Economic Research:

China Credit Spotlight: The Great Game And An Inescapable Slowdown

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Key Takeaways

- After four golden decades, China faces an inescapable slowdown due to demographics, deleveraging, rebalancing, and convergence. This is natural an d mostly healthy.
- Productivity will set the pace of China's slowdown and will depend on the ability to acquire, create, and deploy technology. Reform unleashing markets will be key.
- The Great Game--trade and technology tension with the U.S.--will make the slowdown harder to manage. It may slow China's tech progress and impede productivity at least through 2030. Costs will not be borne solely by China.
- We believe China can grow, on average, by 4.6% over the next decade with moderate reforms and a stalemate with the U.S. A sustained escalation could see growth fall to 3.7%, implying an economy that is 10%, or almost US$2.5 trillion, smaller than the base case by 2030.
- There is an upside. If China steps up efforts to allow markets a freer rein and reaches an understanding with the U.S., we think growth could average 5.4% through 2030.

China's growth slowdown will extend through 2030. Deteriorating demographics and declining productivity growth mean this is almost 100% guaranteed. Of course, there are two known unknowns:

- How much will growth slow?
- Will the slowdown be gradual or bumpy?

China's "New Normal," a concept formally unveiled in early 2014, explicitly recognizes that growth will slow. In response, policymakers have been trying to address these two known unknowns with a two-pronged strategy.

First, supply-side reform. The main idea is to foster a more innovative economy that relies less on the old drivers of growth and more on advanced manufacturing and technology-enabled services.

This vision was set out clearly in the 2015 13th Five-Year Plan. [1] This strategy aims at lifting productivity and ensuring China can continue to grow relatively quickly, despite the structural forces slowing growth.

Second, reducing financial risks. The main focus has been to strengthen supervision and regulation, tighten budget constraints, and, in some cases, introduce a greater role for market forces. S&P Global Ratings interprets these efforts as aiming at smoothing the economy's descent and avoiding the turbulence associated with financial instability.

It is arguable how much progress China had made with this strategy before the Great Game--the tussle with the U.S. over trade, investment, and technology--began in early 2018. On supply-side reform, private firms have ignited growth in sectors such as e-commerce, fintech, and advanced manufacturing. At the same time, there are other signs, including an increasing state-owned enterprise footprint in the economy, that the balance has tilted toward the state and away from the market. China made progress in reducing financial risks but the costs to near-term growth were becoming painfully apparent at the end of 2018. Develeraging has paused more recently.

The "New Great Game" is a serious complicating factor. We define this game from an economic and financial perspective, as a strategic interaction in which both players adjust trade, investment, and technology policies in a unilateral and discretionary way to achieve their objectives. We would distinguish this from a multilateral rules-based relationship associated with high levels of trust and cooperation.

Our view is that a prolonged Great Game--the absence of a lasting deal on trade, investment, and technology--will make China's slowdown harder to manage. Other economies will also suffer costs but here we focus on China. Our reasoning is simple.

- Opening up to foreign trade and investment and reforms unleashed technology-enabled productivity and fueled China's growth surges of the past four decades.
- The Great Game and sluggish reform momentum may slow the pace at which China acquires, creates, and deploys technology across its economy.
- In turn, this would slow productivity growth, which is the economy's only remaining rocket booster.

In short, we believe that the more local China becomes, the slower it will likely grow.

There are upside scenarios. China could surprise the world by both localizing and developing frontier technology rapidly. This is possible but we think unlikely. Based on our reading of the historical evidence, the pace of technological change for countries catching up to the frontier is usually faster when they are more open. We do not dispute China's capacity to reach the frontier, on its own, at some future date. We do think this will take longer if it mainly relies on self-reliant innovation.

A more plausible upside over a 10-year horizon is that China moves quicker on opening up and market-based reforms. That may not only defuse the Great Game but also sustain productivity growth. In this scenario, China would still slow but would continue to outperform global growth. Much will depend on the path China chooses.

China's Four Golden Decades

In the 25 years before China's opening up in 1978, growth was highly volatile and low on average for such a poor country at just 6%. Since then, China has enjoyed four golden decades in which it has grown faster than the rest of the world every year. It has avoided major economic and financial

crises and the economy has expanded at an average rate of about 9%.

Opening up and reforms foreshadowed surges in growth

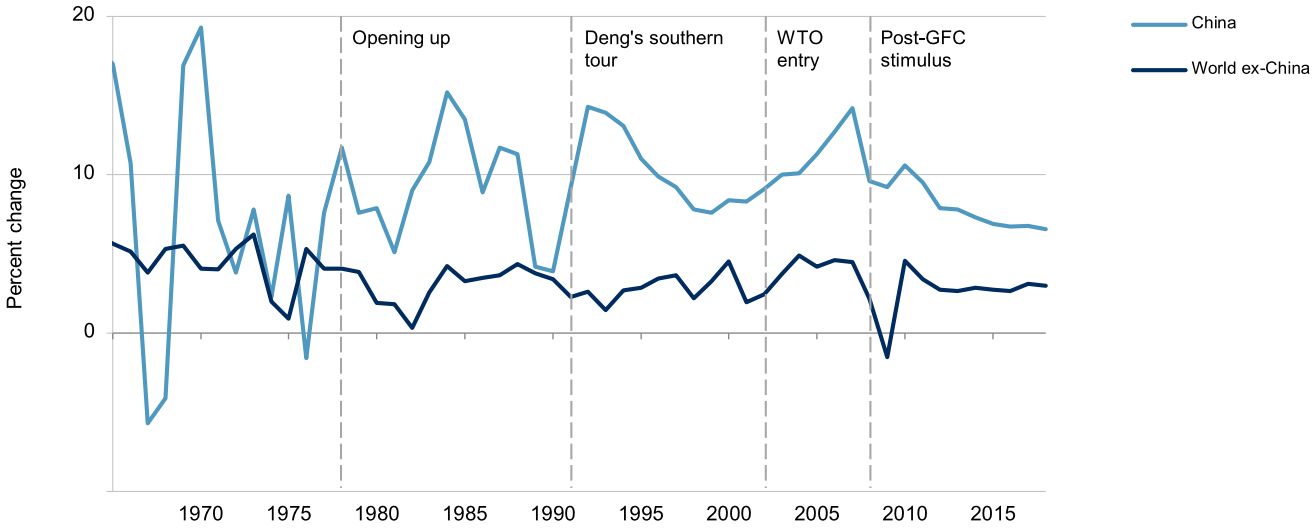
Many reasons lie behind China's spectacular performance over the last 40 years. Still, we think it is no coincidence that breakthrough reforms that opened China to the world and provided a larger role for markets in the economy preceded sustained surges in growth. Three inflexion points are noteworthy:

- 1978: the start of opening up and market-based agricultural reform.
- 1992: Deng Xiaoping's southern tour and the growth of special economic zones.
- Late-1990s: State-owned enterprise (SOE) reform and financial sector clean-up in the run-up to World Trade Organization (WTO) entry in 2002.

China's growth rose, often for as long as a decade, following these breakthrough reforms (see chart 1). Another pattern is evident. These reforms, which required politically hard choices and, in the short term, often entailed painful economic costs, followed periods in which growth was faltering. This is a testament to China's ability to change course in the face of looming economic challenges.

Chart 1

China's Four Golden Decades Of Growth
China's real GDP growth over time



Sources: Penn World Tables 9.1, International Monetary Fund, Conference Board, and S&P Global Economics.

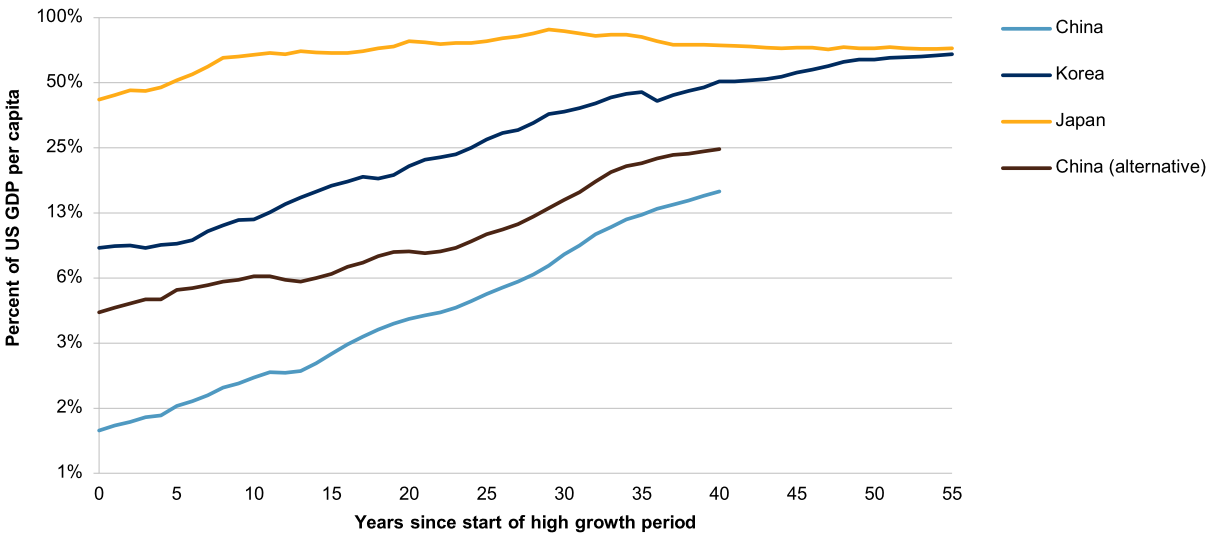
China's extraordinary catch-up...

China was very poor before opening up and should have been growing rapidly. In 1978, official data show that per capita income was less than 2% of that in the United States. From a low base, China is following the footsteps of its most successful neighbors Japan and Korea, as we show in chart 2. This compares real incomes per capita, relative to the U.S., for all three economies at the start of their high growth periods. We have adjusted the scale to reflect progress; while a rise to 10% from about 1% may not seem much, in reality, it means China became more than 10x richer relative to the U.S. To repeat that success from 10% would mean getting to 100%. We have also included alternative data for income per capita from the well-known Penn World Tables (see sidebar: Alternative Histories Of Growth).

We draw two comforting conclusions from this picture. First, China was much poorer when it began its high-growth period than either Japan or Korea. This gives China more headroom to keep growing relatively quickly. Second, China's progress is good but not unprecedented.

Chart 2

China Follows Path Blazed By Japan And Korea
Real GDP per capita evolution in Asia



The series 'China (alternative)' uses Penn World Table estimates for China's GDP. Source: Penn World Tables, Oxford Economics, and S&P Global Economics.

... means China is now comfortably middle income...

A simple way to express China's progress is by comparing income per capita in U.S. dollars at 2018 prices across countries. Table 1 shows how far China's income capita has come and how it compares with the average, or median economy.

Table 1

China's Rise Through The Income Ranks

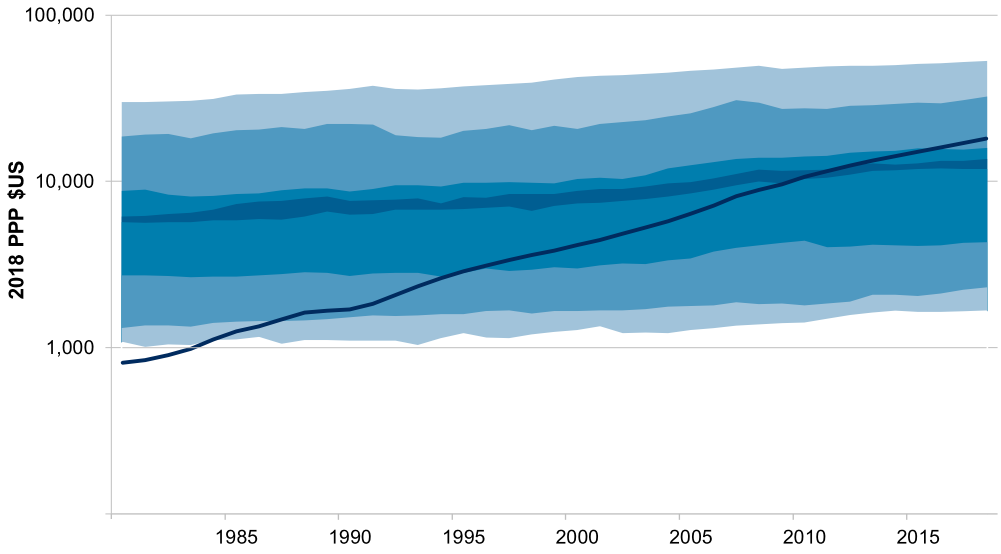
	Economy		GDP size			
Year	Median	Closest to China	Median	Closest to China	China	United States
1980	Angola	Ethiopia	5,936	818	812	32,778
1990	Thailand	Tanzania	7,422	1,708	1,705	41,344
2000	Serbia	Angola	8,698	4,193	4,142	51,344
2010	Dominica	Jordan	11,578	10,710	10,623	55,590
2018	Bosnia	Azerbaijan	13,491	18,076	18,110	62,606

Note: GDP per capita in 2018 U.S. dollars measured using PPP exchange rates. Sources: World Bank, International Monetary Fund, and S&P Global Economics.

We take a broader perspective in chart 3 and show China's income per capita compared with a distribution of 194 economies each year since 1980. China's climb through the income distribution has been steady since 1978 and exceeded the median country less than a decade ago. The message is clear--China is now comfortably middle income but is still some way from being a rich country.

Chart 3

China Is Comfortably Middle Income But Not Yet Rich
China's GDP per capita compared with the global distribution



Distribution of US$ GDP per capita at 2018 prices and PPP exchange rates of 194 economies. Shading denotes the 10th, 25th, 45th, 55th, 75th, 90th percentiles of the distribution. Sources: World Bank, International Monetary Fund, and S&P Global Economics.

...but poorer provinces still have headroom

As China has become richer, the income gap across provinces has narrowed somewhat but remains stubbornly wide. Table 2 shows the average GDP per capita for the richest and poorest three provinces. We compare these provinces to countries with similar income levels and see a range from low-income to upper-middle income peers.

Table 2

More Than One Chinese Economy

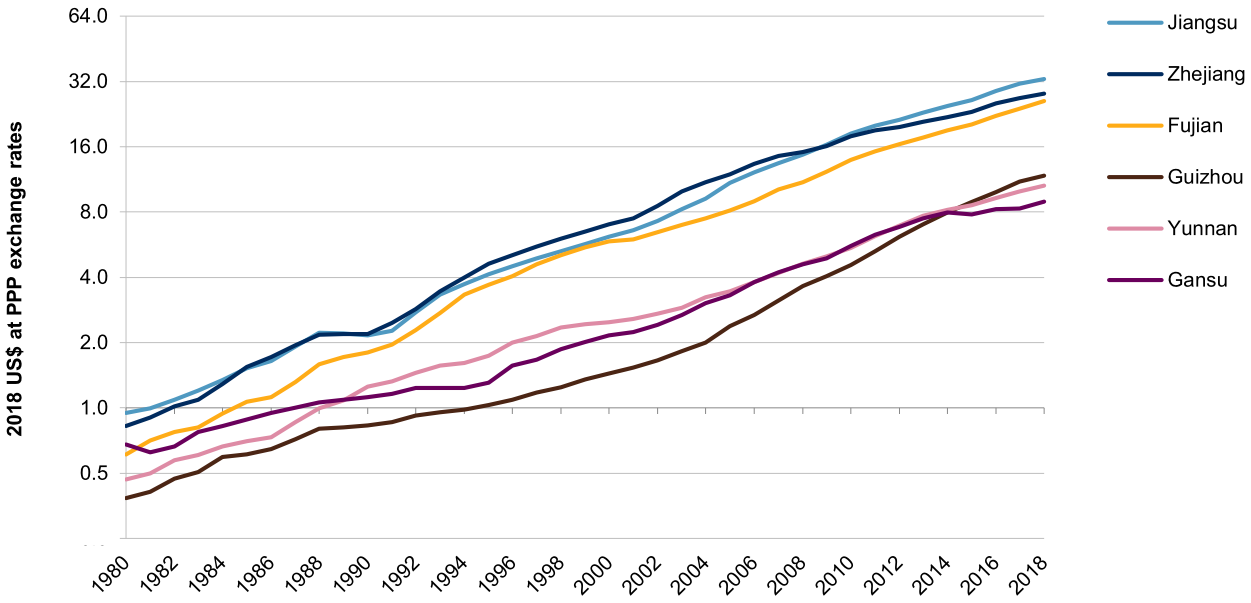
	Economy closest to China's:		GDP size			
Year	Richest 3 provinces	Poorest 3 provinces	Rich peer country	Poor peer country	China's Richest 3 provinces	China's Poorest 3 provinces
1980	Cape Verde	Lesotho	800	508	794	510
1990	Nigeria	Madagascar	2,037	1,078	2,048	1,068
2000	Paraguay	India	6,400	2,026	6,327	2,028
2010	Uruguay	Nigeria	16,623	5,126	16,716	5,201
2018	Greece	Fiji	29,123	10,234	28,966	10,419

Note: GDP per capita in 2018 U.S. dollars measured using PPP exchange rates. Excludes Beijing, Shanghai, and Tianjin. Source: World Bank, International Monetary Fund, and S&P Global Economics.

Chart 4 shows that the three provinces with the highest income per capita earn about 3x as much as the bottom three, which is very close to the average multiple between the top and bottom three since the start of China's golden period. (We exclude the municipalities of Beijing, Shanghai, and Tianjin.) While this shows the extremes of the distribution, the general picture does not change much if we include all provinces.

Chart 4

China's Income Gap Has Remained Wide
China's wealthiest and poorest provinces measured by GDP per capita



GDP per capita in 2018 US$ at PPP exchange rates. Source: National Bureau of Statistics, International Monetary Fund, and S&P Global Economics.

One interpretation of Chart 4 is that China's economy resembles a fast locomotive pulling carriages. In other words, the richer coastal provinces that have most enjoyed the fruits of opening up drag their poorer peers behind them. Of course, the reality is more complex. When we think about long-term growth, the key question is whether, if the rich provinces slow down, can the poorer laggards ignite growth, close the gap, and prevent the overall economy from stalling. Can Gansu become more like Jiangsu?

Alternative Histories Of Growth

To tell the right story about China, we need to make sure we have all the facts. That's why any discussion of China's growth should acknowledge uncertainties about data. Accurately charting China's growth is hard, given the country's size, rapid transition, unique institutional structure, and legacies from the central planning era. The National Bureau of Statistics has made much progress in refining the national accounts but previous research does suggest it may have overstated growth for a few reasons as set out in table 3.

Other research, however, contradicts these findings and concludes that the official data are either broadly correct or even understated. One reason is that we should not be surprised that productivity is especially high in a transition economy. [8] Some authors have used similar alternative data, satellite night imagery, and concluded that growth rates are understated. [9].

With evidence in both directions, we base our analysis on official data but, where relevant, present some perspectives using well-known alternative datasets.

Table 3

Previous Research Has Concluded China's GDP Growth Is Overstated

Reason	Why This Could Overstate Growth	Key papers (see references)
Service sector productivity	Estimates of growth in this sector well above the historical experience in a broad range of countries.	[2], [3]
Employment data breaks	Large unexplained rises in employment in earlier periods may understate the historical level of GDP and overstate subsequent growth.	[4]
Price indexes	Possible downward bias to the change in price indexes which, when used to deflate nominal output, results in higher growth.	[5]
Alternative data	Broader range of data that are likely correlated with output (e.g., value-added tax receipts and satellite night light imagery) are consistent with lower growth.	[6], [7]

Source: S&P Global Economics.

China's Productivity Booster Rocket Is Losing Power

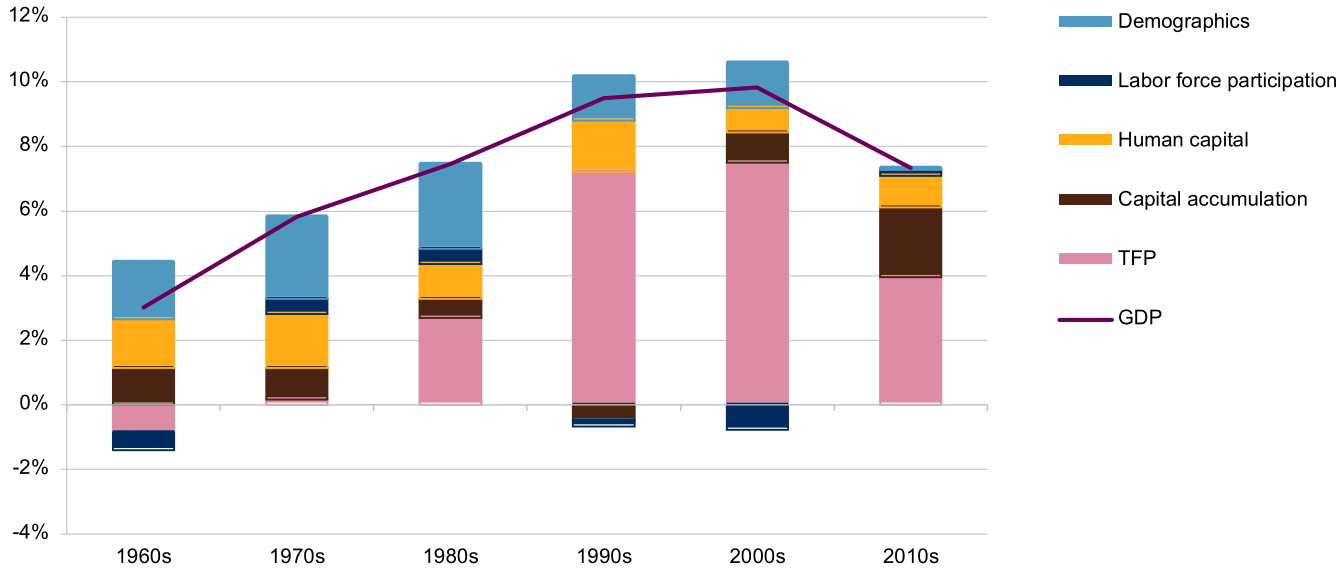
We find it helpful to unpack China's growth from the supply side and we show the results in chart 5 (see Appendix for details). Here are our takeaways from this breakdown. First, the economy benefitted from a rising number of people of working age, the so-called "demographic dividend," in the 1970s and 1980s (the light blue bar). Second, these workers were steadily more educated and skilled, which added to the economy's potential (the yellow bar). Third, high investment rates and rapid accumulation of fixed capital has also lifted growth, especially in the last decade (the brown bar).

Our main conclusion, though, is that productivity--China's ability to get more out of the same amount of capital and labor--has been the booster rocket driving China's rapid growth over the

past four decades (the pink bar.) The official data suggest that productivity lifted growth by more than 5 percentage points between the 1980s and the 2000s, making it the biggest contributor, by far, to China's stellar performance.

Chart 5

Accounting For China's Growth Since 1960

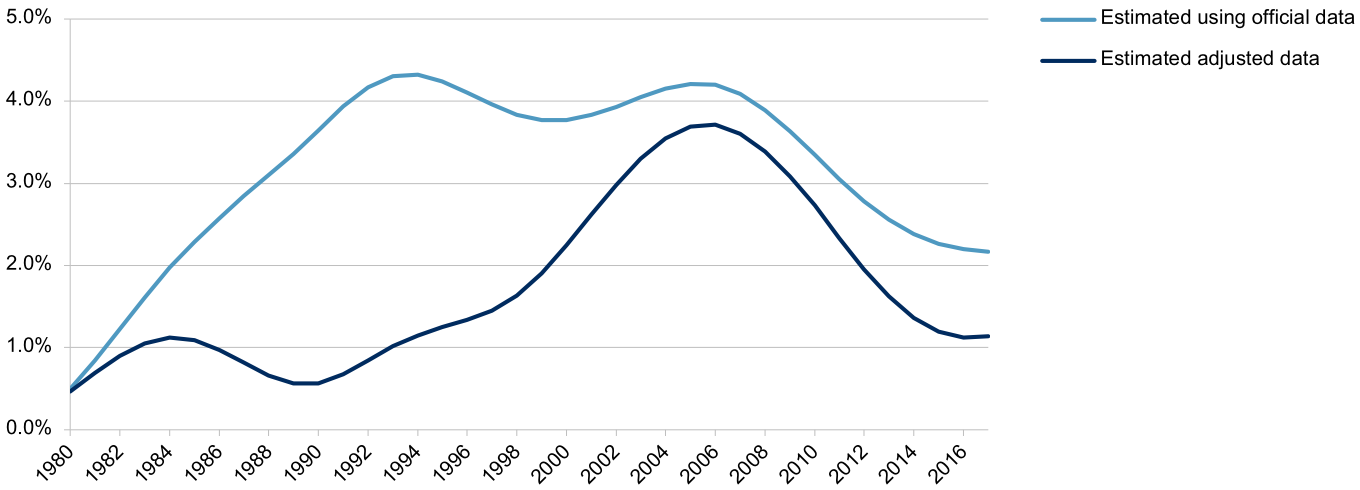


Source: Penn World Tables 9.1, National Bureau of Statistics, Oxford Economics, and S&P Global Economics.

China's productivity booster rocket, while not flaming out, is now waning. Chart 6 shows an estimate of trend productivity growth based on official and alternative data (in this case the University of Groningen's Penn World Table 9.1 or PWT). [10] Official data point to a rise in trend productivity growth that happened earlier and was more powerful than suggested by the PWT. Still, both illustrate a surge and a pronounced slowdown that began just after the global financial crisis of 2008.

Chart 6

China's Waning Productivity Growth



Hodrick-Prescott filtered trend of total factor productivity. Sources: PWT, CEIC, and S&P Global Economics.

Productivity's substantial contribution to China's growth since 1980 suggests we must have a view of its future path if we are in the business of medium-term forecasts. There are good reasons to expect productivity growth to continue slowing and trade-tech tensions with the U.S. are likely to apply more downward pressure.

China's Inescapable Slowdown

After four Golden Decades, China now faces an inescapable slowdown through the next decade and beyond. This is due to four deep, structural factors.

- Demographics: China's labor force has peaked and has begun to shrink--steadily for now but more quickly over time.
- Deleveraging: China will rely less on debt-financed capital accumulation to guard against financial stability risks.
- Convergence: China is getting richer and there is less scope for technology transfer and catch-up, especially in richer locomotive provinces.
- Rebalancing: Services will drive the economy more than manufacturing. Productivity growth is--always and everywhere--slower in services.

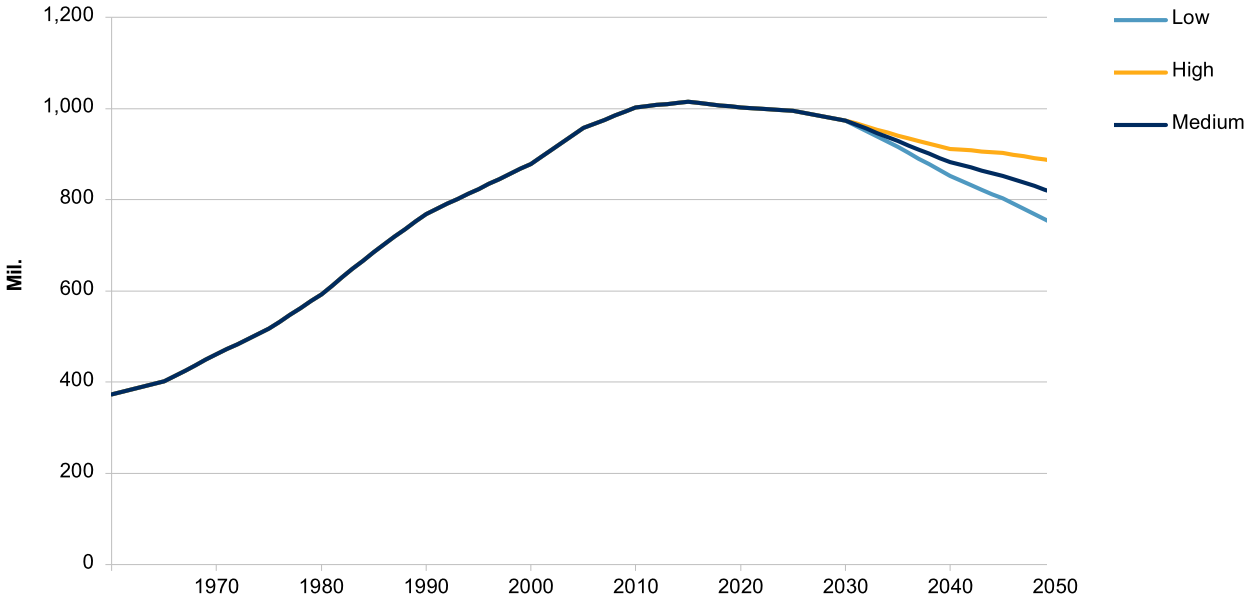
Demographic destiny means fewer workers

Chart 7 shows that China may have passed the Lewis Turning Point--the transition from a labor-surplus to a labor-shortage economy--just a few years ago. [11] This is not just due to demographics--it also depends on surplus agricultural labor--but declining fertility rates will be

the main driver in the future. The United Nations estimates that the working-age population grew fastest in the 1980s at over 2.6% per year and projects that it will hardly grow at all in the 2010s before shrinking by 0.3% per year in the 2020s.

Chart 7

China's Working Age Population Has Peaked



Population aged between 15 and 65 years. Low, medium, and high refer to the United Nations estimate variants which differ according to assumptions. Sources: United Nations and S&P Global Economics.

Rising labor force participation, that is more people of working age making themselves available for employment, is unlikely to offset this trend. Participation rates fell steadily by about 10 percentage points to 70% over the past three decades, based on different estimates. [12] Persistent factors, such as the 1990s' restructuring of state-owned enterprises (which eliminated many regular jobs) and more students attending tertiary education, are unlikely to reverse.

Deleveraging leaves limited space for capital accumulation

China can no longer rely on exceptionally high investment rates and rapid capital accumulation for growth. The reasons are well known. While investment, largely funded by credit, helped the economy grow since 2008, there is strong evidence that the marginal return on capital has fallen. Debt may also be increasingly used to buy existing assets rather than new productive capital. This has contributed to the debt problem.

One way to see this is a higher credit intensity of growth--the amount of non-financial sector credit associated with a RMB1 rise in GDP has risen from about 1x before 2008 to about 3x since

then (we exclude central government borrowing from our measure of credit). Credit intensity will determine the steady-state debt-to-GDP ratio. If intensity averages 3x over a sustained period, then debt-to-GDP will settle at 300%.

S&P Global Ratings believes that deleveraging remains a policy objective for China. At an economy-wide level, the People's Bank of China (PBOC) has focused on "macro leverage," which it has defined as gross debt as a percentage of GDP for all sectors of the economy. [13] Last year, the PBOC discussed explicitly its expectation that macro leverage would stabilize in the future, which we interpret as an objective to achieve a steady (or even declining) debt-to-GDP ratio.

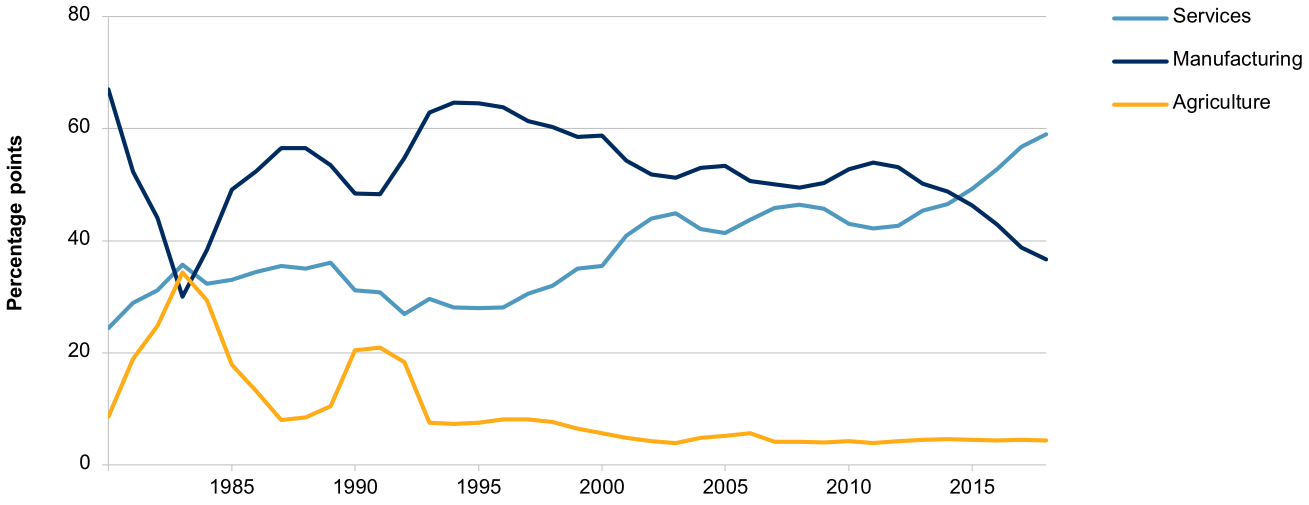
Putting this together, if the marginal return on capital remains lower than in the past, investment remains largely debt-funded and policymakers are targeting a stabilization in macro leverage, the space for further capital accumulation is limited.

Rebalancing means a larger role for services

Services are driving growth more than in the past, as they should while China becomes richer and consumers acquire a larger slice of the income pie (see chart 8). Rebalancing from manufacturing to services and investment to consumption (see chart 9) is healthy because it should reflect lower saving and investment. In turn, this would slow the rise in macro leverage and result in safer growth.

Chart 8

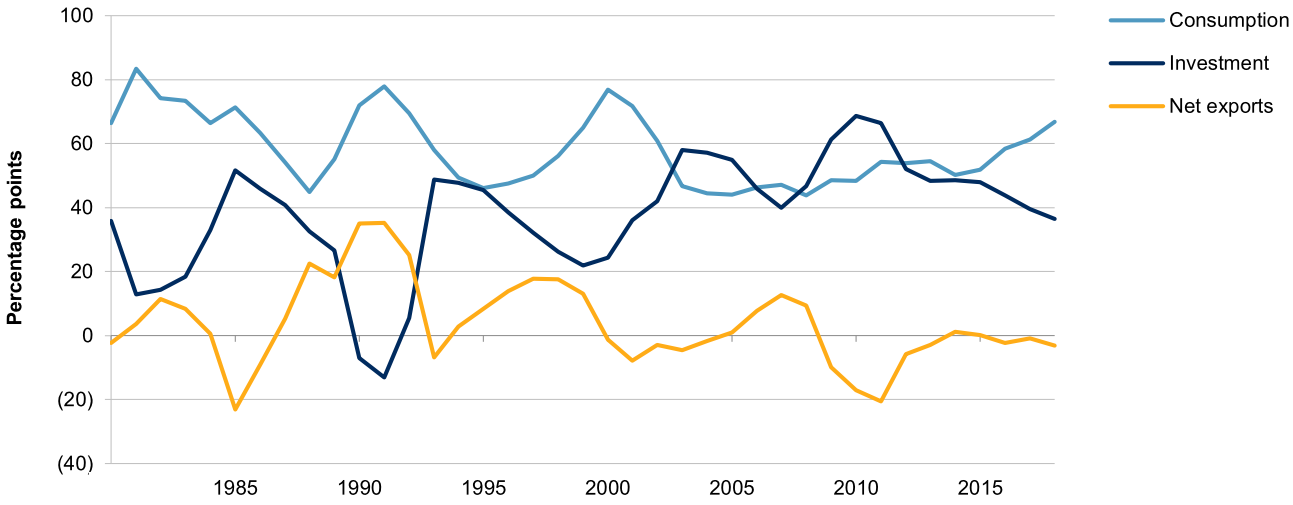
Service Sector Is Now Main Supply-Side Driver Of Growth
Contribution to GDP by industry



3-year moving average of contribution to real GDP growth. Sources: National Bureau of Statistics, CEIC, and S&P Global Economics.

Chart 9

Consumption Has Taken Over As Demand-Side Driver Of Growth
Contribution to GDP by expenditure



3-year moving average of contribution to real GDP growth. Sources: National Bureau of Statistics, CEIC, and S&P Global Economics.

However, rebalancing also means slower growth. Evidence from China and across the world is clear that productivity growth in services is lower than in manufacturing. [14] As we show below, manufacturing in China has retained a 3-percentage-point labor productivity advantage over services since 2010. Even the emergence of the new service economy, powered by e-commerce and fintech, has been unable to close this gap.

Technology's Starring Role In Growth

We think the pace of the slowdown will depend largely on China's ability to acquire, create, and deploy technology. This is not just about the technology sector--structural reforms that create more space for the private sector and markets would facilitate a stronger push into tech and knowledge-intensive industries across the economy. For example, leveling the playing field between SOEs and private firms, including foreign firms, would help capital and labor flow toward more innovative parts of the economy. We think it is no coincidence that many of China's new economy tech champions are private firms.

Technology and manufacturing productivity growth outpace that in services

Our conviction that technology is so important comes from the data. We have estimated productivity across industries in China between 1980 and 2010. We define productivity growth here as "total factor productivity" or TFP for short. TFP is the change in real gross value added not accounted for by changes in labor and capital inputs. TFP usually represents better technology,

knowledge, and efficiency (see Appendix for details).

These estimates use the China Industrial Productivity (CIP) Database meticulously constructed from input-output tables by the Research Institute of Economy, Trade, and Industry. [15] The input-output tables are consistent with official GDP data. Although somewhat dated, these data do illustrate long-term trends.

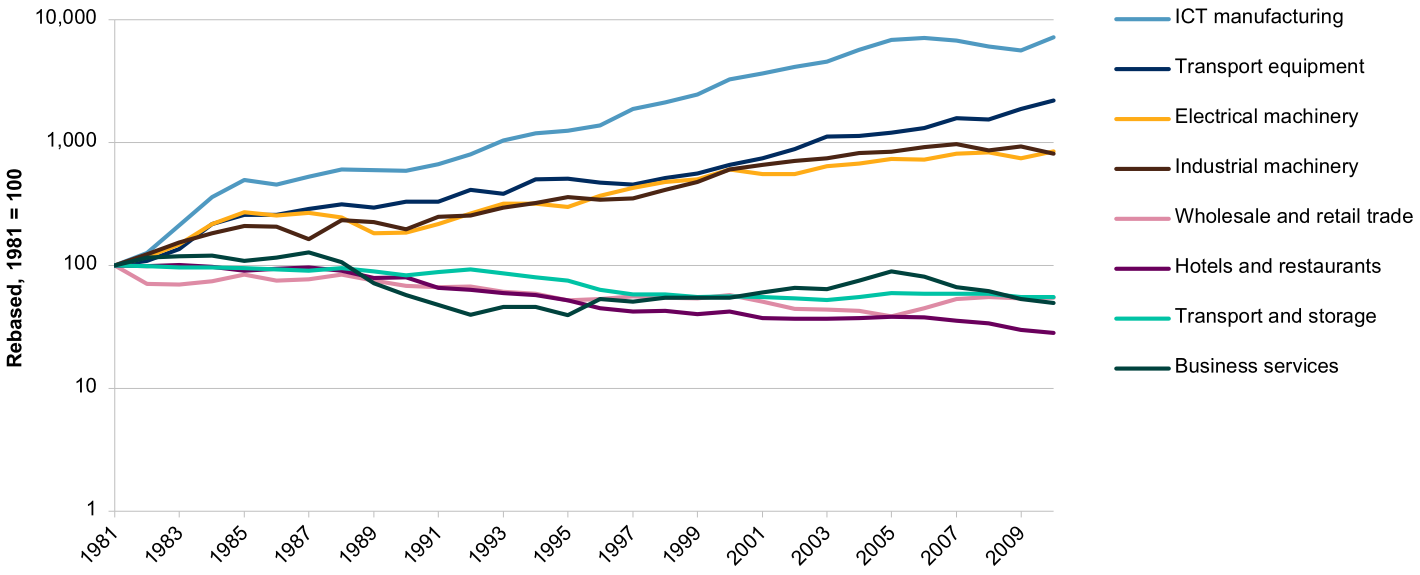
Chart 10 shows a dramatic productivity outperformance by manufacturing industries over service industries. The numbers are not even close--we estimate that between 1980 and 2010, productivity growth in information and communication equipment (ICT) manufacturing rose by a compound annual rate of above 10%. Other advanced manufacturing activities also experienced rising productivity, including transport equipment and machinery.

The service sector grew mostly by adding workers

Most service sectors saw productivity stagnate or worse even as, between the early 1990s and 2010, the service sector's contribution to growth roughly doubled to 50%. The answer to this apparent puzzle is that the service sector grew mainly by employing more workers. In the early 1990s, the service sector employed about 130 million people, a bit less than the manufacturing sector. By 2010, service sector employment had almost doubled to 260 million people, almost 50 million more than in manufacturing.

Chart 10

Technology And Manufacturing Have Been China's Booster Rockets
Productivity levels across industries



Total factor productivity index calculated from REITI CIP databse. Sources: REITI CIP Database 3.0 and S&P Global Economics.

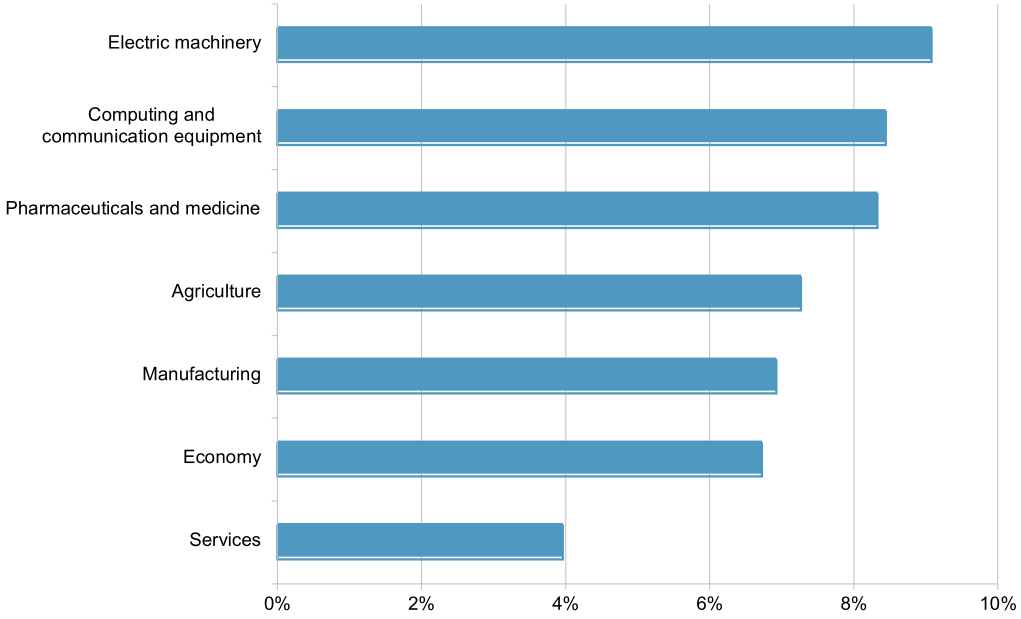
The labor-driven services story has been true over most of the last 40 years in China...

This growth story is evident when we consider less granular but more recent data. Chart 11 shows that across tech-related and knowledge-intensive industries (including pharmaceuticals) labor productivity growth has powered above the economy's average and been twice the level recorded in services. Labor productivity is a slightly different concept from the total factor productivity shown in Chart 10 because investment in new capital can raise output per employee.

Still, the broad story is the same--the service sector is growing because it is absorbing workers. Since 2010, service industries have added almost 100 million workers while manufacturing industries have shed 5 million workers.

Chart 11

Manufacturing And Technology Lead Output Per Worker Since 2010
Labor productivity growth



Annualized compound growth in real value added per employee between 2010 and 2018. Sources: National Bureau of Statistics, CEIC, and S&P Global Economics.

...and across countries

Manufacturing and technology's special role in driving productivity and convergence to rich

country income levels is a global story. We have quite strong evidence that the manufacturing sector drives a convergence of income levels across countries. Evidence of convergence in the broader economy, including the service sector, is much weaker especially if we do not take into account other economy-specific factors, such as the quality of institutions.

Recent research shows that the manufacturing sector is the most effective vehicle for catch-up. Harvard University's Dani Rodrik found strong evidence of convergence in output per worker across aggregate manufacturing industries. [16] He estimated a global convergence rate of almost 3%, which means that an industry which is half as productive as the most advanced firms should enjoy a convergence boost to its productivity growth of about 2 percentage points. This brings our story to the trade and technology tension with the U.S. and why it matters for China's long-term prospects.

The New Great Game Matters For Long-Run Growth

China's evolving relationship with the U.S. has many dimensions, but looking through an economics lens, technology, not trade, is at its heart (see S&P Global Ratings' report, "The Great Game: the U.S., China, and Technology," published May 2019). Within technology, we include knowledge-intensive industries such as health sciences. We say this for three reasons:

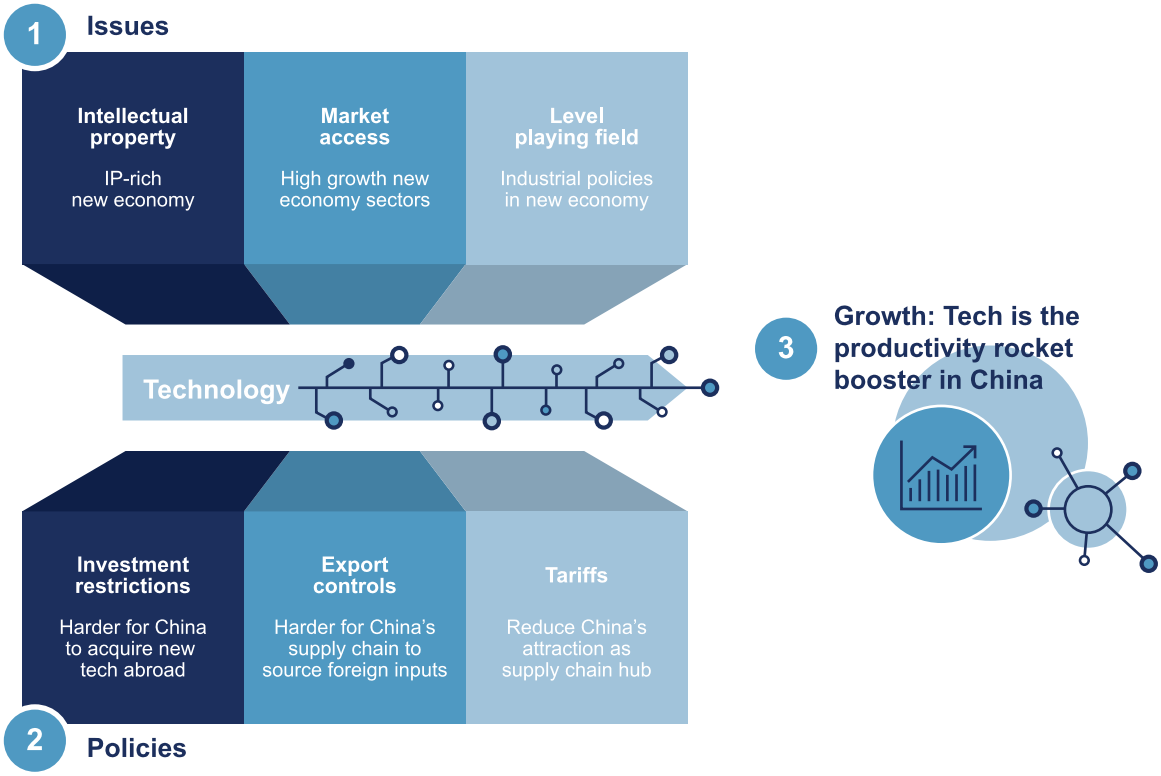
- Issues: Economic stress points are most apparent in the tech- and knowledge-intensive sectors;
- Policies: Measures taken by the U.S. will have the largest impact on the tech sector; and
- Growth: Technology and knowledge acquisition is critical for China's medium-term growth path.

The Great Game will affect many players, not just China

Although we focus on China here, we should recognize that many players, not just China, would feel the economic pain of a prolonged Great Game. Other economies would suffer from China's slower demand but also reduced access to its burgeoning new economy, innovative eco-systems, and the diversity of ideas and opportunities that such a large country provides.

How the Great Game will evolve is uncertain and is a subject best left to political scientists. Nevertheless, the gap between the two sides appears to have widened over the past year and may not be easily closed. One or both parties may need to compromise on some of the "red lines" each has drawn since the start of 2018 to reach a deal that would re-open trade and investment flows.

U.S-China Tension: Technology More Than Trade



Technology transfer to China may be affected

Our focus is on the economic implications for China. Until now, we have told a story that features technology as a lead character in driving China's four golden decades of growth. The world changes but we continue to see technology, through its impact on productivity, as the most important driver of China's growth over the next decade.

The Great Game matters because it could affect the rate of technology transfer to, and innovation in, China. The three main policies adopted by the U.S.--investment restrictions, export controls, and tariffs--all potentially affect China's access to technology. The first two affect China's access directly, and tariffs, more indirectly, by weakening incentives to locate supply chains in China.

We believe China's acquisition and development of technology would likely be faster in a world with lower trade, investment, and human capital barriers. Technological progress depends on new ideas, learning-by-doing, and exposure to global competition. The more local China becomes, the slower it will likely grow.

Foreign Direct Investment Is A Key Channel Of Tech Transfer

Foreign direct investment (FDI), especially when it leads to more activities by multinational corporations (MNCs), offers knowledge and technology transfer through many legitimate channels. Recruitment of foreign-trained employees by domestic firms, joint ventures,

collaboration with local suppliers, and legitimate imitation all contribute to transfers. [17] Weak intellectual property (IP) protection may also spread technology but this may be a less powerful channel than it appears. Indeed, strong IP protections may boost the transfer of technology in the long term if they encourage MNCs to bring more technology into local production markets and share with local partners.

Evidence points to strong channels of technology-related productivity spillovers from MNCs in China. Many micro-level studies find strong productivity spillovers from MNCs to domestic firms, especially from companies headquartered in advanced economies.

These spillovers mainly benefitted other firms in the same province or region--there was less evidence that productivity spillovers stretched nationwide. This is consistent with the "locomotive" model of growth we suggested earlier, in which richer provinces stayed relatively rich. [18] Vertical effects are often stronger than horizontal effects--in other words, MNCs mostly affect the productivity of upstream domestic suppliers rather than domestic firms competing in the same industry. [19]

Both FDI inflows and outflows are important for China

Unlike many developing countries, China was never satisfied with the "passive recipient" FDI model. A few years ago, China appeared to update its strategy and began scouring the planet in search of technology it does not yet have but wants to acquire quickly. Chinese firms are now trying to acquire large or controlling stakes in foreign businesses that own valuable technology IP. Examples of notable successes in 2016, a peak year for FDI outflows, include: (i) the Midea Group Co.'s US$5 billion acquisition of 25.1% stake in the German industrial robotics maker Kuka AG and; (ii) Tianjin Tianhai's US$6 billion acquisition of technology distributor Ingram Micro Inc.

Acquisitions are recorded as FDI and a changed direction of net FDI flows hints at this strategic shift. Chinese FDI outflows to advanced economies more than doubled in 2016 to above US$30 billion. Manufacturing and technology investment saw the largest increases, suggesting currency-related capital outflows were less important than in 2015.

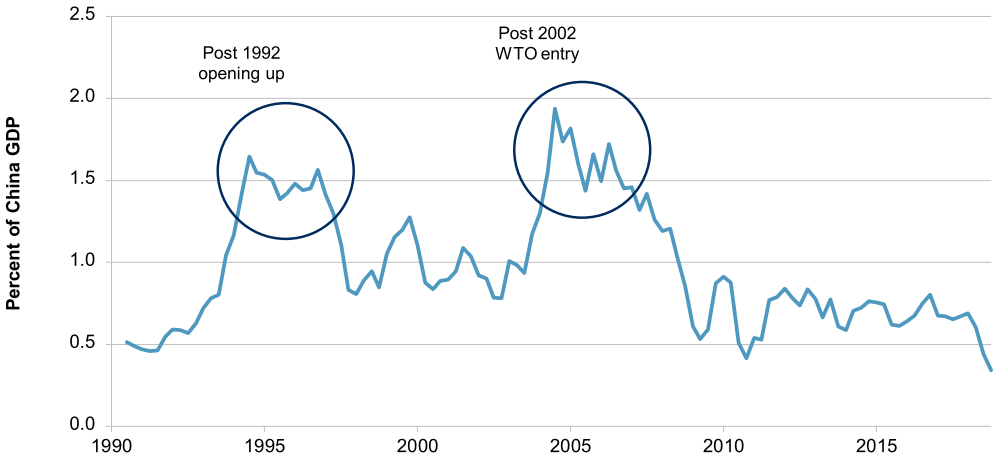
But China's FDI is now falling

Chart 12 shows that China's FDI flows to and from large advanced economies have plummeted over the past decade. The two waves of large FDI inflows that followed China's opening up in 1992 and 2002 are evident--a period when productivity and growth surged. Also evident is the persistent decline in flows over the past decade. Flows in both directions are now close to the lowest point, as a share of China's GDP, for almost three decades. This seems remarkable in a world of technological disruption.

The dollar amount of FDI is a rough proxy for the cross-border flow of technology and ideas. Such transfers can happen in other ways, including human capital. The dollar amount also tells us little about the quality of technology embedded in the investment. Still, we think this is a helpful guide to the broad flow of ideas.

Chart 12

Getting More Local—China's FDI Flows In Both Directions Keep Falling



Measured as the rolling four-quarter sum of FDI divided by the rolling four-quarter GDP. Includes Finland, France, Germany, Italy, Japan, Korea, Netherlands, Sweden, the United Kingdom, and the United States. Quarterly data from OECD country national or regional statistical agencies where available. Where data are unavailable, annual OECD FDI inflows and outflows are equally distributed across quarters. Some data are not reported due to confidentiality. Most countries FDI measured as per the IMF Balance of Payments System 6. Local currency data converted to US$ using average quarterly exchange rates. Source: Bank of Japan, Eurostat, Korea Ex-Im Bank, United States Bureau of Economic Analysis, Organization for Economic Co-operation and Development, and S&P Global Economics.

Both FDI inflows and outflows are weak

As China becomes larger and better at producing frontier technology, one might expect FDI inflows as a share of GDP to fall. Still, we have not seen any offsetting outflows, except for a brief period in 2016. We might expect China to scale up its overseas investment activity to acquire new intellectual property and create opportunities for its more dynamic companies to compete in global markets.

However, the Great Game, which has resulted in closer scrutiny of Chinese investments abroad, has made such acquisitions harder. This is true in Europe as well as the U.S. China's FDI outflows to major advanced economies was barely above US$5 billion for the four quarters through March 2019.

Shared Pain Of Separation In Revealed Comparative Advantage

If FDI points to potential decoupling of China and some advanced economies, revealed comparative advantage (RCA) suggests a painful divorce. RCA helps us understand how competitive a country is by comparing the share of a particular product in a country's exports to that product's share in global exports. When this ratio is above 1, then the country is exporting

more than its "fair share," and is revealing a likely comparative advantage in that product's production.

RCA can also help assess the pain of separation. For China, the less competitive its producers are in key technologies needed to power productivity (reflected in low RCAs), the more a path of self-reliance will affect growth. For the rest of the world, the more competitive China is in certain products, the more that trade barriers such as tariffs and export controls will force a substitution to less efficient alternatives, which leads to an increase in costs for consumers.

Sticky RCA in technology and knowledge-intensive industries

The RCA in tech- and knowledge-intensive industries may be "sticky," raising the costs of moving supply chains due to three factors: [20]

- Information and knowledge transfer is typically highly complex with respect to product and process specifications.
- It is hard to codify information and knowledge simply so production can be easily shifted to different locations. This is because products are highly differentiated.
- Actual and potential suppliers face substantial technical demands in relation to the requirements of the transaction.

China introduces one more reason for supply chain stickiness--scale. Given China's abundant physical and human capital resources, including burgeoning domestic innovation, foreign firms have been able to scale up complex technology eco-systems. Replicating this in smaller economies will be hard.

Across these dimensions, there is a big difference between a t-shirt (even a washing machine) and a US$1,000 smartphone. In short, moving high-productivity tech supply chains is more difficult and costly than for basic manufacturing.

Once a country has an RCA in tech, it may be hard to budge, but where does the RCA for technology products come from? In our view, two sources are worth noting.

- Intellectual property (IP): The availability of the necessary IP to produce it. Analogous to the natural endowment of commodity exporters--either you have it or you do not.
- Relative costs: The cost of producing the product given the IP is available compared to other trading partners. This includes the technical capacity of the local ecosystem.

There is a wrinkle. In most cases, including our data below, we rely on gross exports, not value-added exports. This means that the IP may have been added at an earlier stage of production but still shows up as an export. One way to address this issue is to focus as much as we can on upstream products such as parts and components that are less likely to have crossed multiple borders than finished products, which we do below.

China retains substantial RCA in many tech-related products

Chart 13 shows how China's RCA across tech-related products has evolved between 2008 and 2017. Each data point shows the RCA for one of 132 industrial machinery and electrical machinery and equipment products, for both years, respectively. These all have a Harmonized System four-digit code that begins with either 84 or 85. When the data point is above 1 (dotted line), China is revealing a comparative advantage. When the data point is above the 45-degree line, its

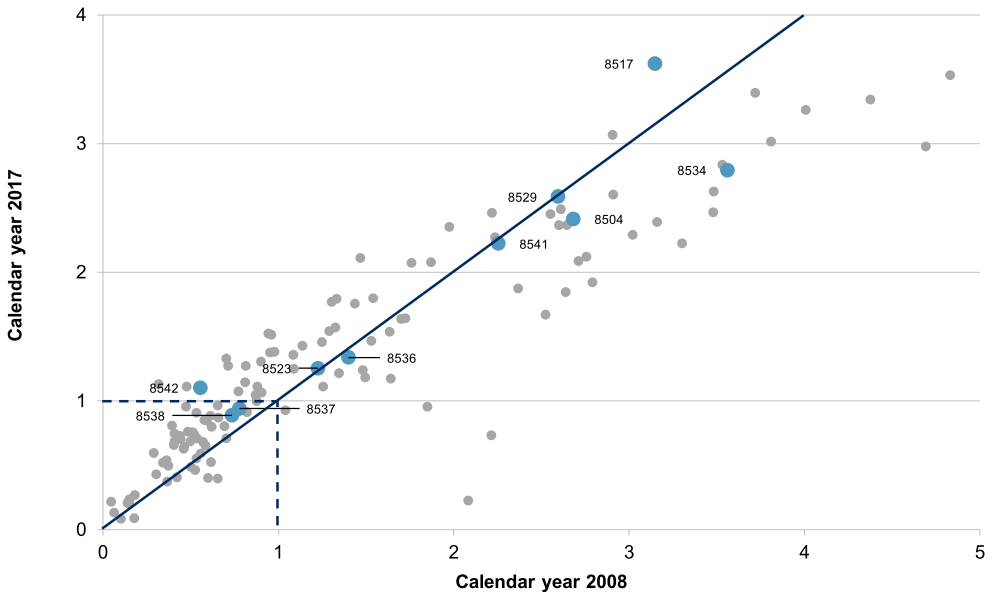
comparative advantage has improved over the 2008-2017 period.

China has retained or improved its RCA for many tech-related products, indicating greater global penetration of China's advanced technology industries. Where it has lost RCA, it has done so from a position of strength--evident in the data points with an RCA above 2 for 2017.

We have highlighted China's top 10 technology imports (a potential proxy for tech dependence). For some products, China retains a substantial RCA, including finished phones (HS-8517) and printed circuits (HS-8534) although we should be mindful of the "gross export versus value added" problem for phones. For other products, notably those further upstream where we can isolate IP better, China has less of an edge but has improved. Examples include electronic integrated circuits (HS-8542) and electrical parts (HS-8538).

Chart 13

China - Revealed Comparative Advantage



Each datapoint denotes China's revealed comparative advantage (RCA) for a 2007 revision HS-code 4-digit product in 2008 (horizontal axis) and 2017 (vertical axis). Datapoints above the 45-degree line indicate a higher RCA between 2008 and 2017. Sources: U.N. Comtrade, MIT Trade Atlas, and S&P Global Economics.

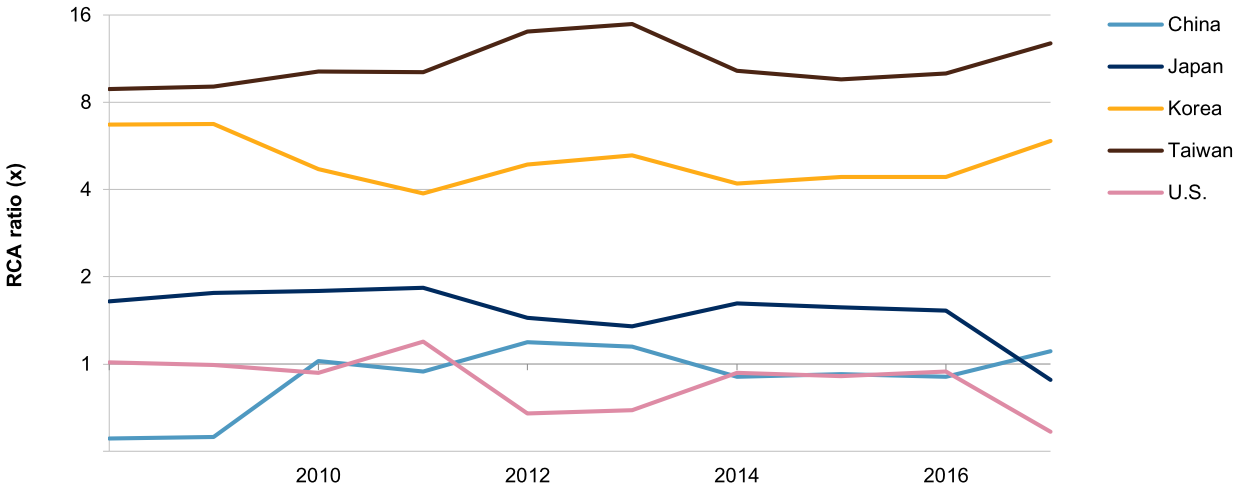
But it lags frontier tech producers in some key areas

If China becomes more self-reliant--as a choice or as a result of the Great Game--the challenge is to achieve significant breakthroughs in key upstream technologies. Here, RCA suggests progress is slow. Looking at the RCA for electronic integrated circuits (HS8542) for five economies since 2007, China has improved and is now marginally above 1 but still lags well behind frontier producers, including Korea and Taiwan (see chart 14).

Note that the RCA for the U.S. and Japan is understated given some production of its HS8542 chips designed using the IP of both economies, takes place in other jurisdictions. This is less true for Korea and Taiwan.

Chart 14

Revealed Comparative Advantage: Electronic Integrated Circuits HS8542



Sources: U.N. Comtrade, MIT Trade Atlas, and S&P Global Economics.

In turn, China's import basket reflects the RCA enjoyed by these frontier economies. Chart 15 shows China's top 10 imports of technology products covering HS two-digit codes 84 and 85 by origin. The value of China's imports in billions of U.S. dollars is given by the figure in each cell. Over time, China's technology import basket has become more concentrated in a smaller number of products. This is because domestic producers have learned to produce more of its own technology and foreign firms have upgraded their China-based production.

However, China remains dependent on key suppliers in some segments, especially semiconductors and printed circuits (HS codes 8534, 8541, and 8542) and phone components (HS 8517). Again, bilateral trade data may understate linkages with the U.S. because some large American semiconductor firms export to China from third countries, including Ireland and Singapore.

Decoupling and more self-reliance may be costly and not just for China

Our analysis of RCAs tells us two things. First, China has a strong competitive position across many technology products and is deeply embedded in global technology supply chains. Decoupling will be painful for all parties concerned and end-consumers will eventually pay more. Second, China is less competitive in key upstream technologies, which will mean its path to self-reliance and the tech frontier may be tough, given that current gaps appear large and persistent.

These results are consistent with our more granular assessment of China's tech-related export

supply chains (see "A New Great Game--China, The U.S., And Technology," published May 15, 2019). We found that foreign headquartered firms accounted for more than half of the suppliers for 657 listed Chinese exporters going back three steps in the supply chains. Most of those foreign suppliers were from frontier economies and operated in the technology industry.

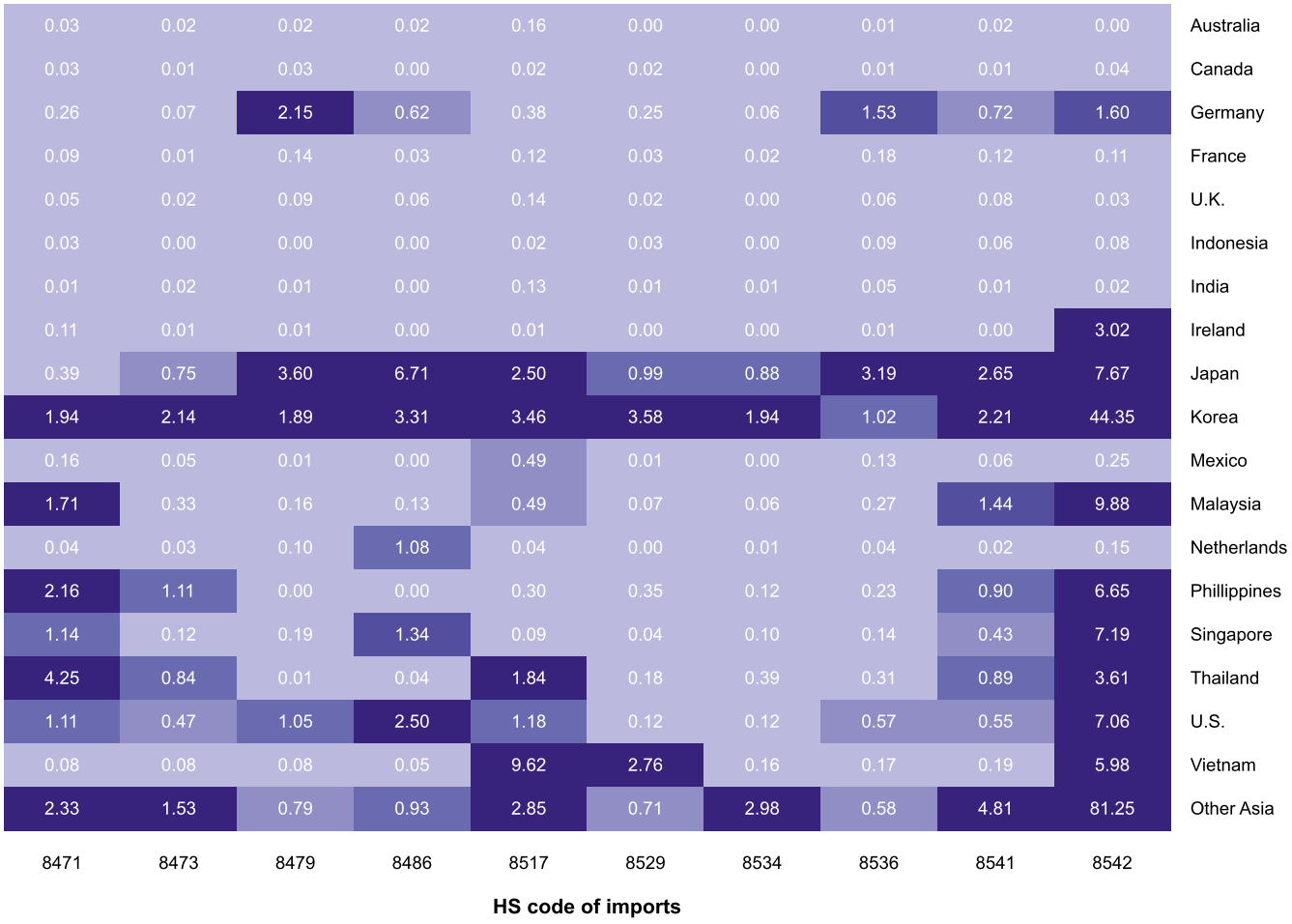
Table 4

China's Top Technology Imports By Harmonized System 2007 Four-Digit Code

Electric transformers, static converters (e.g. rectifiers) and inductors	8504
Telephone sets and telecommunications equipment.	8517
Sound storage media	8523
Parts of radios, telephones, and T.V.s	8529
Electronic printed circuits	8534
Electrical apparatus for < 1k volts	8536
Electrical boards	8537
Parts for electrical apparatus	8538
Diodes, transistors, similar semiconductor devices	8541
Electronic integrated circuits	8542

Source: United Nations, World Customs Organization, and S&P Global Economics.

China's Import Basket Reveals Reliance On Foreign Tech



Source: MIT Trade Atlas.

China's potential to reach the tech frontier quickly is a wildcard

One wildcard is China's capacity to accelerate homegrown innovation and technology development. China's past record and scale, particularly in terms of potential human capital, provides an edge that is unrivaled with the possible exception of the U.S. and India. Made in China 2025 aims to achieve such an outcome and, given the size of this effort, it should not be discounted entirely as a scenario.

History suggests a purely indigenous and rapid surge to the tech frontier is unlikely, however. Much of the evidence from China over the last two decades, as we saw above, points to openness as a key driver of technological progress and productivity growth. The presence of MNCs in China's supply chains and exposure of Chinese firms to global markets--two facets of an open economy--lift the performance of domestic firms.

We do not dispute that China has the capacity, on its own, to reach the tech frontier in many areas at some point. Our point is that the historical evidence suggests that this may happen more

quickly in an economy that remains highly globally integrated, which benefits from the free flow of ideas, knowledge, and technology and is exposed to a competitive global market.

Putting It All Together: How China Might Grow Through 2030

Let us recap our story at this point:

- Opening up and market-focused reforms precede technology-driven growth surges in China. One notable feature of growth surge periods is rising FDI flows.
- Opening up and reforms, on some measures but especially FDI, have slowed since 2008. Growth has also slowed, mainly due to a cooling in productivity growth.
- The Great Game and China's possible push for self-reliance could slow future tech and knowledge transfer to China.
- A more local China could mean weaker productivity and an even more pronounced growth slowdown over the next decade.

The Great Game is a long-run global supply shock

If our understanding is correct, China's strategy in the Great Game--in terms of opening up and market based-reforms--will have substantial implications for growth through 2030. Our view has always been that the Great Game's effects should be viewed more as a long-run supply shock that works through investment than a short-run demand shock that hits exports.

Three scenarios—the good, the not so bad, and the ugly

Given the uncertainties, long-term scenarios must be illustrative. Still, even if our flashlight is weak it is better than stumbling around by touch in the dark.

Our three scenarios are rooted in assumptions about China's chosen path--opening up versus self-reliance and the balance between markets versus the state--and how that intersects with the prospects for a lasting resolution to the Great Game. We describe our assumptions in table 5.

Table 5

Qualitative Assumptions For Three Illustrative Scenarios

Scenario	Assumptions	
	China's Chosen Path	**The Great Game**
Baseline		
	Gradual and targeted reforms at similar pace to 2013-2018 period.	Stalemate but no major escalation.
	Opening up: Gradual and targeted opening up to foreign firms (in terms of trade and investment), focusing mainly in "old economy" sectors where domestic firms are likely to maintain a dominant market share. Less opening up in the service sector and high-tech industries prioritized by Made in China 2025.	Tariffs: Remain largely as is with prolonged uncertainty about future changes.
	Market-based reform: Gradual and targeted reforms increasing the role of the market, especially in some parts of the financial system. Slow progress on SOE reforms, including mixed ownership.	U.S. investment restrictions: No change in current policies. Committee for Foreign Investment in the U.S. (CFIUS) approval rates unchanged from recent levels.
		U.S. export controls: Some broadening in controls to sectors identified by the Export Administration Regulations of 2018.
Upside		
	Quicker and broader reforms.	Gradually easing tension and a comprehensive deal in the medium term (2-4 years).
	Opening up: Faster pace and broader scope of opening up, especially in the service sector. Some selected opening up of trade and investment for foreign firms in high-growth technology sectors.	Tariffs: Gradual return to pre-trade war levels by 2025.
	Market-based reform: Reduction of barriers to entry across a broad range of sectors, especially the service sector, and a focus on "competitive neutrality" with SOEs.	Investment restrictions: Some easing for Chinese firms acquiring U.S. assets. CFIUS approval rates rise.
		Export controls: More narrowly focused on sectors covered under previous legislation/ regulations.
Downside		
	Slowdown in reform.	Escalating economic and financial tension and diminishing prospects of a lasting deal.
	Opening up: Slowdown in the pace of opening up with little progress made in easing trade and investment access for foreign firms in the service sector and the high-growth new economy. Scaling up of efforts to achieve self-reliance.	Tariffs: All bilateral trade subject to 25% tariffs. Discretionary use of non-tariff barriers by both sides.
	Market-based reform: Industrial policies aligned with self-reliance emphasized at the expense of market forces. SOEs take a lead role, including new economy areas where their footprint has traditionally been smaller.	Investment restrictions: Tightening of current policies with CFIUS approval rates declining to low levels.
		Export controls: substantial broadening and higher frequency of resort to controls.

Source: S&P Global Economics.

Quantitative assumptions keep it simple

As we go from qualitative scenarios to hard numbers, we avoid false precision by keeping it simple and transparent, focusing on the two variables that drive our growth projections: productivity growth and the capital-output ratio.

We project future productivity growth using China's current labor productivity gap with the frontier (we use the U.S.) and the historical convergence of growth to the frontier across 123 countries between 1950 and 2018 (see Appendix for details). We then adjust the unique "China effect" for the 2020-2030 period to reflect different assumptions about reforms and the trade-tech tension:

- Baseline: China becomes more like the average (median) country in our sample but continues to outperform. Total factor productivity growth averages just under 2%, a little below the recent trend.
- Upside: China retains the characteristics it has exhibited in the past and remains a strong outperformer. Total factor productivity growth averages 2.2%, about the same as the current trend.
- Downside: China becomes a lower-than-median performer. Total factor productivity averages 1.4%, some way below the current trend.

Our main assumption for the capital-output ratio is credit intensity, or the steady-state debt-to-GDP ratio. We pin this at 3x, or 300% for total social financing including local government debt. Other factors we keep in line with historical averages include the dividend payout ratios of firms and the proportion of new debt used for investment.

In the baseline, our assumptions about debt and the return on investment mean that the capital-output ratio stabilizes like it did during the 2000s. In the upside scenario, capital can continue to grow relative to output, boosting growth. In the downside, capital grows more slowly than output.

We keep some variables unchanged from recent levels through 2030, including improvements to human capital (better education and training) and labor force participation. Of course, China can change some of these growth drivers with policy changes, including changes to the retirement age. We use the United Nations projections for the growth of the working age population.

Baseline growth through 2030 at about 4.6%

In our three scenarios--the not-so-bad, the good, and the ugly--we project average growth over the next decade of 4.6%, 5.4%, and 3.7% (see table 6). The compound effects of these growth rates are large. By 2030, China's economy, in our downside scenario, will be about 10% and 18% smaller in U.S. dollar terms than the baseline and upside scenarios, respectively (note that different productivity growth rates also imply slight changes in the path of the real exchange rate over time).

Watch credit intensity for economic cycle and financial stability signals

Growth rarely moves in a straight line and these scenarios do not touch on what this means for the economic cycle and financial stability and risks of more abrupt changes. This may depend largely on how policymakers and financial markets respond in each scenario. This is likely to show up in credit intensity.

Policymakers may recognize the structural trend in growth and try to keep actual growth close to underlying potential. This would mean refraining from excessive stimulus or tightening and a stable or even declining credit intensity ratio. This would be consistent with a smooth glide path. However, if policies push growth too far above underlying potential, credit intensity will rise and the risks of abrupt changes, which may include financial instability, will edge higher.

Table 6

Illustrative Scenarios For China's Growth Path Through 2030

	Units	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Baseline (stalemate with the U.S. and gradual reforms)												
Total factor productivity	Percent change	2.2	2.1	2.1	2	1.9	1.9	1.8	1.7	1.6	1.6	1.5
GDP growth	Percent change	6.2	5.8	5.5	5.2	4.9	4.6	4.1	3.8	3.5	3.3	3.2
GDP at market prices	Bil. US$ (2018 prices)	15,648	16,600	17,557	18,513	19,462	20,397	21,282	22,137	22,955	23,758	24,557
GDP per capita	US$ (2018 prices)	10,985	11,639	12,296	12,951	13,599	14,235	14,836	15,414	15,965	16,504	17,039
Upside (trade deal and faster reforms)												
Total factor productivity	Percent change	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
Capital depth	Percent change	2.3	2.1	1.8	1.6	1.4	1.2	1	0.7	0.5	0.3	0.3
GDP growth	Percent change	6.2	6.1	5.9	5.8	5.6	5.4	5.1	5	4.8	4.6	4.6
GDP at market prices	Bil. US$ (2018 prices)	15,648	16,646	17,680	18,751	19,856	20,994	22,133	23,298	24,486	25,695	26,963
GDP per capita	US$ (2018 prices)	10,985	11,671	12,382	13,116	13,873	14,652	15,429	16,222	17,029	17,850	18,709
Downside (self-reliance and little reform)												
Total factor productivity	Percent change	2.2	2	1.9	1.7	1.5	1.4	1.2	1	0.8	0.7	0.5
Capital depth	Percent change	2.3	2	1.7	1.4	1.1	0.9	0.6	0.3	0	-0.3	-0.3
GDP growth	Percent change	6.2	5.7	5.2	4.7	4.2	3.7	3.1	2.6	2.1	1.6	1.3
GDP at market prices	Bil. US$ (2018 prices)	15,648	16,586	17,492	18,352	19,156	19,893	20,522	21,060	21,498	21,830	22,096
GDP per capita	US$ (2018 prices)	10,985	11,630	12,250	12,838	13,385	13,883	14,305	14,663	14,952	15,165	15,332

China's Policy Choices And The Great Game Will Define The Slowdown

China must live with some things as they are, including demographics, debt, and rebalancing. China has also become richer. These factors point to an inescapable slowdown over the next decade. This is natural and mostly healthy.

China also faces policy choices that will determine how much the economy will slow. These choices will affect its ability to acquire, create, and deploy technology and lift productivity. At a broad level, China may have two big choices to make:

- More opening up or greater self-reliance;
- A substantially larger role for markets or a bigger role for the state in the economy.

This is not either or, of course, but the mix will be important. There is also no "right answer" but the result will be important for growth now and through the next decade.

China's choices may also have implications for the complicated geopolitical environment, especially the Great Game. We recognize that some issues stretch well beyond economics and finance. Nevertheless, a decisive move toward opening up to foreign trade and investment and a larger role for the market could ease tensions. This could pave the way for a comprehensive deal.

Our baseline for China assumes a broadly unchanged pace of structural reform from recent years. In terms of opening up and allowing markets to play a greater role, this suggests an approach that is targeted, gradual, but somewhat slower than we have seen in the 1980s and 1990s. We think this is consistent with a stalemate but no major sustained escalation in the Great Game. Finally, we think this means growth will average about 4.6% over the next decade.

If our baseline is right, whether the glide path lower is smooth or bumpy may depend on whether China tolerates its inescapable slowdown.

Appendix

Growth accounting

This exercise follows a well-worn path in the literature and assumes that output is a function of capital, labor, land, and total factor productivity (TFP). [14] Our starting point is a standard Cobb-Douglas production function [20]:

$$Y(t) = A(t)\,[\lambda(t)K(t)]^{\alpha}T(t)^{\beta}[\omega(t)H(t)]^{1-\alpha-\beta}$$

Y(t) is gross value added or GDP, A(t) is technology or the level of total factor productivity, λ(t) is the capacity utilization rate, K(t) is physical capital, T(t) is land, ω(t) is the employment rate, and H(t) is quality-adjusted human capital. Income shares for capital and land are denoted by α and β, respectively.

Quality-adjusted labor is assumed to be the product of three inputs:

$$H(t)=X(t)L(t)Z(t)$$

X(t) denotes annual hours worked per person employed, L(t) is the labor force, and Z(t) is a human capital per worker. As has become standard practice, we assume this is positively related to educational attainment, measured as the average years of schooling among the working age population and denoted "s" and the marginal return from an additional year of schooling denoted by Θ.

$$Z(t) = exp[\Theta\, s(t)]$$

After some algebra and adjusting this function for missing data in China, we arrive at an expression for the log change (approximate percent change) in real GDP growth, where lowercase g denotes log change:

$$g_Y(t) = (1/(1-\alpha))g_A(t) + (\alpha/(1-\alpha))\,g_{K/Y}(t) + \Theta\Delta\, s\,(t) + g_{LFP}(t) + g_{AGE}(t) + g_N(t)$$

In this expression, the contribution to growth from labor is a function of the growth in labor force participation (LFP), the growth in the share of the population of working age (AGE), and the growth in population (N).

Cross-country productivity growth estimates

We estimate an unbalanced panel regression using data from the Conference Board's Total Economy Database. Our sample includes 123 economies and data over a maximum of 13 non-overlapping five-year periods from 1953 through 2018. The estimated equation is:

$$\Delta \ln(Y_{it}/Y^{US}_{t}) = \alpha + \mu_i + \beta \ln(Y^{US}_{t-1}/Y_{it-1}) + \varepsilon_{it}$$

Where Y(it) is real PPP GDP per employee for economy i in period t and μ(i) denotes economy-specific fixed effects. The coefficient of convergence, conditional on fixed-effects is denoted by β. The convergence coefficient is estimated precisely and is statistically significant at the 1% level.

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