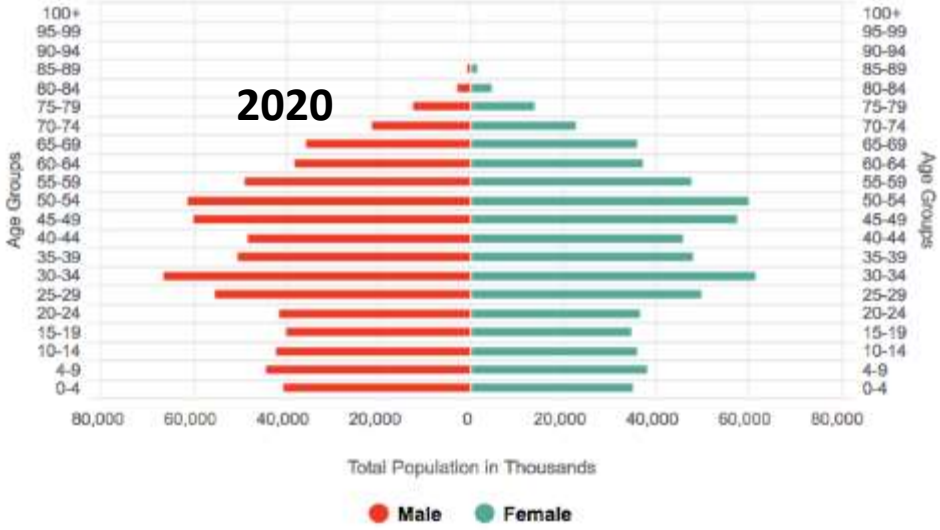
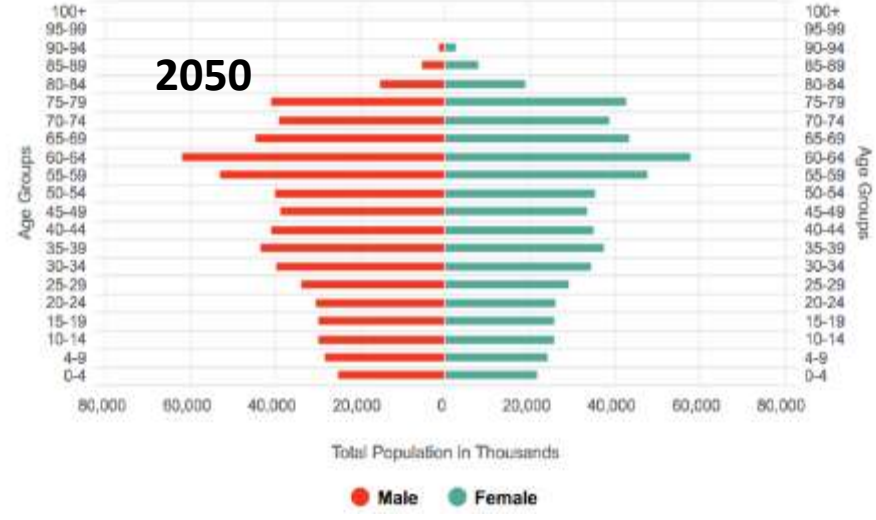
UN View of China's Changing Demographics: Aging and Sex 1970-2050









Percentage of Chinese above the retirement age is expected to reach 39 percent of the population by 2050. At that time, China's dependency ratio (the number of people below 15 and above 65 divided by the total working population) is projected to increase to 69.7 percent, up from 36.6 percent in 2015. This means that China will have a proportionally smaller working-age population with the responsibility of providing for both the young and old.

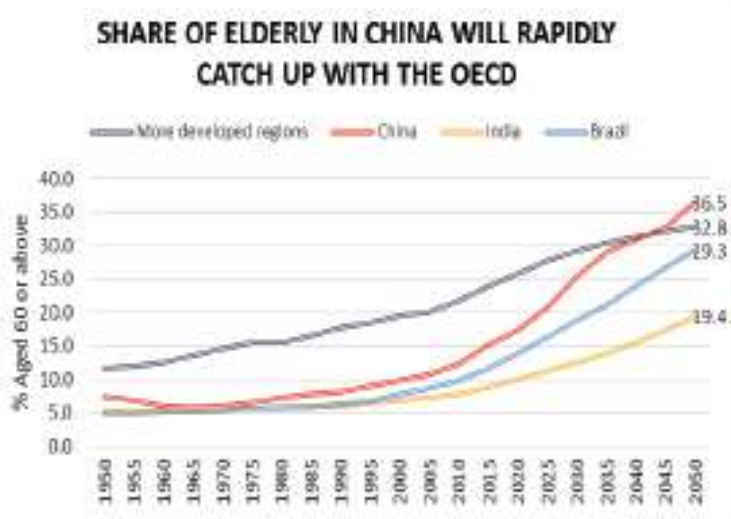
CSIS, China Power Project, https://chinapower.csis.org/aging-problem/. Data source is UN World Population Prospects.

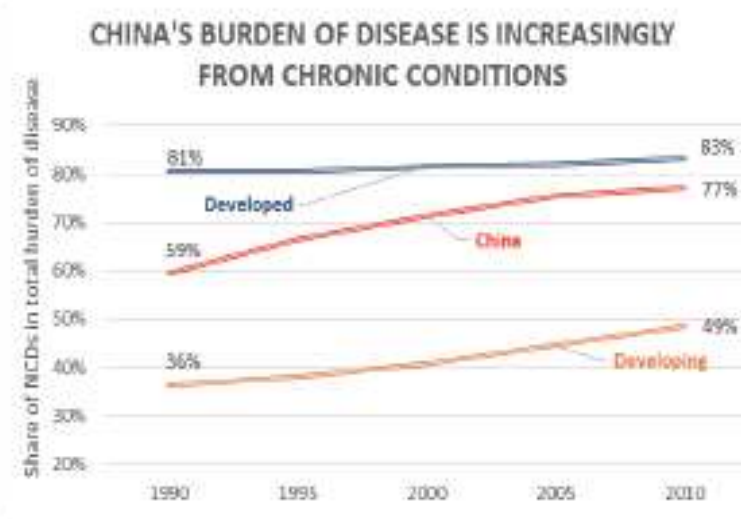
China's Continuing Sexual Imbalance: UN Estimate of Ratio of Males to Females in Percent: 1950-2100

Year	Males/ Females	Year	Males/ Females	Year	Males/ Females
1950	107.9	2005	105.6	2060	104.2
1955	107.1	2010	105.7	2070	105.2
1960	106.4	2015	105.6	2075	105.5
1965	105.4	2020	105.3	2080	105.6
1970	105.4	2025	104.9	2085	105.6
1975	105.4	2030	104.5	2090	105.5
1980	105.4	2035	104.0	2095	105.1
1985	105.4	2040	103.7	2100	104.7
1990	105.4	2045	103.5		
1995	105.4	2050	103.5		
2000	105.4	2055	103.8		

Source: UN, *World Population Prospect, 2019*, https://population.un.org/wpp/Graphs/Probabilistic/POP/TOT/156, and https://population.un.org/wpp/DataQuery/.

An Aging Population and Growing Health Issues





Sources: United Nations, Department of Economic and Social Affairs, Population Division (2015). I nstitute for Health Metrics and Evaluation (2010).

The aging of the population is increasing the population's vulnerability to poverty. Low fertility and declining mortality and rising life expectancy are translating into a rapidly aging society (Figure 2.11). In 2016 230.86 million people were above the age of 60, representing 16 percent of the total population, and both numbers are projected to increase. This can have significant implications for poverty because the elderly are less capable of earning income. Demand will continue to rapidly grow for a range of aged care services that traditional family-based arrangements may not be able to meet. The government has set up elderly care subsidy systems in 20 provinces for the elderly with economic difficulties. The government has also provided for the poorest elderly people through the Destitute Support programs, but these programs cover just over 5 million people (in 2011).

Noncommunicable diseases (NCDs) are responsible for 77 percent of the loss of healthy life and for 85 percent of all deaths, giving China a profile similar to OECD countries. In comparison, a mere quarter century ago, injuries, communicable diseases, and newborn, nutritional, and maternal conditions accounted for 41 percent of the burden of disease in China, a profile little different from that of the average developing country today (Figure 2.11). Cardiovascular diseases and cancers alone account for more than two-thirds of China's total mortality. [112] The growth of chronic illnesses in China are due to high-risk behaviors such as smoking, poor diets, sedentary lifestyles, and alcohol consumption, as well as environmental factors such as air pollution.[113] An alarming 49 percent of Chinese men are daily smokers, a proportion more than twice the OECD average. The incidence of NCDs is particularly high among the elderly.

Source: World Bank Group, *China Systematic Diagnostic, Report 113092-CN, 2017, p. 40.*

China's Gender Gap vs. Aging: Population 2015-2050

Ratio of males to females was 1.06:1 in 2015. Projected to be 1.08: 1 in 2050. But, gender roles may be more important than number.

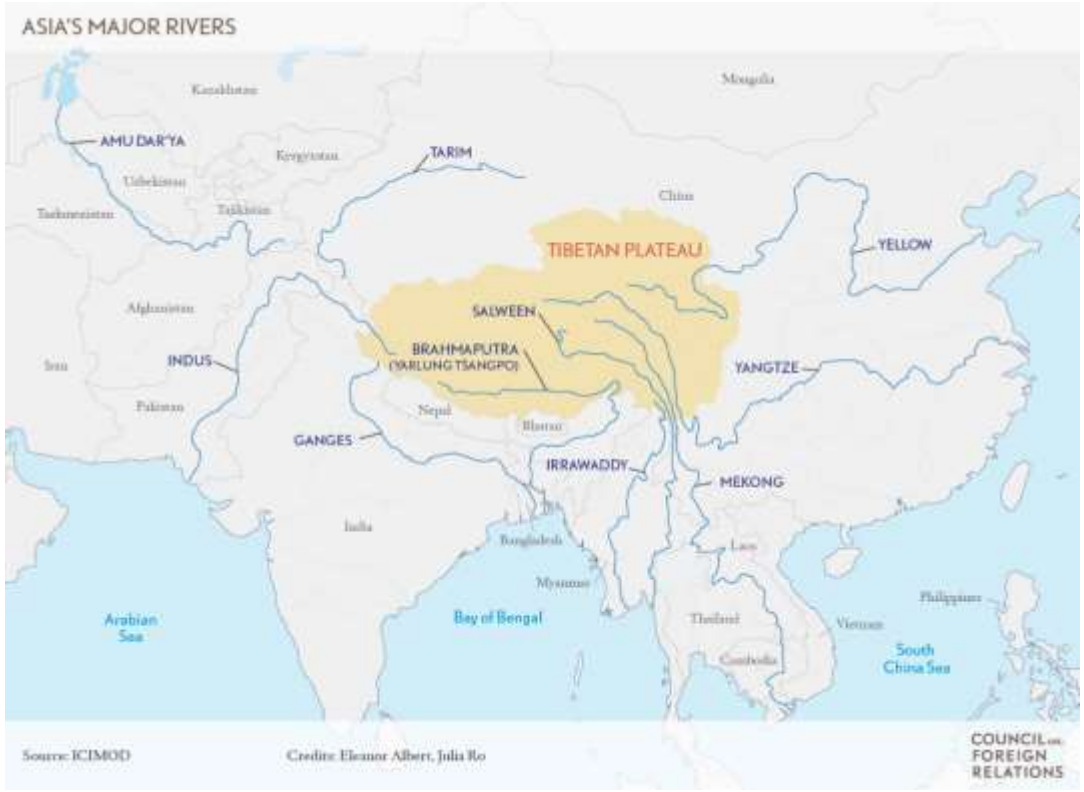
Aging may be far more serious. China is aging at a rate that few countries have matched historically.

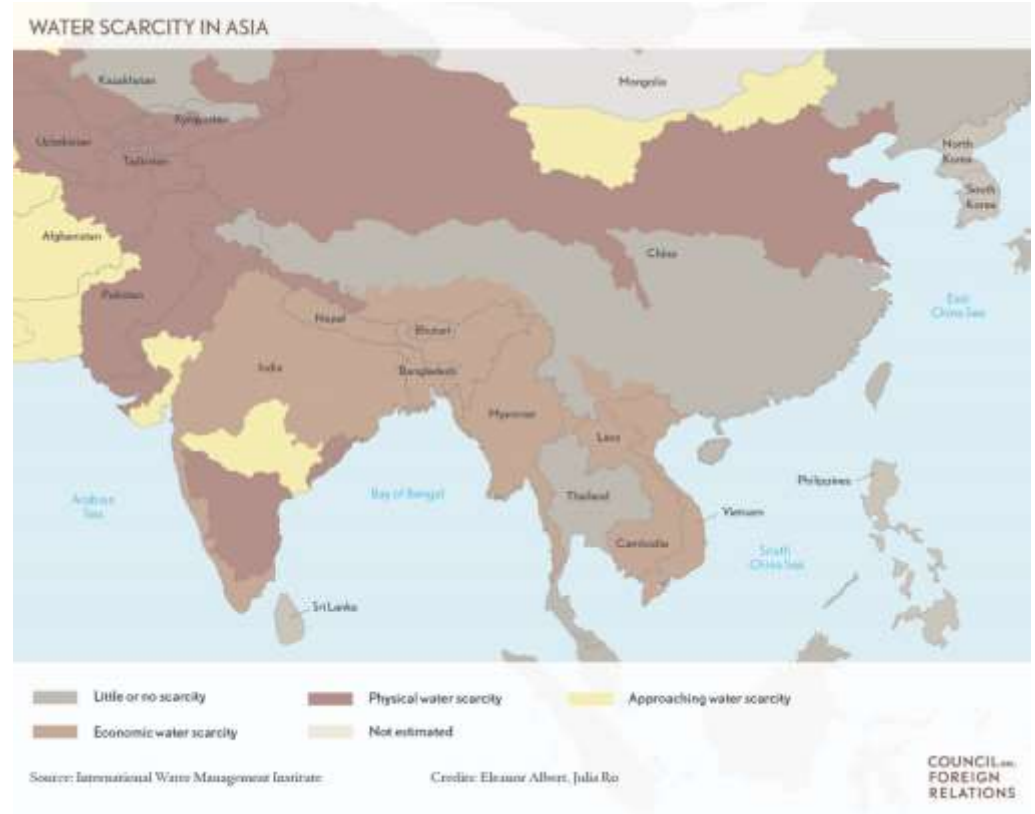
While it will take China 20 years for the proportion of the elderly population to double from 10 to 20 percent (2017-2037), this process took 23 years in Japan (1984-2007), 61 years in Germany (1951-2012), and 64 years in Sweden (1947-2011).

Japan is the oldest country in the world, and has aged more quickly than most other nations. In 2015, 9.5 percent of the population of China was aged 65 or older. The UN projects this percentage to 27.5 by 2050.

CSIS, China Power Project, https://chinapower.csis.org/aging-problem/.

China's Reliance on (Clean) Water from Tibet





The Asian Development Bank (ADB) estimated that more than 75 percent of the broader Asia-Pacific region suffers from water insecurity, and that South Asia's problems are severe. The subregion, much of which relies on water from the Tibetan Plateau, supports more than 20 percent of the world's population but only accesses 8 percent of the world's water resources.

Scores of upstream water projects underway, such as water diversion or dam construction, may alter the quality and quantity of water available to lower riparian states. While the greater Himalayan region as a whole struggles to deal with growing demand for water, individual countries face different challenges. Some depend on external water flows—for example, Bangladesh, Pakistan, and Uzbekistan have 91.4 percent [PDF], 77.7 percent, and 80 percent dependency ratios [PDF] (the amount of total renewable water resources originating beyond a country's borders), respectively.

India and China top the list of countries with the greatest number of people living without access to safe water, 75.7 million and 63.1 million respectively, based on a March 2016 report from global charity WaterAid. Water pollution has also increasingly been linked to elevated levels of cancer in local communities, especially in China and India.

Source: Eleanor Albert, "Water Clouds on the Tibetan Plateau," *Council on Foreign Relations*, May 9, 2016. https://www.cfr.org/backgrounder/water-clouds-tibetan-plateau